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PIPES AND PIPING

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Engineering News-Record

Devoted to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC.

July 4, 1918

War-Engineering Issue

g Island Ships Designed for Efficiency of Fabrication

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, JULY 4, 1918 — Number 1

American Engineers in the War

TO GIVE the engineering profession some glimpse of the things its members are accomplishing under the stress of war, in the hope that the story of these achievements will inspire others to still greater efforts, is *Engineering News-Record's* purpose in devoting this issue to the engineering work of the war. The subject is so large and many-sided that the scope of our engineers' achievements can hardly be more than touched on in a single issue. Yet it has seemed well to devote one number entirely to war, treating most fully the outstanding engineering development of the year—ship construction—in order to emphasize the important contribution which engineers are making to the conduct of the war, and to visualize for them the tremendous part which the country expects them to play in winning it.

"Contractor" Consolidated With "Engineering News-Record"

BEGINNING this issue there is consolidated with *Engineering News-Record The Contractor*, a McGraw-Hill publication specializing on construction methods and contractors' problems. The publishers believe that by the consolidation they can best serve the interests of the construction division of the field. Charles S. Hill, editor of *The Contractor*, becomes associate editor of *Engineering News-Record* in charge of construction, and will bring to the larger paper his long experience in editorial and construction work, while Fred W. Schultz, manager of *The Contractor*, takes charge of the research and statistical division of the larger organization. By these additions the *Engineering News-Record's* service to the construction side of the civil engineering field will be intensified and broadened.

Inland Waterway Progress Is Slow

CANAL and inland waterway transportation seems to be making heavy weather. Only one waterway has been taken over by the Government and on that operation is hampered by lack of boats. Other rivers and canals, investigated and favorably recommended for Government aid by the Inland Waterways Committee, have been unfavorably reported on by the regional railway directors and are now under investigation by a representative of the Director General of Railways. Barges for the upper Mississippi will be ready next spring; bids on concrete barges for the New York canals have been received, a few steel barges are under construction and a number of old boats commandeered; but traffic has not been built up in general products. Taken as a whole progress has not measured up to the promises of some months ago. Just how badly will the railroad administration feel if the whole waterway program amounts to nothing?

Municipalities Answer Call to Help Win War

AMERICAN cities in their corporate capacity are helping win the war. This is clearly shown by the municipal surveys contributed to this issue of *Engineering News-Record* by twenty-five representative city engineers. Our municipalities are conserving capital, man-power and materials by postponing such improvements as are not necessary to maintain health and essential industries. They are providing utility services, street improvements and other public works needed for war plants. The spirit of service, of municipal and per nal sacrifice, is dominant. Engineering staffs have gone freely into one or another branch of the Government service, one city engineer department having sent 22 of 23 men. This is the supreme test, the complete proof, of the whole-heartedness of the municipal contribution to the needs of the nation and of democracy against autocracy.

City Engineers Catching Up and Planning for Future

WHILE municipal work is at a low ebb, the municipal surveys published in this issue show that some engineers are bringing records and surveys up to date. Others are planning for the future. This planning ranges from detached improvements to large projects and in the case of one or two American cities to a considerable reconstruction program. Depleted as some city engineer's staffs are, few are so small that some catching up work cannot be done during this period of little new construction. Rarely will it be impossible to do some planning ahead. Where there's a will there's a way. City engineers should show the will and point the way.

More City Revenue from Assessments for Benefits

BESET on the one hand by the demands for war economy and on the other by the need for improvements essential to health and industry, where are our cities to find the money to meet the irreducible minimum of their needs? One source little drawn upon by some cities and fully utilized by comparatively few is assessments for benefits. Further drafts on this resource

were suggested in the address by Mr. Lewis, in the issue of June 27, p. 1223. A merit possessed by assessments for benefits is that they afford an acid test of the demand and perhaps of the ability to pay for several classes of city improvements, more or less local in character. Those who urge the improvement do it knowing they will have to pay the bill. In the report from Pittsburgh, on p. 34, it is stated that demands for local improvements have been above normal of late, notwithstanding high costs. The community is prosperous. Property owners can afford to pay. Where the reverse is true, few demands for paving, sewers, water mains and parks will be made if it is known that the petitioners must foot the bill.

Low Engineering Salaries a Municipal Handicap

DIFFICULTIES arising from depleted staffs are increased, several city engineers report, because of the low salaries paid. If this were due to war economy few would complain. It is not. Instead it is chronic. Not for twenty years, the city engineer of Chicago writes, have salaries been raised in his department—and the city council refuses to meet the present emergency. From Pawtucket comes a similar if not so deplorable a story. To continue such a policy will prove suicidal.

Edgar Marburg—a Loss to American Engineering

AMERICAN engineering has lost one of its most useful members in the passing away of Edgar Marburg. He was not only a good engineer but a good teacher of sound engineering practice. As a structural engineer, he won favorable notice while still a young man, and his studies of cantilever bridge design in particular drew general attention to his capacity for original investigation. In his teaching work he took deep and justifiable pride. He had the welfare of his students deeply at heart and strove to develop to the utmost the latent capabilities of each of them. Teaching was a profession to him, not a mere source of steady income to be earned with the least possible work, and his friends had many opportunities to learn that his own personal test of success was the success of the young men he educated.

It is hard to think of the American Society for Testing Materials without also thinking of Marburg and Dudley, ideal secretary and ideal president. The success of this organization was achieved very largely by the enthusiasm and hard work of these two men, who foresaw the important economic results which would follow the standardization of requirements for the materials used in a large part of American engineering construction. The skill with which they made the path smooth for producer and consumer made them at the same time real pioneers of industrial progress. No work was too hard and no controversies too vexatious to check the enthusiasm of Marburg in his activities for this organization.

Marburg's strong personality and readiness to enter the lists to champion any cause he thought needed a defender developed a number of opponents and a host of friends. Every strong man enjoys a good controversy on a worth-while, debatable subject, and Marburg was engaged in a controversy with one or more friends most of the time. They were educational clashes to both sides, and those who had these mental tilts with Marburg learned to admire his resourcefulness and his fairness. In addition, he had that admirable gift in a friend, silence when not asked for an opinion, and complete frankness, no matter how adverse the criticism, when his opinion was asked. He was truly strong in counsel, earnest in purpose, with high ideals and lovable character.

New Methods Applied to Shipbuilding

APPLYING new methods to an unprecedently new problem, men of many kinds entered into high-speed shipbuilding just a year ago. Shipbuilders, contractors, steel fabricators and lumbermen were among them. In the twelve months since, they have multiplied and again multiplied this country's output until today the United States is by a large margin the greatest shipbuilding nation in the world.

Figures on what is to be done and what has been accomplished up to now are contained in the summary of the Emergency Fleet Corporation's statistics given on p. 40. Two points in this summary illuminate the situation strikingly. The first is that the greatest shipbuilding year in American history, 1901, was surpassed by the single m nth of May, in respect of ship output, and this in turn will be surpassed by monthly figures half again as large, or perhaps twice as large, every single month into the indefinite future. The second is that we have made our steel industry tributary to ship construction to its full capacity. Every ton of plate production—deducting the necessary boiler and fire-box material and minor uses no less essential—is being devoted to building ships.

The creation of the new shipbuilding was a process very different from simple quantitative expansion. Increased production speed beyond all dreams of former times regenerated the old shipyards. In addition, a new kind of shipbuilding planned on an immense scale and equipped with new ideas and new processes came into being.

Why this just-created industry is new, and in what way the men who took it in hand drew upon peace industries for their tools and methods, is reflected in the story of the Hog Island ship design recounted on p. 4 of this issue. The processes summarily sketched in that article succeeded in putting thousands of hands to work at the most vital behind-the-lines occupation that we have. Without this reinforcement of the shipyard army, shipbuilding in all probability would have remained hopelessly inadequate in quantity.

Resourcefulness and adaptability were displayed in this new development to an admirable degree. In recent issues *Engineering News-Record* has outlined the machinery employed for erection at two of the emergency shipyards, equipment which embodies new conceptions of shipyard method, fitted to the conditions confronting the builders. Casting aside tradition, engineers grappled with the problem of shipbuilding on the basis of knowledge gained in other steel construction. The same spirit and equal resourcefulness were displayed by the men whose task it was to make

the bridge shops serviceable for ship fabrication.

In the magnitude and the many-sided variety of our emergency shipbuilding, it is easy to overlook the fact that two separate agencies are responsible for high speed of construction: standardization, and the massing of enormous productive resources on the problem through the joining of bridge shop and shipyard. Shop fabrication no doubt occupies at the moment the place of prime distinction. Since it will produce half our output when the maximum rate is reached, it is the magic means of doubling the greatest results that we could accomplish without its aid. But the future also deserves consideration, for the rank of leading shipbuilding nation will not be taken from us, for many years at least. The ships of the future will doubtless be fabricated at the shipyard itself. Standardization, on the other hand, will retain its importance. It is to be hoped that the conditions of the past—which created a new type, new form and dimensions, for every new ship—have been outlived. The cargo-carrying service of the standardized vessels now being turned out is likely to give a convincing showing against the custom-made ship ideas. Excellence of detail, rapidity of construction, and low cost will be unanswerable arguments for standardized ships.

In forecasting the future from the present, however, it is necessary to be keenly appreciative of the fact that building at high speed does not necessarily mean building at low cost. All of the ship construction now going on has been planned for speed and nothing but speed. To cut the time of building a ship from six months to three months, any expenditure is justified under the stress of war need. After the war, cost competition will quickly force us back to the basis where economy is the decisive factor.

Of our present methods, only so much can survive permanently as serves economy and speed of construction jointly. Balancing plant cost and labor charge will again give rise to close study. Though we will not go back to the shipbuilding of former times, the lessons learned under the present tremendous pressure will remain chiefly in the form of greater standardization.

The Nation at War

WE HAVE stumbled. We have halted. Even today some obviously necessary things are undone. But, by and large, we are proceeding in a manner worthy of the manhood and resources of this country.

Our first year at war was confusing beyond anything in the memory of this generation. Would the nation back the President? Would pro-Germans carry on an orgy of violence? Could we train men fast enough to get into the conflict in time to help? Could we defeat the submarine? Would the strained relations between employers and labor be adjusted and a serious industrial conflict avoided? Would the confusion in Washington cease, would business methods succeed red tape, would the lack of coördination and the jealousies end in centralization and in a clear-cut program, adequately planned, adequately carried out?

How strange now these questions! Some of them we have entirely forgotten. The asking of them and the accompanying criticism was necessary. There still are problems and mighty ones, but the record to date gives us confidence of the future.

TO APPRAISE our various accomplishments in the order of their importance is difficult. The future historian is likely to place second that which we put first—military progress. He will look on our war making as a factor in and an evidence of our national development. From his point of view the great achievement of fifteen war months will be psychological. No one knew in April, 1917, whether our hundred odd million people were in fact one nation, whether we could find a standard to which all would rally. There was disturbing apathy in some sections as late as last autumn. That is at an end now. East and West, North and South are backing the Government. There is criticism of detail—and properly so—but opposition to the war only from scattered and discredited individuals and groups, rapidly diminishing in number. We have found a national purpose. We are a nation. The test is that of great sacrifices cheerfully borne.

But the psychological effect takes on even something of the international. We have become part of the family of nations. We have learned to think internationally, in world terms. Our insular thinking was named as one of the barriers to rapid foreign trade development by Charles A. Stone, president of the American International Corporation, in the *Engineering Record* of Jan. 6, 1917. Many failed to get his meaning, or refused to believe his position sound. Today the thought needs no elaboration, the position no defense. Poland, Roumania, Servia, Mesopotamia, words a year ago, stand now for political ideals, the striving of nations. Even Russia was hardly more than a name for a vast country; now the symbol of a people distracted, in danger of submersion, a people for whom, because of their past suppression, we have a natural sympathy; the symbol, too, of a land of wonderful potentiality being opened to the exploitation of a ruthless power. Economic penetration, also, was but a word to us; we cared nothing about its inevitable political consequences. Berlin to Bagdad—a Kaiser's fancy then—now one of our problems. China—a geographical fact—now a stage upon which we may have to become actors.

What the results of our new attitude will be can, to some extent, be foreseen. Having acquired international sympathies, having shed priceless blood to establish the reign of justice, we shall never retire to our former political isolation and be indifferent about the destruction of a people's liberties by an outside power in any part of the globe. We will have paid too dear a price to abandon that which our sons have died to gain. Our international sympathies and interests will deepen and broaden.

Following upon this international political viewpoint will certainly come an international outlook on business and commerce. The wide extension of foreign trade, with its certain influence on our domestic industrial structure, is certain. Before the war we had a relatively small foreign trade, and while it was enjoying a healthy growth there were severe handicaps—all leading back to our isolated thinking.

Then we had no merchant marine, no banking facili-

ties in foreign lands, meager foreign investments. When the war ends we shall have the ships and the banks, while the sympathy with and understanding of foreign peoples will favor foreign investment—in the wake of which follows foreign trade. Our industries expanded by the war will have great surplus capacity. At the same time we shall be competing with nations bending every effort to recoup themselves from the ravages of war. They will go into the foreign field with a sharper prod than we shall be feeling, and their best brains, served by labor cheaper than ours, will make new and severe demands on our engineering and managerial ability. It will be most assuredly the age of the engineer and the scientist.

BUT these effects are of the future, rather than of today. Where do we stand as to war problems—problems of immediate import?

Successful warring makes demands of fighting men, of materials and transportation, of money. Of these, we may call money and fighting men extra-engineering; they are not primarily the problem of the engineer, though he has the citizen's interest and responsibility in them. Materials and transportation are his affair.

As to these the problem has been stupendous. From a peace-time organization of industry we have had to jump, in a year, into war. One fourth of our productive capacity had to be converted to military uses—and under two very serious handicaps, a railroad system in a sub-normal condition, and a labor supply shortened by the withdrawal of upwards of a million and a half men. The machine put to new uses creaked. Under the best of conditions there would have been difficulties; the strain was severe. But in addition to the railroad and labor-shortage handicaps, executive control was not efficient. The Government had no appreciation of industrial organization and entrusted high places to theorists, while an army organization, lacking in the coördination necessary for the execution of industrial tasks and in knowledge of methods of large-scale production, was allowed to handle work for which it was not fitted. The result was a confused industrial situation, headed by a capital city that was a vertiable madhouse.

But the machine has found itself, the bearings are aligned, the most glaring weaknesses in design are corrected. The red tape is still strong, the coördination is not perfect, but at least the main lines of procedure are on a good basis, and each day sees further improvement. We are getting into production, the necessary industrial adjustments are made or are being completed. Coal still gives worry, so does the railroad situation—and both, be it noted, are under inexperienced heads.

AS TO labor, there is a decidedly easier feeling. Six months ago this was the most serious of problems. Industrial leaders entertained fear of grave disturbances—in fact, there was widespread expectation of trouble in May. The atmosphere even now is not wholly clear, but the attitude of labor latterly has been such that there is confidence that we can compose whatever difficulties will arise. Labor is patriotic, labor is backing the war, labor, better paid than ever for what it is rendering, making demands that are frequently exasperating, is nevertheless going to bear its share of the sacrifices.

Both sides have learned more about each other. The employee has become convinced that, by and large, capital is not profiteering. The employer has studied his men more closely and has been endeavoring to eliminate as quickly as possible conditions against which complaints might reasonably lie. There have been other stabilizing factors—the Government's study of labor conditions headed by the Lind commission; the excellent work of the industrial service sections of the war department, headed by such men as Dean Schneider and Dr. Hopkins; the emphasis placed by the Government on employment methods and on other largely neglected methods of successful management; the conferences resulting in the Taft-Walsh board, and, not least, the tempering of the attitude of the radial labor elements through the spectacle of the terrible results of Russian radicalism. Now additional steps in labor control—it might better be called employment control—are to be taken, while the Government is getting the data to make it decidedly uncomfortable for those whose war profiteering would offer justification for labor unrest.

The labor situation, then, while not solved is well in hand.

THESE are the major lines as the picture now presents itself. In the details one can find much evidence of the work of the engineer and the contractor. Goethals in the Quartermasters' Corps, Hoover in the Food Administration stand out most conspicuously. The construction of the cantonments is still the best single achievement of our war preparations.

Individually, engineers and contractors have given good account of themselves. That they still have much to do is evident. The scientific and engineering brains of this country and its experimental facilities are not yet fully concentrated on war problems. Nor is development separated from production—a separation the need of which the engineer appreciates better than anyone else. Progress in these directions may shortly be expected. Then, and not till then, can we truly say that in this engineering war, engineers have played their full part.

By and large, then, the nation has reason for satisfaction at the progress made. The first line of defense is 900,000 strong in France and is covering itself with glory. The navy has performed its task well in protecting our ocean transportation lines and in holding the submarines in check. Here at home ships and munitions are coming forward at an ever-accelerating pace, while a nation strong in the purpose of destroying the menace of German militarism, is quickly adjusting itself to the regime of war. Its heart, in a measure, has gone into the conflict faster than its head. Its purpose is better shown by its subscriptions to the Liberty Loans and to the Red Cross, the Y. M. C. A. and the Knights of Columbus funds, than in its actual settling down to a war basis. But where the heart is right, all else will follow. We need not doubt for the future. The big sacrifices, the great sorrows are still to come. We shall bear them in a spirit worthy to be termed American.

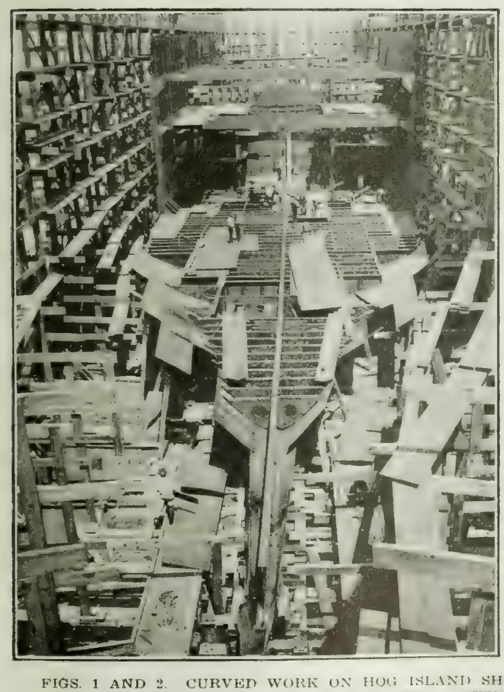
Design Steel Ship for Maximum Efficiency of Bridge-Shop Fabrication

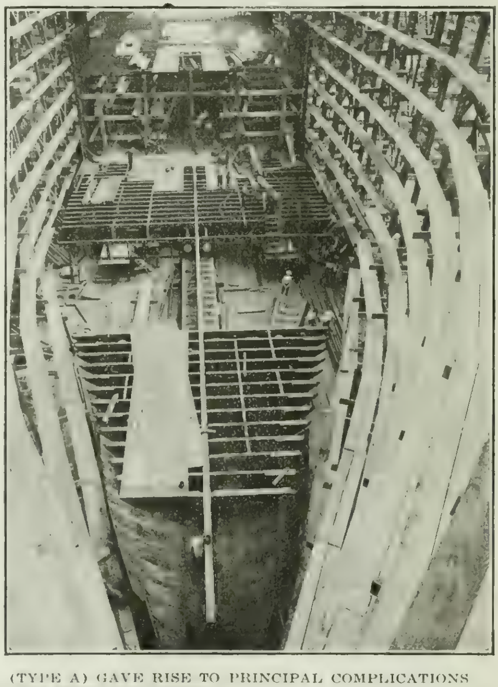
Hog Island a Pure Assembly Plant—Hull Parts Made in Many Distant Shops—Design for Multiple Punching to Develop Greatest Shop Output—Carefully Planned Drawing and Templet Systems

TWENTY-THREE months' time was allowed the American International Shipbuilding Corporation to build at its new Hog Island yard 180 Government cargo steamers, of nearly one and one-half million gross tons carrying capacity. The order meant that 550,000 tons of riveted steelwork had to be produced for assembly into finished ships in a year and a half. Existing bridge shops had to be depended upon to do the work. But no single shop in this country had a capacity nearly equal to the required output, and the half-dozen largest bridge shops, being already engaged in ship work, were not available. The problem was solved by enlisting in the work a large number of small- and medium-sized shops—boiler and tank shops as well as bridge shops—and by working out the design of the ship with such thorough adaptation to existing shop methods as to develop maximum output and greatest economy in fabrication.

It was decided to make the shipyard an assembly plant pure and simple, or, in other words, do 100% of the fabrication in outside shops. This was based on the view that the greatest output capacity would be attained by carrying out to full extent the division of ship construction into shop manufacture and yard assembly. No other large shipyard has attempted to apply the manufacturing principle in this thoroughgoing manner. Two large structural shops are being built at the Hog Island yard, one for correction of error, the other for fabrication in case of default of an outside fabricating shop.

Last August, when the corporation grappled with the emergency shipbuilding problem, it found the situation about as follows: The supply of plates and rolled shapes (though of bridge, not ship, steel) promised to be adequate, and Government priority control was in prospect to regularize the distribution of these materials. Structural or bridge sections of rolled shapes were at the time the only ones available, but a future supply of some ship shapes seemed probable, enough to warrant the use of a limited number in the design. The supply of large steel castings (required for sternposts and rudder frames) was rather in doubt, as other shipbuilding interests had already taken over most of the producing capacity; this suggested the desirability





FIGS. 1 AND 2. CURVED WORK ON HOG ISLAND SHIP (TYPE A) GAVE RISE TO PRINCIPAL COMPLICATIONS ENCOUNTERED IN DESIGN AND SHOP PROCEDURE

of designing the ships to eliminate large steel castings as far as possible. With respect to the shop operations of shearing, punching, bending and forging the hull parts, it was already an obvious fact that existing shops—bridge shops—would have to be depended upon to do most of this work. The market was limited, however, by the fact that the shops of the American Bridge Co. were likely to be occupied largely by ship work for the United States Steel Corporation, and

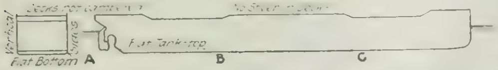


FIG. 3 STRAIGHT LINES OF THE HOG ISLAND SHIP (SECTIONAL AND PROFILE SKETCHES)

that many of the independent shops had already been put under contract by other shipbuilders.

Canvass of the equipment of the available shops showed two facts of primary importance. First, four or five large multiple punches—gang punches with spacing tables—were found, which promised great help in dealing with the plate-punching part of the work; second, there was not enough equipment for bending the frames of the molded parts of the ship or for rolling the curved plates. All other operations required in the fabrication of hull parts could be carried out well and economically by the shops with their regular equipment and methods. This statement applies not only to the punching and riveting, but also to the "stapling" or crimping of angles forming the boundary of water-tight floors and bulkheads and to the welding required at the corner bends of these angles; these operations were sufficiently related to the crimping of plate-girder stiffeners and ordinary bridge-shop forge work so that no trouble was expected.

Some fifty-five bridge shops and boiler and tank shops were placed under contract To make contracting on a businesslike basis possible at all, bids were called for on the basis of a thoroughly analyzed classification of work. The general design being outlined, it was possible to list and grade the various parts in an arrangement something like this: Water-tight keelson girders; water-tight floors, solid floors, open floors, brackets, shell plating multiple-punched and countersunk, shell plating multiple-punched but not countersunk, shell plating single-punched, sketch plates, beveled liners, furnace plates, stapled angles, etc. Some twenty-two of these classes were listed, and sketches of typical work in each class were prepared for submission to bidders. Prices were

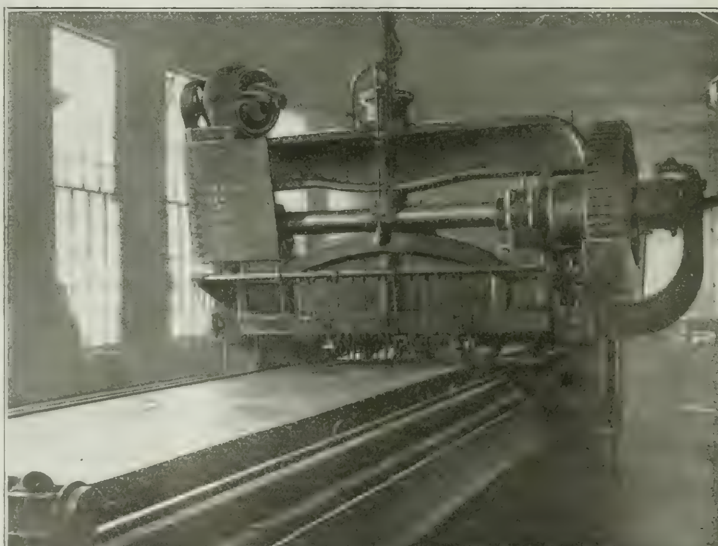
GENERAL DATA ON AMERICAN INTERNATIONAL SHIPS

	Class "A" Ship	Class "B" Ship
Length overall (about)	401 ft.	450 ft.
Length on water line loaded (about)	390 ft.	435 ft.
Molded beam	54 ft.	58 ft.
Depth to 2nd deck	23 ft.	30½ ft.
Depth to upper deck	32 ft.	40 ft.
Draft loaded (about)	24 ft.	28 ft.
Weight of steel hull (estimated)	3,100 tons	3,400 tons
Weight of wood and outfitting (estimated)	140 tons	300 tons
Weight of machinery with water (estimated)	460 tons	760 tons
Total weight of ship (light)	3,700 tons	4,460 tons
Dead weight capacity (loaded to draft)	7,500 tons	8,000 tons
Total displacement (loaded)	11,200 tons	12,460 tons
Number of holds	5	7
Cubic feet of cargo space	380,000	Not est
Gross tonnage (estimated)	5,400	6,200
Speed, knots	11½	15
Fuel	Oil	Oil
Oil capacity (about)	1,100 tons	1,600 tons
Oil consumption (24 hours, estimated)	29½ tons	70½ tons
Cruising radius (nautical miles, with one fuel loading)	10,295	8,132
Boilers (number)	3	6
Boilers (total hp.)	870	1,740
Turbines (number)	1	1
Turbines (shaft hp.)	2,500	6,000

asked on the sketches and on certain statements of quantities based on previous information as to the capacities of the various shops.

The bids received formed the basis for letting contracts. In a few instances it developed later that the early type sketches of work were not representative enough and contracts had to be readjusted.

For one or two classes of work, the bids showed that shop facilities were inadequate or absent. The curved plates of the molded ends of the ship are, with a few exceptions, shaped by bending-rolls. Only one bid was received on these rolled plates, and none at all on the bent and beveled frames of the same portions of the ship. The final outcome was that the American International Shipbuilding Corporation equipped several shops with the necessary plant, leaving the price on the work to be adjusted after determination of the actual shop costs.


F... THE MULTIPLE PUNCH INCREASES SHOP CAPACITY FOR SHIP-PLATE WORK

In planning the distribution of work, concentration of any one class in one or two shops was generally avoided, but certain kinds of fabrication were deliberately concentrated to suit either special experience or special equipment. All the keelson girders are being made at one shop, partly because all the riveting here is "oil-tight" work, which is done most advantageously by a trained organization, and partly because the scarfing of the corners of the web splices of these girders requires a special machine, which this shop provided. All the rolling of curved plates is concentrated in three shops; bending of frames is concentrated in five or six shops and forging of furnace plates in two.

In the case of the rolled plates the concentration makes a certain amount of rehandling necessary. These plates are punched in various shops, and after being punched must be shipped to another plant for rolling before they go to Hog Island. A considerable tonnage is involved, as about 30% of the shell plating is rolled.

In simplifying the general shape of the ship by substituting straight lines and flat surfaces for curved lines or double-curved surfaces, the American International went farther than most of the other emergency shipbuilders, by discarding all sheer, which in conjunction with the elimination of transverse camber made the decks flat from end to end. The sketch, Fig. 3, brings out the main points of modification from normal ship practice as to general shape. The parallel middle body, between points B and C, is straight structural-steel assemblage, except the bilge strake, at A, and the corresponding curved ends of the floors (the transverse girders in the double bottom). Beyond B and C the shell curves inward and the bottom of the ship tapers to bow and stern. Much of the bottom,

FIG. 6. BENT AND BEVELED ANGLES OF FLOORS IN MOLDED ENDS LINE UP WELL

tank top, decks and bulkheads in these end sections is also straight work, but the frames and shell-plating are molded, and the lower flange angles of the floors are beveled.

The situation as to castings already mentioned led to designing a special form of stern for the smaller of the two ships which the corporation is building, the "A" ship, a 7500-ton vessel. The stern-post casting is here replaced by a structural steel assemblage. Fig. 5 sketches this stern and shows that a large amount of extra bent-plate work is involved, including a number of hot-forged or furnace plates. After designing was completed and fabrication was well advanced the situation of the steel foundries changed so that a dependable supply of large stern-post castings was available, but the ships are being built in accordance with the sketch. The larger ship has a stern of the cruiser type.

Development of the design beyond the point shown in Fig. 3—general outlines of the hull having been given by the Emergency Fleet Corporation—was carried out with an organization trained in bridge and structural steel detailing practice. Painstaking study was given to two objective points: (1) adapting as much of the work as possible to the use of the multiple punch, and (2) carrying out the detailing and representation by drawings exactly as for bridge work, so far as possible. The latter was considered essential as a means of securing most efficient use of the organization and methods of each one of many scattered shops, all trained in current structural-steel fabricating methods.

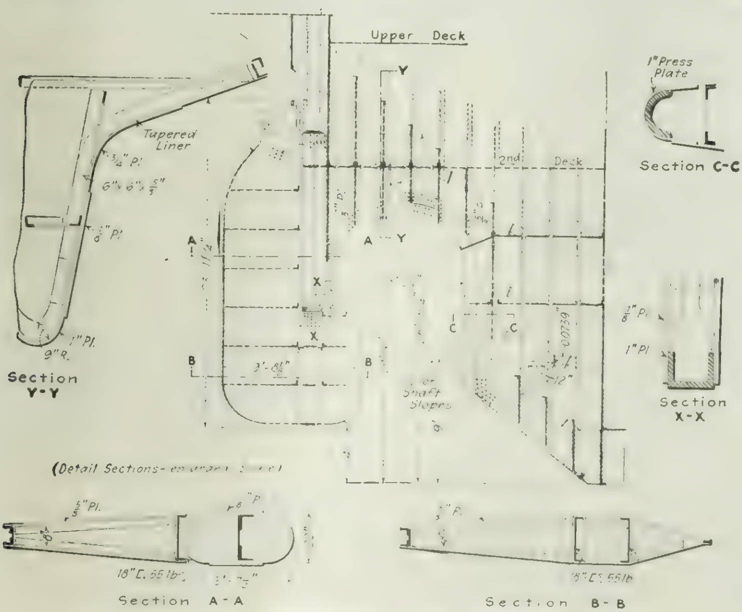


FIG. 5. STRUCTURAL-STEEL STERN OF THE A-TYPE SHIP REQUIRES NO LARGE CASTINGS

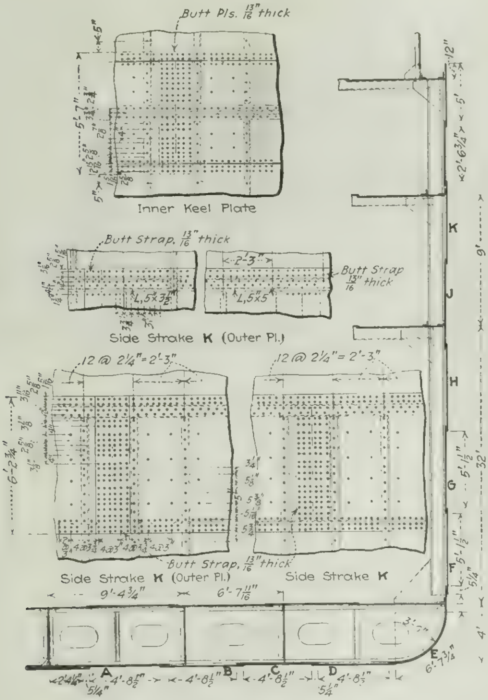


FIG. 7. PORTION OF SHEET SHOWING TYPICAL RIVET ARRANGEMENTS FOR MULTIPLE PUNCHING

Calking introduced no new requirements, as tight calking is fully provided for by using the rivet spacings fixed in ship-classification rules. Packing allowances in the assembly of several thicknesses of steel and allowance for stretch in punching, erection fits, etc., were considered to be no different from those used in bridge and structural practice.

Multiple punching is done at the three or four largest shops which the corporation has under contract. It results in a great increase of output and a marked decrease in cost. The representative of one shop stated that the straight punching capacity of his shop is practically doubled by multiple punches. The prices received in the bidding on the Hog Island work ran more than $5 per ton lower on multiple-punched than on single-punched work—a saving which will affect nearly 100,000 tons of steel before the corporation's present orders are filled.

Current rivet-spacing rules of ship classification societies such as the American Bureau of Shipping make multiple punching impossible, the designers found. Any shell plate, for example, has at least four different transverse rivet rows—at ordinary frames, at watertight floors or bulkheads, at the butts (splices with the adjoining plates of the same strake), and between frames, where only the marginal or seam riveting occurs. For each of these locations the classification rules prescribed rigidly defined rivet spacing, as, 6 rivet, diameters at frames, 5 diameters at oil-tight bulkheads, 4 diameters at quadruple-riveted butts, etc. With these spacings it was not possible to line up the holes to suit the machine, as the gang punches cannot be set closer than about 2 in. and it is therefore necessary that, when all rivet rows are assembled into one, no spacing closer than 2 in. should occur.

The structural engineers of the American International Shipbuilding Corporation, strongly convinced of the value of multiple punching, took up the matter with Lloyds' surveyors. The final outcome was that certain departures from the rivet-spacing rules were agreed upon, which permitted the plate work to be detailed for multiple punching. In substance, it was agreed that the rivet spacing might be varied from that prescribed by the classification rules to the extent of one-half rivet diameter, continuing for three or four rivet spaces before equalizing. The effect of this was that, by shifting the butt or the frame spacing a slight amount for successive short lengths of the rivet line, the two could be made to match for 2-in. minimum spacing. Specimens of typical shell-plate punching are shown in Fig. 7, which reproduces part of the designing sheet showing typical arrangements of punching for multiple work.

The entire problem was worked out on this basis with complete success. Besides the general drawings of standard multiple punchings just referred to, each single plate was shown in full detail on a sheet of its own, for the shop. Assembly drawings of large sections of multiple-punched plates and erection diagrams were also laid out. These and the sheet of standard punchings helped in the templet shop as well as in the

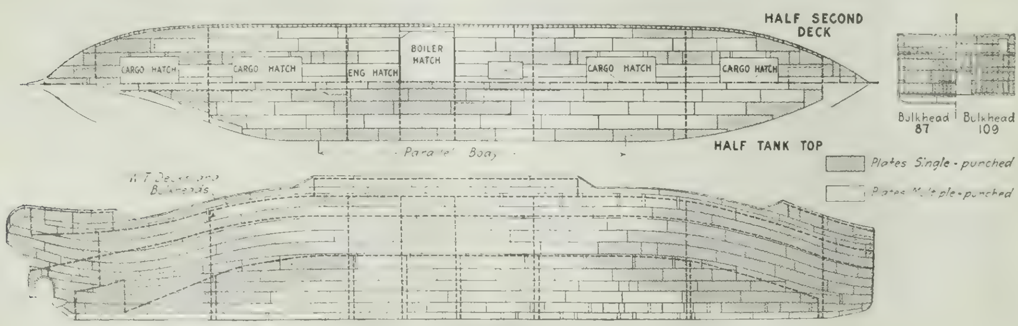


FIG. 8 EXTENT OF MULTIPLE PUNCHING IN SHELL, DECKS AND BULKHEADS

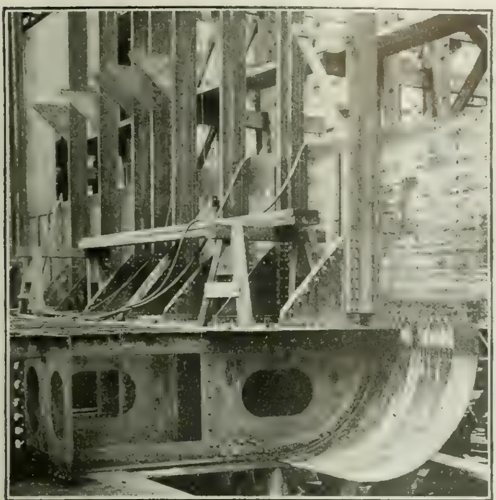


FIG. 9. PARALLEL-BODY CONSTRUCTION IS CLOSELY SIMILAR TO NORMAL STRUCTURAL WORK

drafting room, facilitating the layout and giving a check on the detail drawings.

Multiple punching was extended in all cases as far as possible. All the straight plates of the shell are multiple-punched, as are all bulkhead plates up to the irregular edge section (Fig. 8). The same is true of all decks and the tank top plating. In the case of the webs of the solid floors, all holes except those in the curved ends were lined up for the multiple-punch spacing, leaving the others to be done in a single-punch operation. In a few plates, where both ⅞-in. and 1-in. holes are required, all holes are punched ⅞ and when needed are reamed to 1-in. size.

The templet system adopted by the American International is as follows: All molded work was laid out full size in the Camden mold loft of the New York Shipbuilding Corporation—a company affiliated with the American International Shipbuilding Corporation—following regular shipyard practice. All complete working templets were made in duplicate for each of the plants at which the part in question was to be built, one templet to be kept as a master templet for comparison, and the other to be used in the shop. No templets were made for the straight parts, but these were left for the several fabricating shops to take care of in their customary manner on bridge and building work.

The corporation's templets are all of wood—cardboard templets were rejected at the start—and shipping these to the fabricating shop involved such expense and risk of damage that it was urgently desirable to limit the number of Camden templets to the minimum. Since all structural shops regularly make templets for the work ordered of them, no advantage to the straight part of the ship work could be realized by making templets at Camden and shipping them to the shop, provided full and accurate drawings were furnished. On the contrary, it was believed to be a distinct advantage to vary the whole procedure as little as possible from that customary in bridge and building work. In the case of a bulkhead, the central rectangle was detailed on drawings. The sketch-plate portion along the two edges, however, was laid out in the mold loft, and templets were made and shipped to the shop.

The effort throughout was to suit existing shop methods, in order that all parts of each shop organization would get into the work without hitch or loss of speed. This consideration dictated not only leaving the templet making to the fabricating shop, but also working out the drawings as closely as possible in accordance with ordinary structural practice.

Under this system, which called for shop drawings in very much larger number and also of greater com-

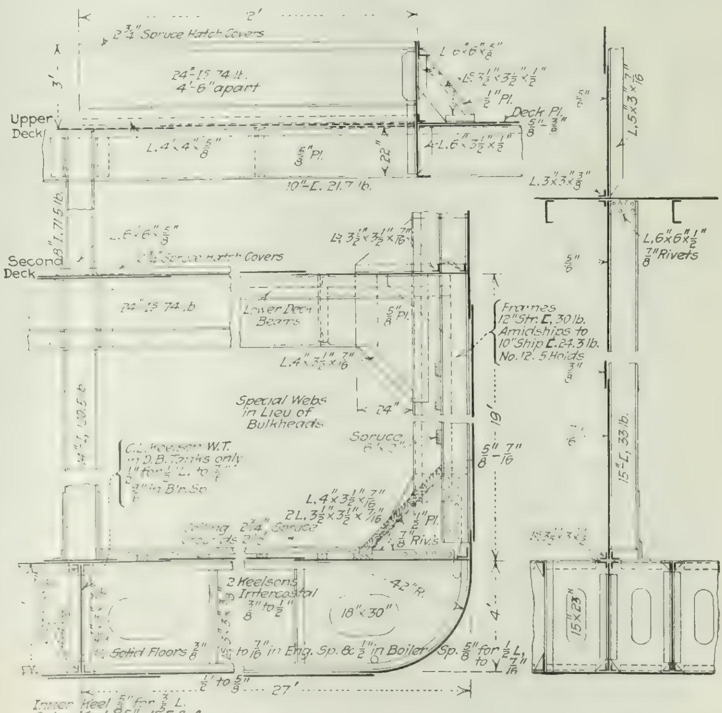
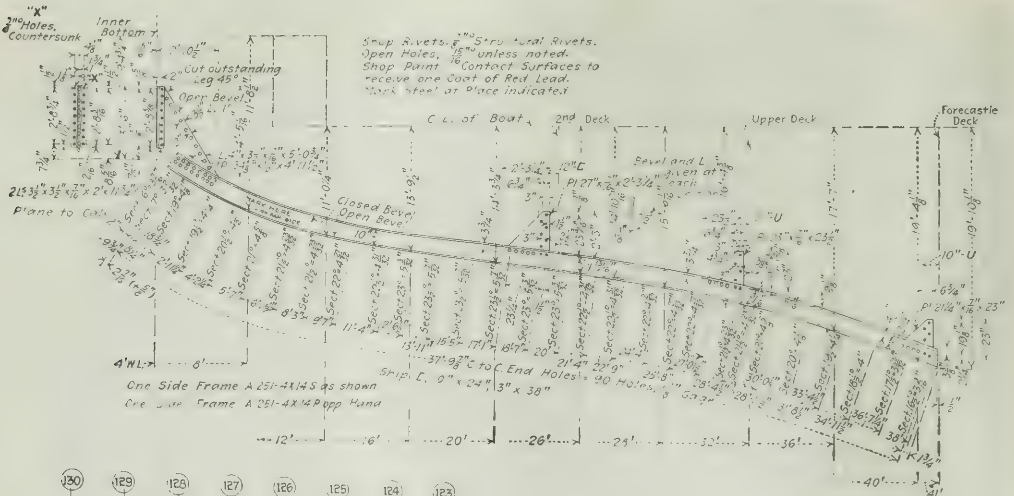


FIG. 10. MIDSHIP SECTION HAS DETAILS OF BRIDGE AND STRUCTURAL TYPE



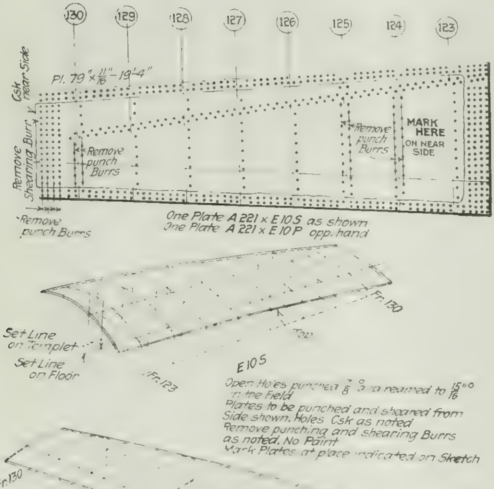


FIG. 11 PICTURE DRAWINGS OF MOLDED PLATE AND OF BENT CHANNEL FRAME

pleteness than ordinary ship practice requires, thorough detailing and the preparation of a full set of working drawings early became established practice in the American International's hull-designing division. The distance between shops and drafting room increased the desirability of thorough detailing, as the clearest possible form of representation would be most likely to avoid delays and misunderstandings in the shop.

In this way a very comprehensive set of drawings was built up. The 7500-ton ship (the "A" ship) requires some 1300 sheets. A ship of somewhat larger size, being built by another company, is completely covered by about one-tenth as many; but in this case, both shop and drafting room are thoroughly familiar with each other's methods, and both have a fair amount of experience in ship work. The American International's very much larger stock of drawings represents increased care and labor in the designing office required because of the absence of this condition and because of having to deal with several scores of shops instead of with one shop.

At first it was not intended to show the rolled shell plating by separate detailed drawings. These plates were worked out fully in the mold loft, and the mold and rolling templets made direct from the lines of the ship as laid down on the floor full size. The same statement applies to the bent frames. When these molds and templets were sent to the shops, it soon appeared that some form of graphic representation familiar to structural shop men would facilitate the fabrication. As a result, sketches of the finished parts were made, from measurements of the molds. These sketches give some general figures, but on the whole are not dimensioned; because of this and the use to which they are put they are called "picture drawings." Two specimens are reproduced as Fig. 11, showing a rolled plate and a bent channel frame. The sketches have been found very helpful in preventing shop errors.

Concerning the question whether designing for fabrication, as in the case of the Hog Island ships, involved a considerable increase in the number of rivets to be driven, H. G. Balcom, the corporation's consulting engineer, states that substantially no more rivets were required than would be used under conventional ship-design methods. The variations of spacing for the multiple punch were so applied as to hold down the number of rivets to that necessitated by Lloyds' rules. At only one or two connections are excess rivets used, for convenience in matching spacing; the total number is 2000 or 3000 per ship—about one-half of one per cent.

Of the 586,000 rivets in the "A" ship, only about 20% are shop rivets, while 466,000 must be driven on the ways.

The variable countersinks ordinarily used in ship

FIG. 12. COUNTERSINKING RIVETS AND CALKING SEAMS FORMS LARGE PART OF SHIP CONSTRUCTION

work were modified to the standard shown in Fig. 13; a single taper is used for a given rivet size. The American International ship has in general only $\frac{3}{4}$- and $\frac{7}{8}$-in. rivets; $\frac{7}{8}$-in. rivets are used everywhere in the shell plating, except at the sheer strake, where 1-in. rivets were insisted upon according to the rules, though an equivalent joint with $\frac{7}{8}$-in. rivets was designed. Straight (cylindrical) rivets are used in nonwater-tight work, and swell-necked rivets in members required to be water-tight or oil-tight.

Punches for rivet-holes in all work made to detail drawings are $\frac{1}{16}$-in. larger than the nominal size of the rivet, and the dies are $\frac{1}{8}$-in. larger. This reduces reaming to a minimum. Some of the early work was punched $\frac{1}{16}$-in. smaller than this, to give sufficient metal for reaming in bringing holes to match, but the allowance was soon found to be unnecessary. Holes in molded work are made with punches of diameter equal to the rivet size.

The drawings specified all points where the burr produced in punching was to be removed. In general, this was at all holes where the die side of the hole came on the contact surfaces of plates. In the regular shell plating, holes are punched away from the contact surface, and the burr, coming on the outside, is removed by the countersinking. Where three thicknesses of metal occur, however, it was required that the punching burr on the middle thickness be removed.

Burrs at sheared edges also had to be removed at those contact surfaces where calking was necessary. Where the burr came at the outside of such an edge, the slight rounding at the point of calking, caused by the pressure of the shear blade, did not interfere with satisfactory calking. It was not required to plane or chip such edges in the shop, and very little chipping was found necessary on the ways.

The edges and ends of shell plates are not planed except where plates butt, as at the inner edge of the strake adjoining the flat keel, the ends of the flat keel, etc. The total amount of this work in the "A" ship is about 4300 lin.-ft. of edge.

Scarfing of plates at the junction of seams and butts of the plating, customary in ship work, requires special equipment, which the bridge shops lack. To provide special rigs for the work would have meant much trouble and delay, it was feared, and on this account scarfing was rejected at the very start. Instead, taper fillers are used, so-called "beveled liners." The amount of extra weight which they add is said to be small, but they have proved troublesome in erection, as the rivet holes through the liners must be drilled in the field because of the variations in the width and edge distance of plates. The exposed edges of liner and abutting plate are required to be calked water-tight, and for good calking the heel of the liner must fit close to the abutting edges of the plate, and the side of the liner must project slightly beyond the edge of the outer plate; it is likely that these required conditions will not be realized if the holes in the liner are punched in advance.

At one point of the ship scarfing is used—in the web splices of the keelson girder. Following ship practice these splices are lapped instead of being butted and fitted with covers as in ordinary plate girders; the lap splice has shorter rivets, which favors the tight calking required to make these girders oil-tight. The lapped plates are scarfed at their upper and lower edges, where they are seated between the flange angles of the keelson girders, so that these angles do not need to be joggled (crimped). All the keelson girders were allotted to a single shop, which has equipped a scarfing machine for the web plates and finds no difficulty in the work.

In normal ship practice, bracket plates such as those connecting frames to tank top and deck beams are commonly flanged over on their free edges, to stiffen them.

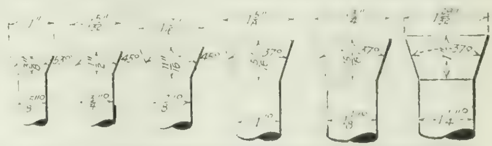


FIG. 13. COUNTERSINK STANDARDS OF AMERICAN INTERNATIONAL SHIPBUILDING CORPORATION

The operation of flanging is not readily done in bridge shops, however, no equipment for it being provided because structural-steel practice does not employ flanging. In detailing the ship, therefore, stiffener angles were called for at these points, and flanging of details was everywhere avoided.

The number of double curved or forged plates in the shell is increased by the special stern shown by the drawing, Fig. 5, as several complex forged parts are required for this stern. Elsewhere only about a dozen forged plates occur in the shell. One or two shops specially equipped for die forging do all of this work, molds for the dies being furnished by Hog Island.

Intercostals, or longitudinal members fitted between floors, were detailed $\frac{1}{16}$-in. shorter than the theoretical length. They were required to be assembled and riveted up in metal frames to this dimension. This allowance proved wholly satisfactory in the erection; no trouble from slack or cramping was reported from the ways.

In fitting parallel liners under the outer plates of the shell and tank top at water-tight floors, a close fit had to be secured so that tight calking would be feasible. These liners were ordered $\frac{3}{8}$-in. over length,

and on the ways their ends were chipped to fit tight between the edges of the inner strakes.

A class of work unusual for bridge shops is found in various holes and notches required at many points. These include a large number of access holes in the floors and longitudinals, notches in the longitudinals to pass the chords of the open floors, and notches in stringer plates of the second deck to pass the frames. In some shops the holes and notches have been cut by special punches. In the majority of shops, however, this work is being done with oxyacetylene flame. The corporation left the method of doing the work optional with the shops; no special requirements were made as to finish.

Standardization or systematization of design is not confined to the hull work, but appears just as prominently in the equipment—piping, machinery, etc. A striking item of standardization is illustrated by the detail construction of the propeller shaft. This shaft is made with its five intermediate sections interchangeable, as much to simplify storage and erection as for shop economy. Every point of the equipment to which such simplification could be applied was treated correspondingly.

Training Engineer Officers for the Army at Camp Lee

Experienced Engineers, Now Reserve Officers, Enlisted Men and College Boys Work Side by Side to Fit Themselves for Service Overseas

By Frank C. Wight
Associate Editor, Engineering News-Record

FORTY young and vigorous soldiers seated around a lone tree; in the background the familiar multiplied roofs of a cantonment; in their direct gaze a triple Burton tackle hanging from a limb, and alongside, the standing figure of a well-remembered professor of engineering now wearing the double bars on his shoulders and the castle on his service shirt collar. Five different opinions from as many men as to the pull on the captain's hands from the line weaving its way through snatch block and pulley to a supposititious hundred pounds in a dependent bucket.

A line of crouching men, shell pits, wire barriers, trenches and at the end a hundred dummies waiting for the thrust of a hundred bayonets, a command, a chorus of deep and threatening growls, and a plunging company goes by in a mimic "over the top." As they come up one recognizes in a grayhaired, lithe, but tired-looking soldier the city engineer of a large and busy city, on the books as a major, Engineer Officers' Reserve, but here in camp no better or no worse than the boy at the nearby tree who is not quite sure how big a proportion of a load passes through the single-turn pulley.

CANDIDATES FOR ENGINEER COMMISSIONS GO THROUGH THE DAILY ROUTINE OF THE SOLDIER

The two pictures visualize the two main problems in the early weeks of the engineer officers' training camp. Each is a part of a necessary course of instruction; each is a step in a process of elimination. Every day a few of the candidates show themselves hopelessly incompetent in the engineering groundwork an engineer officer must have; every week some quite competent engineer fails physically or mentally to measure up to the military requirements of a soldier. The instructors must put the whole ill-assorted mass through the same routine to sift out the different types of incompetence, or in some cases, of incompatibility.

Fourth Camp Now Under Way

Three engineer officers' training camps have been held since the war began. From them have gone forth nearly 6000 officers now en route to France or in service overseas. The fourth camp under way at Camp Lee, near Petersburg, Va., has profited by the experience of its predecessors; its course of instruction is a development of a year; in its corps of instructors are many officers who have served in two or even in three of the earlier camps. Except for the personnel of the students, happily to be improved by the recent call for more engineer officers, it is typical of the coming camps into which more and more of the engineers of America must go. The grade of student is lower, because regimental commanders have defeated the purpose of the General Staff to promote worthy privates and noncommissioned officers by sending to the camp a number of men who by no intensive training could ever become officers, much less engineer officers, but whose removal might conceivably raise the standard of the regiments from which they came.

The Camp Lee training camp now has about 1400 men, a third of whom are reserve officers and two-thirds enlisted or drafted men detailed there for instruction. Among the latter are a number of members of the so-called Engineer Enlisted Reserve, seniors of engineering colleges whose standings during their four-year course have been at least as high as that of the upper third of the students for the previous ten years. All of the men, regardless of their source or their rank, are for the time being considered as privates in companies whose officers are the camp instructors. There are six of these companies, each quartered in the regulation barracks of a divisional cantonment, a portion of which has been assigned to the training camp as a unit independent, except for general regulations, from the remainder of the cantonment.

Officers at the Camp

In command of the training camp is Lieut. Col. V. L. Peterson, Corps of Engineers, U. S. A., and under him as senior instructors are six majors of the Corps of Engineers; R. U. Nicholas, D. O. Elliott, Harrison Brand, Jr., G. J. Richards, A. P. Cronkite and D. A. Harrison. In command of the six companies at the camp are the following reserve engineer officers: Capt. E. B. Wilhelm, Capt. C. T. Chenery, Capt. H. H. Allen, Maj. W. A. Ritchie, Maj. George Blow and Maj. H. F. Cameron, each of whom has on his staff seven other reserve officers acting as assistant instructors. Attached also to the camp are commissioned and noncommissioned officers of the allied armies, men who have seen service in France and whose instruction, therefore, will have the emphasis of experience as well as a special appeal to the student. Some of the assistant instructors, too, have just returned from service at the front, so as to bring the instruction in close touch with the changing conditions of modern warfare. More are expected in the future.

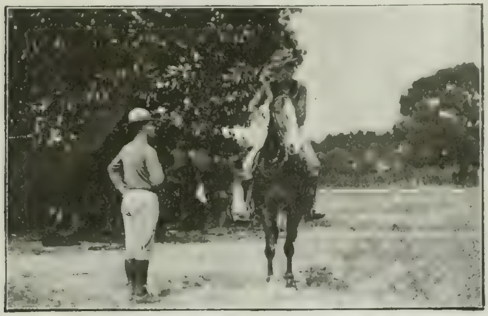
As far as discipline is concerned, conditions of the regular army cantonments prevail. It is continually kept in mind that soldiers are being trained—engineers, of course, but men who will have to enforce discipline and command troops in the field. The famous incidents of the Cambrai fight and of General Carey's "scrap" army, which stopped the advance near St. Quentin, are well known examples of the fighting engineers. Many other incidents, small in themselves though of great importance to the unit concerned and of strategical importance to the whole Army, have been filtering back from the front. Engineers, even pioneer engineers, are not expected to have to do much fighting, but they have to be ready to fight if the need arises.

Hours of Work at the Camp

The camp, therefore, follows in its schedules and rules the familiar cantonment training camp system. Reveille is at 5:45, breakfast at 6:20, and the men are at work at 7 a.m. An hour from 12 to 1 is allowed for dinner, and from 1 to 4:30 instruction continues. After dinner there is an evening study period from 6:30 to 8:30, and taps are sounded at 9:30 p.m. Little time is left for anything but intensive work.

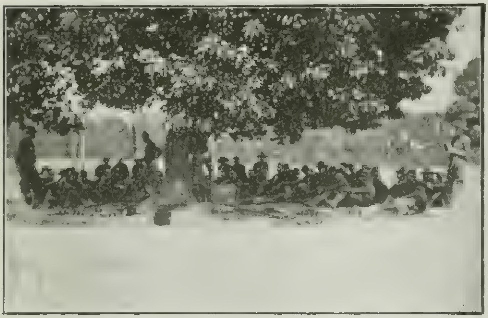
The object of the camp is to impart a sufficiency of military information and sense of military discipline, so that the students as officers can command troops, and at the same time to lay the rudiments, at least, of military engineering on the foundation of civilian engineering which the candidate must have in order to become a successful engineer officer. The first four weeks of the 12 to 14 weeks in camp are given over largely to military instruction and training in the manual of arms, in musketry, physical drill, bayonet and target practice and in tactics, signaling and general maneuvers. This is in charge of the company officers, with advice and supervision by the senior instructors, all of whom are West Pointers. It includes also conferences and lectures on the treatment of animals, wagon, harness and stable management, and on general tactics, together with thorough instruction in administrative work. While all this military instruction is not as elaborate as the similar instruction given to the draft armies in the cantonments, it is more intensive. Judging from the military appearance of men who have been through only four weeks of its routine, it is quite effective in producing a soldierly bearing and an appreciation of military fundamentals. It certainly requires physical qualities not infrequently lacking in the older desk man but which the field engineer has in full.

About the fifth week of the camp engineering instruction begins to predominate. The mornings are devoted partly to military instruction, but some of the companies each morning are engaged in engineering work, and all of the companies give every afternoon to technical details. The engineering instruction is designed for the development of pioneer engineers; that is, the men who

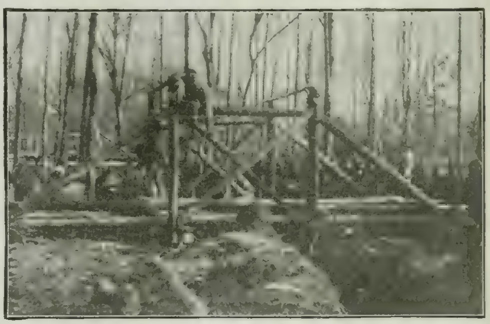


MAJOR DAVISON AND LT. COL. PETERSON (ON HORSEBACK)

LIEUT. SATTERTHWAIT, CAPT. SCHODER, MAJ. CAMERON AND MAJOR RICHARDS



STUDENTS RECEIVING INSTRUCTION ON TACKLES



QUEEN POST TRUSS BUILT IN FIELD

SINGLE LOCK SPAR BRIDGE LOADED

KING POST TRUSS BRIDGE BUILT IN FIELD

PILE DRIVING BY HAND

LIGHT PONTOONS ACROSS THE APPOMATTOX

serve with the active army. The student Bible is the engineers' field manual, issued by the War Department some years ago and revised since the present war started. With that as a basis, the engineer instructors try to hammer fundamentals into the students in six to eight weeks.

Varying times are devoted to each subject, but as a rule a company spends an entire afternoon in one line of work. Regular college schedules are maintained, showing the assignments from day to day, so that any afternoon each of the six companies will be engaged in a different line of study. Senior instructors specialize in special branches and take the companies as they come to the study of each of these branches. Company instructors remain with their companies through their entire program.

Military Engineering Studies

The subjects of study are familiar. They include reconnoissance, field fortifications, trench warfare, wire entanglements, bridges, demolition, pontoons, revetments, rigging, mining and roads. So far as possible, actual service conditions are approximated. The camp has a full set of three lines of trench defense, with the usual accompaniment of boyaus, dugouts, tunnels, listening posts, shelters, bomb proofs, machine gun and Stokes mortar emplacements, etc. Study of this trench system is made and at the same time the students themselves put in short tricks at digging special types of trenches, dugouts and shelters, under the expert direction of those foreign instructors who have seen actual service.

The adjoining river, the historic Appomattox, and many gullies and depressions afford fine opportunity for bridge and pontoon practice. Each group of students must devote a considerable amount of time in setting up pontoon bridges and in building trestle bridges, cutting the wood for the latter from the trees covering a large part of the outlying sections of the camp. Mapmaking, too, is a subject in which actual service conditions can be approximated, and all day long in the early weeks of the camp squads of soldiers can be seen in the woods and roads equipped with the light army plane table.

System of Marking

Through all of this process the engineer instructors are keeping constant and vigilant observance of the candidates. A system of weekly marking is maintained according to rules laid down by the Adjutant General's office for the selection of officers at all training camps. Together with these weekly markings, which are given by all the instructing officers and are weighted according to the rank of the officer to make up the final average, there are frequently written examinations and the standard psychological examination, "which measures intellectual and not educational status" and which all candidates for army commissions must undergo. Obvious misfits are soon returned to private life, or, if already in the service, to their commands, but those who survive the early weeding out as a rule remain until the end of the camp, when the case of each man goes before a final camp board made up of the senior officers. Its recommendations as to the disposition of the candidates are in practically every case adopted. The college and enlisted men are rarely commissioned above second lieutenant. The reserve officers are either honorably discharged or are "graduated" from the camp and assume their rank in whatever assignment is given them.

Pragmatically, the engineer officers' training system is good. It works. The men who have been turned out in the past are making successful engineer officers in France today. The men who are at camp now, from "doughboy" to lieutenant colonel—and one may see them side by side in their blue dungarees—are in deadly earnest. And no less in earnest is the fine group of instructors, each one of whom is giving up his dearest wish—to see service at the front—in order to train the men who must do the pioneer work in the new armies now going over. Lieutenant Colonel Peterson, the commanding officer, is a field engineer of long experience in the Philippines and on the Rio Grande. He appreciates the needs of pioneer engineering as well as he does those of military instruction, and it is his constant effort to impress on his corps of instructors the equal importance of the two. His tall, lean figure and bay horse as he rides from squad to squad on various work are as familiar to the students as are their own immediate officers. To him is in no small measure due the "pep" which characterizes the men as a whole.

Call for More Engineer Officers

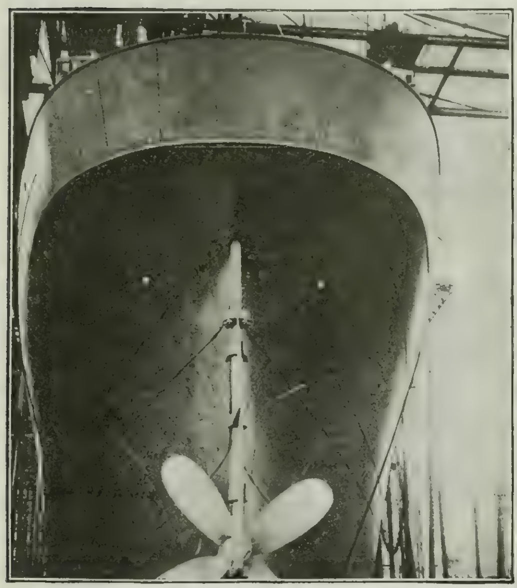
An increased army and the poor quality of the enlisted men designated for training in the last camp have led to a call for more engineer officers from civilian life. Two thousand or more of these men no longer in the flexibility of the twenties will have to go through the strenuous discipline of the training camp this summer, but, judging from the past, what these men lack in suppleness of body they will make up in eagerness of intent and readiness of mind. The training of the engineer officers now is for actual service with pioneer troops in war, and the news dispatches every day emphasize how much more real is the promise of actual service than it was to the students in the earlier camps. This imminence of real war should make the coming camp, which will probably be moved to Camp A. A. Humphreys on the Potomac, if anything more serious and workmanlike than those that have gone before.

Red Cross Uses 634 Motor Cars in France

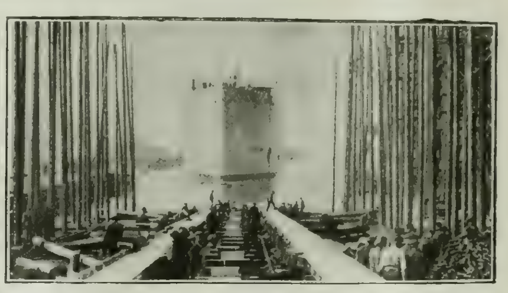
The motor transportation system of the American Red Cross in France handles, on the average, 2500 tons of freight monthly at the 14 ports of entrance, moves nearly a thousand tons per week from Paris stations and the Seine landings, and transports supplies, workers, refugees and wounded in all sections of France. Of the fleet of 634 vehicles, 385 are trucks and ambulances, 246 ordinary cars and 22 motorcycles. The Red Cross maintains two large garages and an automobile park in Paris. Fifteen other garages meet the needs of the port and other transportation services. Complete machine shops, with skilled mechanics, are maintained at the chief garage, and quick repair maintains speed in handling goods. Over 80% of the Red Cross supplies have to pass through Paris on their final journey of relief. Practically every article shipped via the Red Cross from America is handled by this system.

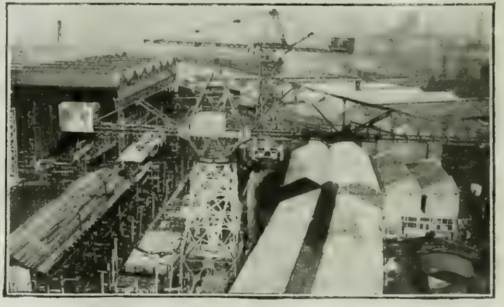
British, Too, Are Building "Standard" Steel Ships

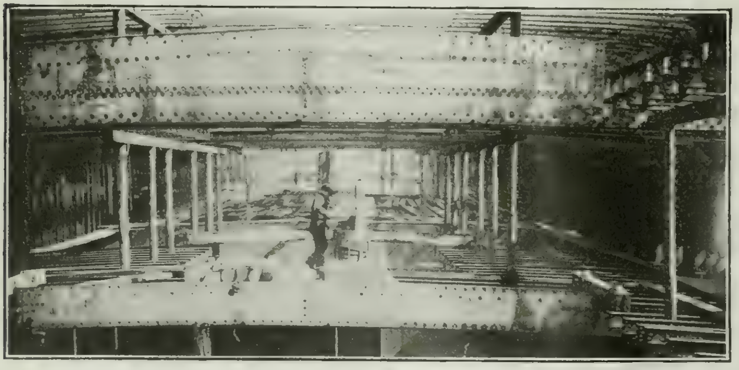
Photographs © British Pictorial Service.



SIMPLIFICATION SHOWN IN STERN





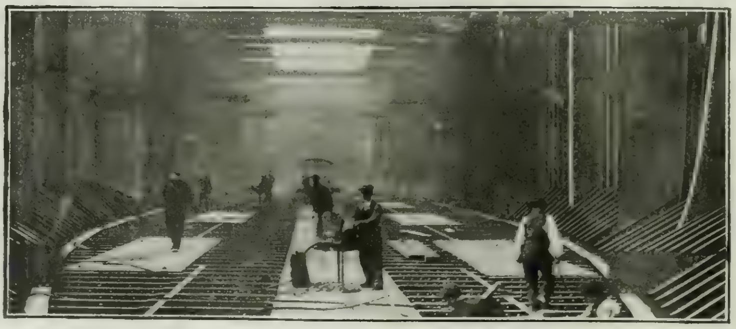


ABOVE — HAMMERHEAD CRANES COMMON IN BRITISH YARDS

BELOW—PREPARING WAYS FOR NEXT SHIP AS ONE IS LAUNCHED

LEFT—CURVED WORK STILL CONSPICUOUS, A SAVING FROM STANDARDIZATION BEING EVIDENTLY CHIEF GAIN OVER OLD SHIPYARD PRACTICE

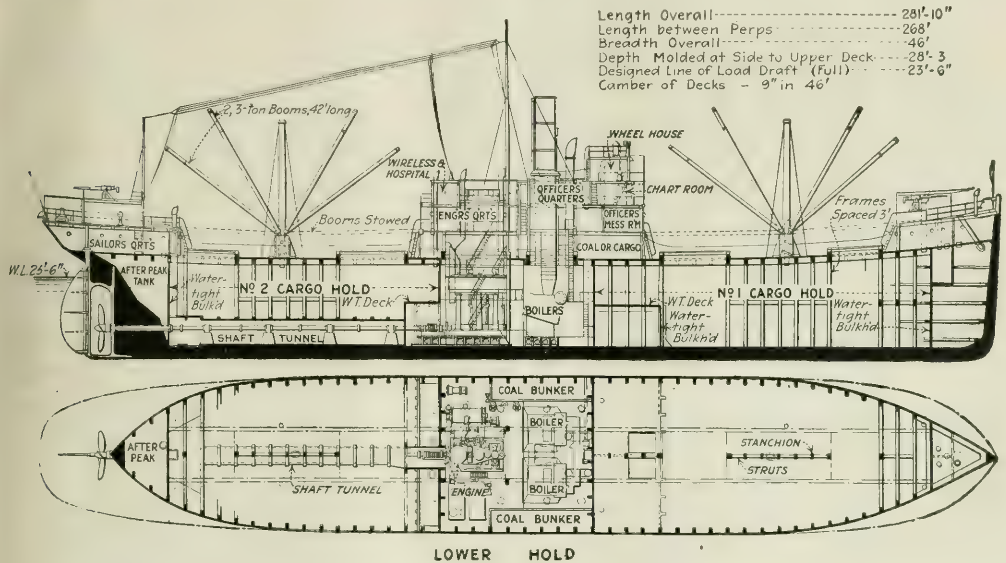
ERECTION FALSEWORK AND TEMPORARY POSTING BETWEEN DECKS ON A "STANDARD" SHIP



Government Designs and Builds 3500-Ton Concrete Ships

Shape and Size of Vessels Under Construction Follow Standard Wooden Ship of Same Tonnage—Usual Concrete Details Adapted to Seagoing Ships

CONCRETE ship construction is now being undertaken by the United States Government on a large scale. Vessels of approximately 3000-ton, 3500-ton and 7500-ton cargo carrying capacity have already been contracted for, and construction on the smallest of the three types, designed by the contractors under Government supervision, has been commenced in two yards. The concrete ship department of the United States Shipping Board, Emergency Fleet Corporation, of which R. J. Wig is chief engineer, has also prepared the design for the 3500-ton ship, of which two are to be built. For the first time in any publication the details of this ship are presented here.



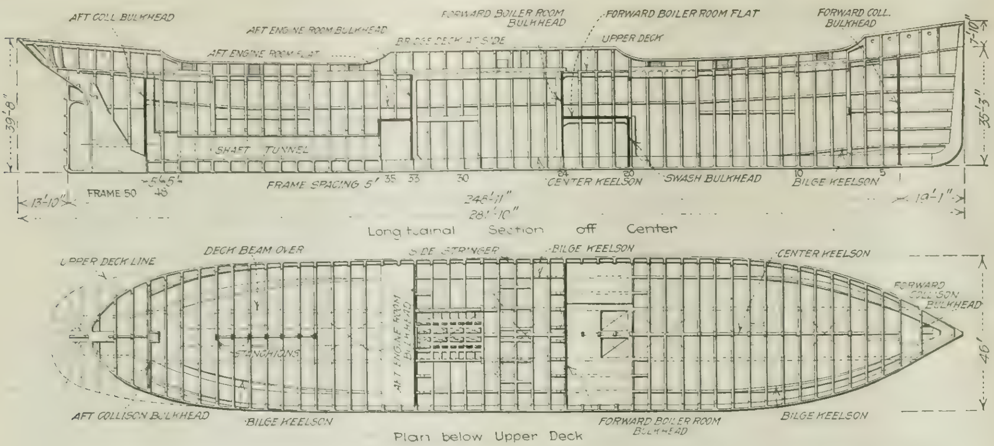
IN GENERAL LAYOUT THE GOVERNMENT'S NEW 3500-TON CONCRETE SHIP IS SIMILAR TO THE STANDARD WOODEN SHIP BEING BUILT BY THE EMERGENCY FLEET CORPORATION

To utilize the already designed and partly manufactured engines and fittings for the Fleet Corporation's standard wooden ships, the first standard concrete ship was made of approximately the same capacity, dimensions and form, except that the sheer line amidships of the concrete ship has been slightly altered and no exterior keel is fitted. The general arrangement of the ship itself and of the propelling machinery is the same in both types. As shown in one of the drawings, the ship is of single deck over its full section, with a poop deck at the stern, a forecastle deck at the bow, and a bridge deck, with a wood frame cabin house, amidships. A single screw turned by a 1400-hp. reciprocating engine located amidships will give a speed of approximately 10½ knots. The boilers may burn either coal or oil.

The ship has a length over all of 281 ft. 10 in., a length between perpendiculars of 268 ft., beam over shell of 46 ft., depth amidships at sides of 28 ft. 3 in., and a loaded draft of 23½ ft. As shown in Table I, giving the comparative weights of concrete, wood and steel vessels of the same type, the concrete ship light weighs 2972 tons, has a carrying capacity of 3203 tons, and a full-load displacement of 6175 tons. It compares closely in these dimensions with the similar wooden ship of somewhat larger dead-weight carrying capacity, but, as will be noted from the table, it is nearly twice as heavy empty as a steel ship, similarly rated, which has a carrying capacity 10% greater. Estimates of cost by the Shipping Board are between \$100 and \$125 per ton for concrete ship dead-weight carrying capacity as against \$165 for wooden ships and \$180 to \$220 for steel ships.

TABLE I COMPARATIVE WEIGHTS OF CONCRETE, WOOD AND STEEL VESSELS OF NOMINAL 3500-TON DEAD WEIGHT CAPACITY

	Concrete	Wood	Steel
Hull	2,500	2,300	1,160
Fittings, outfit, and equipment	191	191	180
Propelling machinery	206	206	200
Margin	75	80	60
Ship (light)	2,972	2,777	1,600
Reserve feed	80	80	8C
Ordnance	23	23	23
Fuel	300	300	300
Stores	40	40	40
Cargo	2,760	2,180	3,057
Total dead-weight	3,203	3,123	3,500
Full-load displacement	6,175	5,900	5,100
Percentage dead-weight to full-load displacement	52	53	68 6



CONCRETE FRAMING IN 3500-TON CONCRETE SHIP. ADAPTATION OF SIMPLE BEAM AND SLAB DESIGN

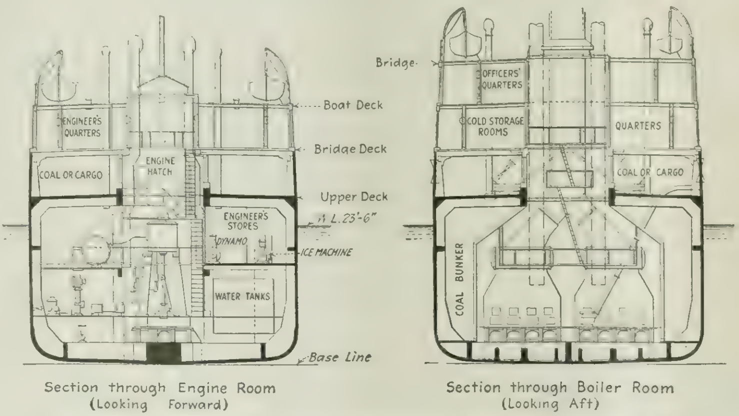
In the general shaping of the hull very little change from the standard wood ship has been made as a concession to the use of concrete. The midship section, which continues for about 35% of the length, is practically square. There is a slight batter in the bridge-deck bulwark and a rise of 9 in. in the bottom from the center to the bilge keelsons.

Stiffness of the bottom is aided by one center keelson and two bilge keelsons, the former turning to make stern and stem posts and the latter following the curve of the hull and ending at the collision bulkheads. These keelsons are concrete girders reinforced with rods in their upper and lower sections and tied together with frequently spaced stirrups. They frame into the transverse frames of the vessel, which are spaced 5 ft. apart on centers. These frames are reinforced-concrete girders turned at the corners to meet the curve of the hull and reëntering at the main deck to form the transverse deck girders which carry the deck and serve as cross-braces for the side members of the frames. The bridge deck bulwark is in effect a continuation upward of the shell of the ship, being formed of girder frames and an outer shell. It is provided with an expansion joint about amidships. The main frames are additionally stiffened by longitudinal, horizontally placed stringers about three-quarters of the way up the frame.

Integral with the main frames is the shell, a continuous, reinforced-concrete plating 5 in. thick on the bottom and up to a point 6 ft. above the base line, and 4 in. thick through the remainder of the hull to the deck line. The main deck is also a 4-in. reinforced-concrete slab continuous except for the hatch openings, which are stiffened by the usual combings.

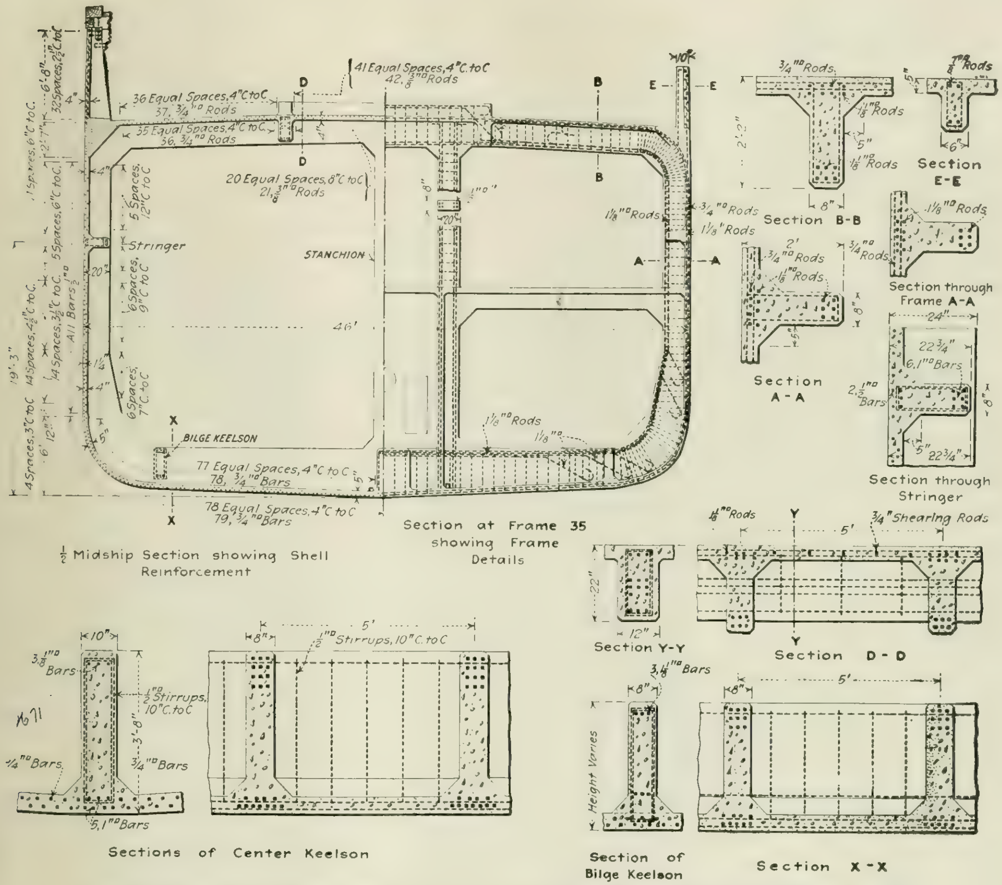
The shell is reinforced at its outer and inner faces with ½- to ¾-in. square bars running around the shell parallel to the water line and spaced at distances varying from 4 to 12 in. c. to c., as shown on the cross-section drawing. These rods are designed to be placed 1¼ in. from the face of the concrete on both outer and inner faces.

In addition, there are vertical ¾-in. shear bars between the horizontal rods spaced on varying centers. They extend around the entire shell and deck. The detail, a heavy connection forming in effect a longitudinal girder between the shell and the deck, is shown in one of the drawings.



TWO CROSS SECTIONS OF THE GOVERNMENT'S 3500-TON CONCRETE SHIP

Between hatches in the cargo holds the deck beams have intermediate supports in the way of reinforced-concrete stanchions designed as columns, these stanchions being braced longitudinally at about half their height with reinforced-concrete struts. In the stern half of the boat the shaft tunnel is of reinforced-con-

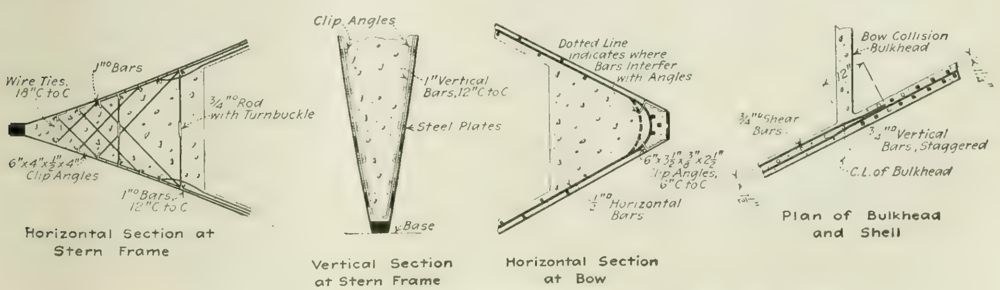


CROSS-FRAMES AND SHELL SLAB IN ONE OF THE AMIDSHIP SECTIONS OF CONCRETE VESSEL

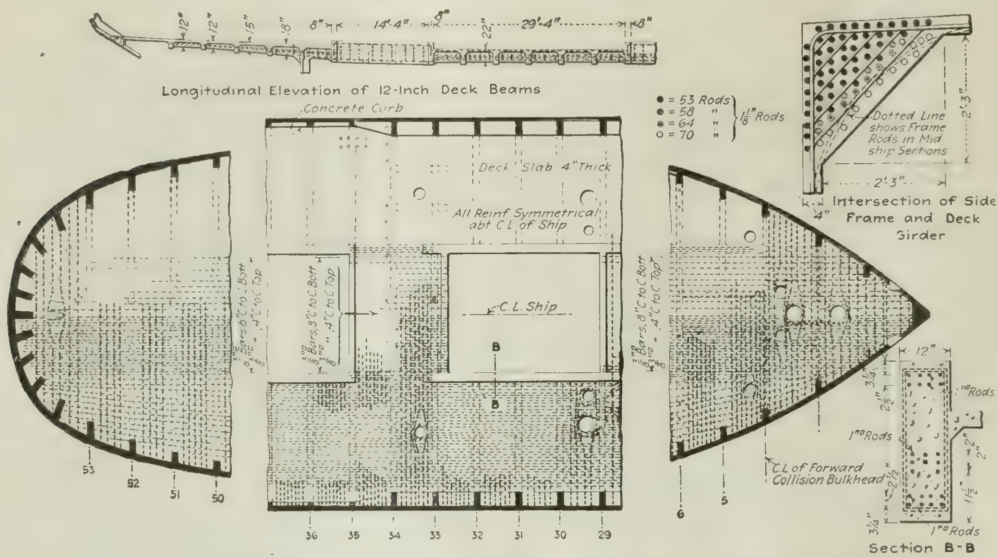
crete framing and the stanchions are supported on the crossbeams in the shaft-tunnel roof, which in turn span between short posts on either side of the tunnel.

Foundations for the engines and the boilers are on steel plate girders footing on an extra framing of longitudinal reinforced-concrete girders running parallel to the keelsons.

Four transverse water-tight bulkheads are provided. Two are collision bulkheads near the bow and the stern, and two inclose the engine-room space. Details of these bulkheads are given in one of the drawings. They consist of concrete slabs reinforced with transverse and longitudinal steel, and backing against vertical stringers and beams which frame into the main frames and deck girders. The engine-room bulkheads are slabs stiffened by vertical beams extending from short



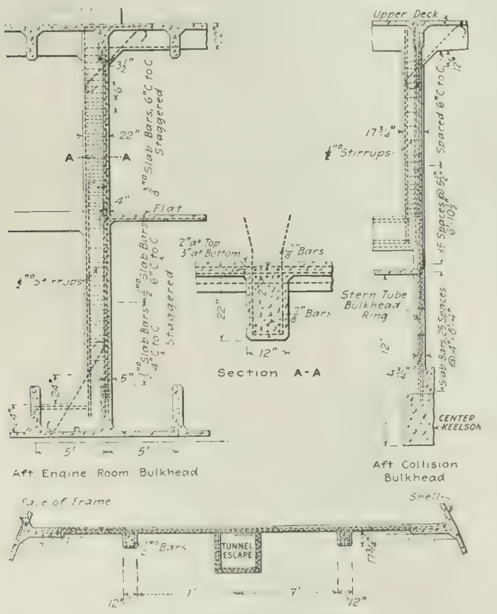
EXTRA HEAVY INTERLACED REINFORCEMENT PROVIDED AT STEM AND STERN



MAIN DECK REINFORCEMENT AND DETAILS SIMILAR TO ORDINARY REINFORCED-CONCRETE FLOOR

stringers in the bottom between two frames to similar stringers framing into the deck beams.

A special effort has been made to avoid sharp turns in the steel reinforcement, particularly in the main frames which are turned on long radius curves. Steel reinforcement in the hull will be ½ and ¾ in. in diameter. Larger rods, as shown in the illustration, are in the



BULKHEADS DESIGNED TO TAKE FULL HEAD OF WATER INSIDE HULL OF THE VESSEL

interior framing. All reinforcement will be continuous, though the exact method of insuring this continuity has not yet been decided. Neither has the exact nature of the aggregate been settled, although experiments have been made with various light-weight aggregates which seem to promise a possibility of a concrete weighing less than 110 lb. per cubic foot with a strength of 4000 lb. per square inch at 28 days.

An analysis of the ship to determine its stability shows that the metacentric heights in the light and full-load conditions are respectively 2.15 ft. and 2.2 ft. This is well within the limits of present practice for vessels of this type and size. The freeboard amidships at the side is 4 ft. 9 inches.

As this is a seagoing vessel, it has to be analyzed to take care of the extreme condition of a ship in open ocean. Standard practice for the longitudinal analysis has been followed; that is, the same basic assumptions as to length, depth and form of wave and the same method of procedure as is standard in analyzing steel ships was followed throughout. Hogging and sagging analyses were made for five conditions of load and sea. The strength of the ship's shell was determined, analyzing the ship as a hollow beam with tension and compression going to the bottom and deck. The results of the analyses are shown in Table II. The strength of the shell plating as a slab spanning the frames was considered in combination with longitudinal flexural stresses. The Concrete Ship Department made analyses of the frames for conditions due to different loadings of the hull and to transverse rolling. This transverse section was designed to stand outside water pressure with water to the gunwales and with minimum cargo load, with maximum cargo load and a sagging draft of 15½ ft., and in listed positions with loading both light and heavy.

For all these conditions of loading the frames were

designed to have stresses not to exceed 16,000 lb. per square inch in the steel and 1500 lb. per square inch compression in the concrete. Bulkheads were designed to carry a head of water on either side up to deck. The collision bulkheads fore and aft were designed for 1500 lb. per square inch in the concrete and 16,000 lb. per square inch in the steel. Steel stress in the engine-room bulkheads was advanced to 20,000 lb. per square inch. The deck was designed to carry 5 ft. of water or its equivalent, which is somewhat in excess of the loading on the decks of standard steel ships being built by the Emergency Fleet Corporation.

Extra strong and a more plastic concrete is expected to be achieved by the use of a specially fine cement. Any standard portland cement which will meet the Government specifications may be used, provided the fineness is increased so that at least 90% will pass a No. 200 sieve. This is hoped to give a concrete of 4000 lb. per sq.in. compressive strength at the end of 28 days.

TABLE II. STRESSES IN GOVERNMENT 3500-TON CONCRETE SHIP

Condition	Maximum Bending Moment Foot-Tons	Maximum Tons per Sq In Fiber Stress in — Deck Reinforcement	Keel Reinforcement	Pounds per Sq In Fiber Stress in Concrete
Ship without cargo, hogging	25,175	5 53	2 80	728
Ship fully loaded, hogging	37,000	5 63	2 95	766
Ship without cargo, sagging	14,400	1 28	2 63	270
Ship light with enough cargo in forward hole to trim sagging	11,960	1 07	2 19	210
Ship fully loaded, sagging..	9,400	0 84	1 72	70

With a standard 150-lb. concrete it is estimated that the ship will contain 1761 tons of concrete, 400 tons of reinforcement steel and 811 tons of wood, fittings, machinery and equipment, making a total of 2970 tons, as shown in Table I. That is, the steel in the reinforced-concrete ship will be about one-third of the amount of steel in the steel ship of equal capacity.

Long Trestle Controls Concreting on Big Office

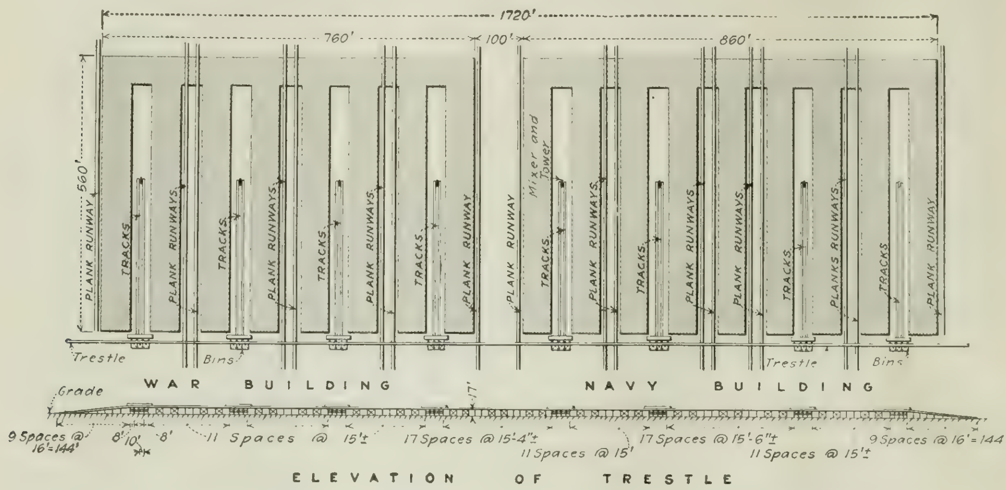
Mammoth New Buildings for Army and Navy Have Eight Mixing Plants, Each Fed from Separate Bins

CONCRETE materials for a large building now under way in Washington are being delivered to the site in motor trucks which run over a long trestle paralleling the bulding. They dump at eight points into storage bins spaced under the trestle opposite tracks leading to eight mixing plants which control the entire area. The group of two reinforced-concrete buildings of unprecedented ground area is being built as one operation for use as offices for the War and Navy Departments. It comprises virtually a head house 60 x 1720 ft. in plan, with 17 wings extending 500 ft. in the rear, making a total area to be covered of 1720 x 560 ft. The buildings are to be only three stories high, but they will have a floor area of 1,800,000 sq. ft., the largest yet attempted in one operation, though some of the coming army terminal warehouses will surpass them in that respect, on account of their greater height. In Washington, the main problem lay in the difficulty of distributing the concrete over so extended a ground area.

The trestle is of exceptionally heavy timber construction, capable of carrying the 5-ton motor trucks which deliver the concrete materials to the bins along the line. It is 2200 ft. long and 17 ft. above the ground. with approaches on an 11.8% grade from the streets. The loaded motor trucks bring sand and gravel from nearby river dredgings, and cement in bags from a railroad siding at one end of the site, pass up the

TRUCK ON TRESTLE IS ABOUT TO DUMP CONCRETE AGGREGATE IN STORAGE HOUSE

cast approach, run over the trestle, and after dumping where the materials are required pass off the west incline to the street. This permits a steady procession of such trucks, in no way interfering with one another in their trips across. It has been found that the approaching grade is just about as high as the loaded truck can make without difficulty.



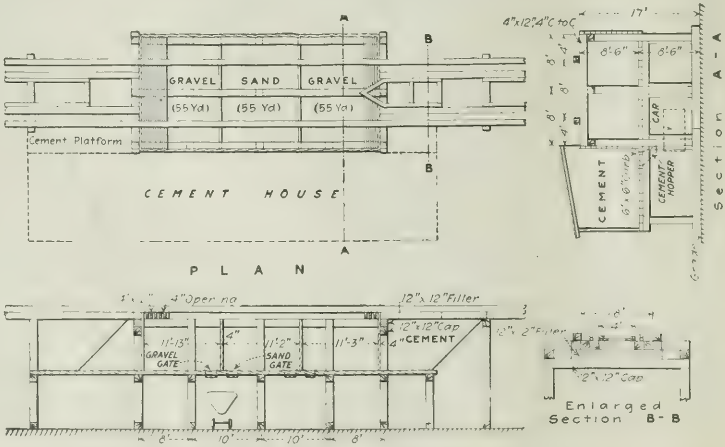
MOTOR TRUCKS DELIVER CONCRETE MATERIALS TO EIGHT MIXING PLANTS OVER TRESTLE 2200 FT. LONG ON ARMY AND NAVY OFFICE BUILDINGS AT WASHINGTON

For the most part, the trestle is built of heavy timbers lent for the purpose by a local underpinning and house-moving concern, and they will be removed but little damaged when the work is done. Sticks of 12 x 12 in. timber form the uprights, resting on mud sills, and the stringers, together with alternate sway-bracing, give longitudinal stiffness. As shown in the drawings, a track for the trucks is formed by two 12 x 12's for each wheel, with outside guards of 10 x 10's. Inner guard timbers held apart by braces every 5 ft. or so complete the main floor of the trestle proper.

At intervals corresponding to every other court between the wings of the building are spaced the storage plants, eight in all and alike in design. These provide housed storage for gravel, two bins each of 55 cu.yd. for gravel, a central bin of 55 yd. for sand, and room for cement in a house off line of the trestle. Gratings made by 4 x 12-in. plank on end, spaced to give 4-in. openings, cover the aggregate bins, and the motor trucks dump on the gratings. Cement is brought in sacks and dumped down chutes just outside the main house and is stored in the cement house.

Under each storage house narrow-gage tracks extend at right angles to the trestle into the site. Cars with separate compartments for the sand and the gravel are run under the storage hoppers, and the sand and gravel are allowed to run into their compartments. Cement is thrown in on top and the car, controlled by an endless rope from the engine near the mixer, is moved to the mixer. There are two parallel tracks under duplicate hoppers at the bins running to each side of the mixer hopper.

The eight mixing plants, the locations of which are shown on the drawings, are alike. Each comprises a $1\frac{1}{4}$ yd. mixer sunk below ground level with an accompanying tower and elevator. Each mixer is driven by a 40-hp. electric motor which also raises the skip.



STORAGE BINS ON TRESTLE TAKE AGGREGATE AND CEMENT FROM MOTOR TRUCKS

A separate motor draws the material cars to and from the bins, a distance of about 300 ft. Concrete is delivered to place in buggies traveling along plank walks for the ground floors, and on walks on the forms for the upper two stories. Connection from the mixer to these floors is made on trestles at each floor reaching from platforms alongside the tower at the respective floor levels. Each plant has a capacity of 400 yd. per day, with 50 men per plant, and as the storage facilities for each plant are separate there is nothing to prevent all eight mixers working at once at a capacity of 3200 yd. per 10-hour day, although the restrictions of construction will probably never permit this. As each storage unit holds only a limited amount a steady supply must be maintained by constant delivery by motor trucks.

On the large insert sheet accompanying this issue of *Engineering News-Record* is a view of the whole site as it appeared on June 10.

The buildings are being erected by the Turner Construction Co. under the direction of the Bureau of Yards and Docks, United States Navy, with Civil Engineer A. L. Parsons, U.S.N., in charge and Civil Engineer O. A. Mechlin, U.S.N.R., as resident engineer.

Engineering Aspects of Government Operation of Railroads Are Broad

Amalgamation Into One National Railroad, and Primary Need for Traffic Capacity to Help Win War Present Problems Never Met Before—Progress to Date Centers Around Work of Budget Committee.

By C. W. Stark
Associate Editor, Engineering News-Record

GOVERNMENT operation of the railroads of the United States has brought the railroad engineer opportunities never before enjoyed. Unification of the railroads under one head has done this. Heretofore the engineer has been obliged to confine himself to his own road, and to modify what was needed in the light of what his company could afford. Now his problems have become national, and whatever is sufficiently needed is to be built. It might seem that the removal of financial restrictions simplified the problem; but there comes in the engineer's responsibility to see that no material or labor is squandered in unessential construction. The railroad administration has organized its engineering work to see that what improvements are needed for winning the war are built. The slogan is—not maximum economy of operation, but maximum capacity for moving traffic for war purposes.

Doubtless, when William G. McAdoo became Director General of Railroads last December he was well aware that the railroads had fallen behind in the matter of improvements, and needed to have a vast amount of money spent on them to put them in a position to handle the abnormal war traffic. At the same time the old test, applied by the individual railroad company, to determine whether a given improvement was required to enable the company to get more business or handle its present business more cheaply, had to give way to the test as to whether the national railroad system needed the improvement to help win the war. Hence the Division of Capital Expenditures was created by the railroad administration, with Robert S. Lovett, director, E. E. Adams, engineering assistant, and F. W. Sercombe, accounting assistant; and the railroads were informed that all capital expenditures exceeding $25,000 must be authorized by the division.

Most of the railroad congestion of last fall and winter was in the East—east of Chicago and north of the Ohio River. The reason for this is no mystery. Most of the factories and munition plants, most of the coal mines, most of the war ports are in the East, hence most of the freight movement was in the East. Furthermore, the East, being nearest the ports, naturally bore the brunt of the shortage of ships, and any defects in terminal facilities were accentuated there; or perhaps it is better to say that superior facilities in the East were needed to overcome the congestion caused by the lack of ships to carry away the goods brought to the seaboard.

Budget Committee Is Created

To help meet the special requirements of the Eastern territory an advisory engineering committee, termed the budget committee, was created. The country had at that time been divided into three regional districts, Eastern, Southern and Western. The Eastern region extended west to Chicago and St. Louis and south to the Ohio, and included the Virginia coal roads. To the budget committee was given jurisdiction over the same territory, reporting to A. H. Smith, regional director. When the Allegheny and Pocahontas regional districts were later carved out of the Eastern region the jurisdiction of the committee was not changed. The committee consists of Francis Lee Stuart, consulting engineer, chairman; A. T. Hardin, vice-president of the New York Central R.R.; A. C. Shand, chief engineer of the Pennsylvania R.R., and H. A. Lane, chief engineer of the Baltimore & Ohio Railroad.

In May the budget allowances to the various railroads were announced. They totaled $946,293,828, divided into $445,639,225 for additions and betterments, $482,417,179 for equipment and $18,237,424 for construction of new lines. Two-thirds of this amount goes to the original Eastern regional district, and was passed upon by the budget committee. Representatives of the various railroads went in turn before the committee, and their needs were discussed at length. When the committee reached its conclusions as to the items to be authorized they were submitted to the Division of Capital Expenditures, which in most instances approved the recommendations of the budget committee. The railroad administration has ordered the improvements covered by the budgets carried out with all possible

speed, and also that the companies take up with the Division of Finance and Purchase any difficulties they may encounter in financing these improvements. The \$500,000,000 revolving fund provided in the railroad act can be drawn upon for this purpose.

The Half Billion for Betterments

Examination of the published summary of items making up the \$445,639,225 authorized for additions and betterments gives some indication of the kind of improvements allowed and the kind disallowed. Additional yard tracks, sidings, and industry tracks head the list in point of size, with a total of \$98,661,553; shop buildings, engine houses and appurtenances come second, with \$61,979,476; and additional main tracks third, with \$47,471,002. All of these are classes of improvements that increase operating capacity—the first and third items by providing more trackage, the second by helping keep equipment in service. On the other hand, many items for additional main tracks were deferred, where the budget committee felt that the objective was not so much increased capacity as economy of operation. Because economy of operation was not the immediate object of the administration, grade revisions, too, were crossed off, unless it was shown that they would enable the lines to carry more traffic. New passenger stations and grade-crossing eliminations were among the projects disallowed as unessential to the winning of the war, and allowances were made only where needed to put in passable shape work already started. Electrification was generally disallowed, on the ground that it would tie up materials and labor needed elsewhere, that it would not greatly increase operating capacity, and that any saving in coal by the developing of water power would be too remote for consideration this year.

The table widely published showing the budget allowances to the individual railroads shows not only a large range in the allowances, but also in the items eliminated. To the New York Central R.R. was allowed \$70,672,087, and only \$41,000 was dissallowed, whereas from a total of \$76,030,461 the Southern Ry. obtained the approval of only \$29,113,511. These seeming discrepancies are of little significance. The committee had the budgets under consideration some three months, and some of them were referred back to the railroads several times. In general, the budgets submitted late, after extended conference and correspondence, suffered less than those submitted early. And while the eliminations may look large in some cases, there were also additions "inspired" by the committee. One receivership road which had a monopoly of a rather large and important territory and served it none too well, but which had for years been forced by lack of funds to pare its expenditures down, until this had perhaps become second nature, was asked to resubmit its budget, with large amounts added for engine terminals and shops, and with an item for strengthening its bridges on an important division where the management thought the old ones would do. Where war conditions and congested routes existed along the Atlantic coast, interior routes were opened for additional traffic. Conditions in New England received particular attention in view of the scarcity of bottoms for water-borne business.

All of this analysis of budgets, while rather a large beginning, is only a beginning of the work of the budget committee. The engineering organizations of the several railroads have had their attention concentrated for years on the development of the several properties they served, and can hardly as yet have got rid of their biases toward those properties and their needs. To the budget committee has been assigned the larger task of considering the country's railroad network as one national system, and, disregarding corporate ownership if need be, to weld the system together and effect maximum capacity and facility of operation. Little can be said at present of the changes so far under consideration. Most of them are in the early stages, and will require much study and discussion by the interested parties before they materialize. Something can be said of the general character of those changes, and the way they are being handled.

Considerable attention is being given to our ports, treated as a whole and not merely as the termini of certain railroads. Regional Director Smith, in a report made public two weeks ago, indicated something of the possibilities along these lines when he mentioned as reform measures already initiated the common use of terminal facilities at large commercial centers, and the coördination of harbor facilities at New York. These things cannot be completely accomplished without exhaustive study.

The Port of New York

The port of New York alone offers a fertile field for study. A first step has already been made in the diversion of Baltimore & Ohio through passenger trains from the Jersey Central terminal in Jersey City to the Pennsylvania Station in New York. This involved no engineering difficulty, as the physical connections were already there; and a similar diversion of Lehigh Valley traffic will be equally simple. The budget committee aims to do more than that, however. It holds the theory that while suburban traffic should not be disturbed, for the reason that suburbanites have usually chosen their homes because of convenience to certain points in New York, through passenger traffic from New Jersey should be concentrated and brought into the heart of New York—that is, into the Pennsylvania Station—and as much trackage as possible released for freight service.

In some cases this can be brought about easily, Jersey Central trains from Philadelphia and from Scranton can follow the route now taken by Baltimore & Ohio trains, while the proximity of the Delaware, Lackawanna & Western to the Pennsylvania for a short distance east of Newark affords a ready way to take care of Lackawanna traffic. On the other hand, the Erie, the West Shore, the New York, Ontario & Western and the coast lines of the Central of New Jersey offer the committee no small problems.

Other Atlantic ports are being studied in a similar manner. Coöperating with the Division of Operation, which is already, as noted in Mr. Smith's recent report, diverting traffic to less congested routes and to lines with more favorable grades, redistributing motive power as needed, and eliminating unessential passenger service, the committee is studying ways of strengthening weak links of existing routes by more sidings and

the like, or of eliminating them and creating new routes by combining parts of existing and formerly competing lines. Certain secondary lines may be linked up to form important belt lines, if plans contemplated go through. The general purpose of the committee is to segregate freight and passenger traffic, eliminate duplication of service and unnecessary mileage, and put each bit of railroad to its best use, regardless of its ownership. More attention will also be given to new lines and extensions when the reinforcement of existing lines is farther advanced.

How the Studies Are Made

All details of the committee's investigations are handled by the engineering departments of the railroads. The committee has no organization to handle these details, and makes requests on the roads for whatever plans and estimates it needs. The chairman of the committee devotes most of his time, however, to the committee's affairs. His experience as former chief engineer of two of the four trunk lines to Chicago, and that of the other three members of the committee, who occupied positions in the active service of three of the largest Eastern trunk lines, give the committee a broad understanding of the whole railroad situation and enable it to initiate a large percentage of the studies being made. The railroad engineering departments are also instructed to look beyond the boundaries of their own companies and make recommendations leading to more nearly complete unification.

To date, as far as outward evidences show, the possibilities of this broader railroad engineering have only been touched. The way has been pointed out, and the plans and estimates called for by the committee from time to time will help those with vision who have to prepare them to work independently along the same lines. The railroad act and the railroad administration assume that Government operation is only for the period of the war. That the old competitive system is to be restored is open to doubt. If, as seems more likely, it is to be replaced by a regional plan of private operation, the work being done at present will fit exactly into such a plan. The railroad civil engineer of the day has a splendid field for his endeavors.

Army Leads in Waste Prevention and Utilization

Conservation and Reclamation Division Stimulates Economy, Prolongs Life of Materials by Repairs and Salvages Wastes

CONSERVATION to the utmost, then the greatest possible reclamation of unavoidable wastes, is the object of the conservation and reclamation division of the Quartermaster Department of the United States Army. All materials and supplies used by the Army are being conserved—food, hats and caps, uniforms and other clothing, shoes, tents, cots and bedding. When conservation can do no more, reclamation of wastes begins—bread, meats, grease, bones, leather, rubber, metal of all sorts, wood, tin cans, bottles, paper, cloth, dead animals, manure. Conservation of hats, caps, clothing and shoes includes repairs, for which special shops are maintained. Dry cleaning of clothing and laundry service are conducted on a large scale. The laundry charges to officers and men are far below those which prevailed under private service—which is not permitted where camp laundries are maintained.

Organization Extends from Washington to Camps

Military organization, centered in Washington, extends through the various sections which handle garbage and waste disposal, salvage of metal, leather, etc., repairs of clothing, and operate laundries. Each camp has a conservation and reclamation staff. By these staffs and in special schools at some of the camps men are trained for conservation and reclamation service, both in the United States and overseas. Incidentally, the authorities have in mind much vocational training which will be useful to the country at large after the war. Men disqualified for fighting are utilized at repair shops. Wives and mothers of soldiers are employed.

Commanding officers impress upon their staff and troops the importance of, (1) conservation through care; (2) turning in clothing, etc., for repair before it is too late; (3) saving all wastes for reclamation. Thus, each unit commander must see that all shoes belonging to his command are inspected weekly and, when in need of repair, that they are properly cleaned and then turned in to the shoe-repair section.

Records Kept to Insure Efficiency

To insure the greatest possible economy, records on a strictly comparable basis are kept—not merely for each camp, but also for smaller units, such as men's kitchens. For example, all meat is weighed before use, and as a check against waste a separate record is kept of the corresponding weights of (1) trimmings and condemned meat; (2) cooked grease, and (3) bones that appear in wastes. By this means kitchen can be checked against kitchen and camp against camp, reasonable wastage and salvage determined and emulation secured.

Gardening is a branch of the division which it is hoped will eventually utilize all available land at each reservation. This year some 3000 acres are under cultivation.

Garbage and Refuse Utilization

Millions of pounds of garbage and other refuse are produced at the camps each month. This material is collected by the Government. The garbage from the 16 National Army camps and from many of the National Guard camps is sold to contractors at central loading stations, and is either fed to hogs or else reduced; mostly the former course is followed. Manure and other wastes at some of the camps are also sold. When the various camps went into operation in 1917, prior to the organization of the conservation and reclamation division as it now exists, the contracts were let on a variable basis. These contracts expired June 30. Bids for 1918-19, on uniform specifications, were received May 28. A review of a considerable number of the old contracts appeared in *Engineering News*

GARBAGE AND WASTE REPORTS FOR APRIL, 1918, AT CAMPS AND CANTONMENTS OF NATIONAL ARMY AND NATIONAL GUARD

(All Quantities Are in Pounds)

Camps	Disposition and Contract Price	Fats and Tallows, Total	Fats and Tallows, Per 1,000 Men	Bones, Total	Bones, Per 1,000 Men	Other Garbage, Total	Other Garbage, Per 1,000 Men	Total Garbage, Total	Total Garbage, Per 1,000 Men	All Other Waste, Total	All Other Waste, Per 1,000 Men	All Wastes, Total	All Wastes, Per 1,000 Men
National Army:													
Custer													
Devens													
Dix				76,175	71	1,158,865	1,088	1,235,040	1,160	320,756	301	1,555,796	1,465
Dodge		7,850	11	46,070	60	439,040	531	492,960	638	122,398	158	615,358	797
Funston	$6.00 per kitchen.			17,425	20	419,650	491	437,075	511	1,387,125	1,622	1,824,200	2,133
Gordon													
Grant		3,168	3	56,270	60	652,800	697	712,238	760	135,525	144	847,763	906
Jackson													
Lee		7,750	6	7,595	6	514,560	423	529,905	436	240,370	198	770,275	634
Lewis		442	4	4,026	4	1,047,498	1,027	1,051,965	1,031	2,622,953	2,572	3,674,918	3,603
Meade				33,500	36	1,224,205	1,316	1,257,705	1,352	2,714,250	2,919	3,971,955	4,271
Pike						1,397,250	1,605	1,397,250	1,606	3,651,450	4,197	5,048,700	5,803
Sherman				31,400	28	675,000	573	706,000	603	102,100	87	808,100	687
Taylor				57,200	87	616,900	934	674,100	1,021	224,000	339	898,100	1,361
Travis	$3.50 per kitchen..			4,500	6	444,000	559	448,500	564	11,100	14	459,600	578
Upton													
National Guard:													
Beauregard	$4.55 per kitchen .												
Bowie	$7.60 per kitchen												
Cody	$1.60 per kitchen .									13,095	19	130,950	19
Doniphan	$0.42 per kitchen..												
Fremont										5,000	11	5,000	11
Greene	$245 garbage ..			3,000	3	535,800	547	538,800	548	600	1	539,400	550
Hancock													
Kearny	$0.01 per man....									5,190	8	5,190	8
Logan	$10.50 per kitchen												
MacArthur	$7.50 per kitchen..												
McClellan										45,746	68	45,746	68
Sevier				11,400	13			11,400	13	174,800	194	186,200	707
Shelby													
Sheridan	$0.02 per man			14,760	22	666,600	989	681,360	1,023	30,000	45	711,360	1,068
Wadsworth													
Wheeler				200	3			200	2	31,830	53	32,030	53
Total..		19,210	[illegible]	363,120	29	9,792,168	830	10,174,498	751	11,838,288	628	22,012,786	1,275

Record of Oct. 18, 1917, p. 731. April quantities of garbage and other wastes are shown by the accompanying table, the totals running well into millions.

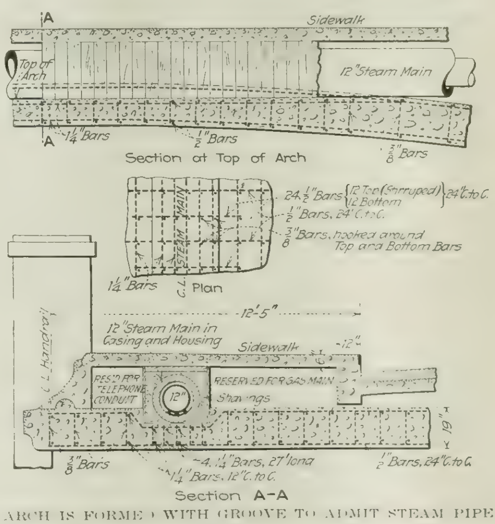
Ten separations of kitchen and barrack wastes are now made, but as two are for weighing purposes eight receptacles suffice. The eight final separations are into (1) bread, which after drying is put in salvaged bags; (2) cooked meat, raw fats and meats, and cooked grease, which after being weighed separately go into one can; (3) bones; (4) other garbage suitable for animal food; (5) table wastes not suitable for animal food, including coffee grounds, tea leaves, egg shells, citron rinds, banana peels and stocks, fish heads and scales, and broken glass; (6) tin cans, which must be washed and rinsed; (7) all waste paper, which must be placed in salvaged bags; (8) empty, unbroken glass bottles and containers, which after being washed and rinsed must be kept in salvaged boxes for weekly collection.

Manure, dead animals and ashes are handled separately, much of the manure being sold to contractors. During April 37,625.5 lb. of manure, nearly all from 11 National Army and National Guard camps, were sold, bringing the Government $14,087. There were also salvaged 548.8 tons of hay, which brought $4371; 190 tons of straw, yielding $62; and 0.4 tons of hides, bringing $66.50. At one camp manure was removed free of charge in April, and at another its disposal was included in the garbage contract. Six camps reported that the manure was burned or destroyed; one, burned or dumped; and two, removed to dump.

Concrete Arch Altered to Carry Pipes

PROVISION for carrying a steam main across the Grand Ave. bridge over the Des Moines River at Des Moines, Iowa, became a necessity after the plans for the concrete-arch bridge had been completed. Space for gas and water mains and electric conduits had been provided under the sidewalks. At the crown of the arches, however, the height of this space was only about 18 in., while the steam pipe with its insulation and housing required nearly 26 inches.

In constructing the arches, therefore, the necessary space is obtained by reducing the thickness of the arch



ARCH IS FORMED WITH GROOVE TO ADMIT STEAM PIPE

ring, forming a groove of sufficient depth and width to accommodate the conduit.

Special steel reinforcement is introduced to give the necessary strength to the arch at this part. The 12-in. pipe has a wood casing and is inclosed in a box packed with shavings. This solution of the difficulty was worked out under the direction of Karl C. Kastberg, city engineer.

Engineers Convert French Beet-Sugar Fields Into Advance Depot

Build Railway Receiving and Classification Yards, Nineteen Warehouses and Balloon Shed—Regulating Officer Controls Train Movement To and From the Battlefront

BY ROBERT K. TOMLIN, JR.
War Correspondent, Engineering News-Record

All Photographs by Engineering News-Record War Correspondent.

NINETEEN warehouses, each 50 x 500 ft., railway receiving and classification yards with 50 miles of track laid and 50 miles more yet to be placed, two steel ordnance structures which sprawl over about seven acres of land, a big balloon shed 180 x 100 ft. in plan, scores of smaller wooden buildings serving as barracks for troops—this is an advance depot and regulating station for the American Expeditionary Forces as I saw it during a recent tour of the places in France where our engineer regiments have been at work. American construction genius has taken a string of beet-sugar fields and in only a few months' time, has converted them into one of the most important railway and freight-handling centers in France.

An advance dépot contains, in effect, the pulse of the great arterial system of army traffic whose heart is at our army's docking basins and railway yards on the coast of France, for through it passes the daily flow of food, ammunition supplies and men on their way to the front. Much of our engineering work over here has, until recently, been on paper or in the early stages of construction, but now we have begun to strike our stride, and things are moving rapidly. This advance depot is already a going concern. "It is a job 125% completed," said Colonel B——, the commanding officer of the engineer troops which did the bulk of the construction work, when I called at his headquarters recently. He went on to explain how the original plans have been expanded to one-quarter more than the size contemplated when the job was begun, and how new projects for a big bakery, a power plant and acres of additional covered storage space promised to dwarf the volume of work as first laid out. Look at a map of France and see that the front north of Toul, which the first official announcement stated was being occupied by American troops, is something like 400 miles, in a straight line, from the coast. By the railroad routes over which supplies must be carried the distance is somewhat greater. In these traffic chains which connect our seaport terminals and front-line trenches there are three master links—the so-called base, intermediate and advance depots. At the base depot, I was informed, there must always be on hand, as a minimum, army supplies of all kinds for a long period. The intermediate depot is a supply station for a shorter period, while at the advance depot supplies for a still shorter period must be held in reserve. The names of the depots indicate their relative positions in the scheme of transport and storage. If, for example, something should go wrong at a base or intermediate depot, or on the railway lines running to the advance section, the advance depot could continue making deliveries of all essentials to combat troops for a considerable period. Likewise an accident at the advance depot—a big fire, or damage by an air raid, for instance—would not stop the flow of material to the front, as the intermediate depot reserve would immediately be drawn upon.

The scheme is almost exactly the same as is followed in the design of large water-works systems. For example, in the Catskill Aqueduct system for New York City's water-supply, we have the big Ashokan reservoir, or base depot, at the end of the line farthest from the ultimate consumer. Then, the Kensico reservoir, or intermediate depot, near the city, and finally the Hillview reservoir, corresponding to the advance depot or regulating station, close to the city limits. It is with the advance depot that this article will deal.

In place of a plan showing the relations of the railway yards and warehouses to each other, which, of course, cannot be published under present conditions,

A. THE NINETEEN WAREHOUSES ARE EACH 500 x 250 FEET IN PLAN AND ARE ARRANGED IN SIX PARALLEL ROWS

B AFTER THE WOODEN FRAMEWORK WAS SET UP THE BUILDINGS WERE SHEATHED AND ROOFED WITH CORRUGATED IRON

I must give only a rather vague outline of the layout. The storehouses are arranged in six parallel rows, running north and south, one of these rows, half a mile long, comprising five of the 50 x 500-ft. standard structures. There are two aisles for open storage between the lines of buildings and a third larger open storage space to the east of the last line of warehouses. Along the sides of the warehouses run platforms flanked by lines of depressed track on both the incoming and outgoing sides, as shown in the photographs. The warehouse structures are of extremely simple design, having wood frames sheathed with corrugated iron sheets. The floors are of earth. The several rows of buildings are connected at intervals by wooden drawbridges to permit the handling of freight across the railway tracks. There are in all 14 lines of railway track, such as that shown in Photographs A and B, serving the warehouses and uncovered storage strips.

South of the warehouse group are the main-line tracks of a French railway from which connections have been made to the new receiving and classification yards (Photograph C), which American engineer troops have built to the west of the warehouses. Some distance to the north of the yards are the buildings of the engineer's camp and the headquarters of the commanding officer of the advance depot, while the two ordnance buildings and balloon shed (Photograph D), previously noted, are at the southeast end of the warehouse site.

When the engineer regiment arrived at the site of this advance depot last October it began work on the receiving and classification yards and the diversion of about 1½ miles of existing double-track French railroad, which, to accommodate the new yard layout planned, had to be moved laterally about 400 ft. This job required the removal of about 30,000 cu.yd. of rock by hand-drilling and blasting, as practically no mechanical equipment was then available. In fact, in the early days the engineers made most of their own tools. About 200,000 cu. yd. of earth were removed by hand-labor methods before horse-drawn scrapers arrived. On the railway yard work the American engineers were assisted by a French engineer company. For the 160 kilometers of track in the yards, of which about 70 km. have been laid, 120 km. of rails were received from the United States and 40 km. have been borrowed from the French. For the first unit of the depot it was necessary to provide 700,000 sq.ft. of covered storage and 3,250,000 sq.ft. of uncovered storage. One of the men of the American engineer regiment had formerly been connected with a large building construction company in the United States, and his experience was used to good advantage in organizing and directing the work. It was not until the job was in full swing, however, that the engineer troops began to think about barrack buildings for themselves. Up to Jan. 20 they lived in canvas tents. After that date, however, wooden barrack structures were set up, a water-supply system and two electric lighting plants were installed. In addition, a number of miscellaneous jobs were handled—the placing of plumbing fixtures in nearby hospitals, the building of a medical laboratory, and an extra job involving camouflage warehouses and painting shed.

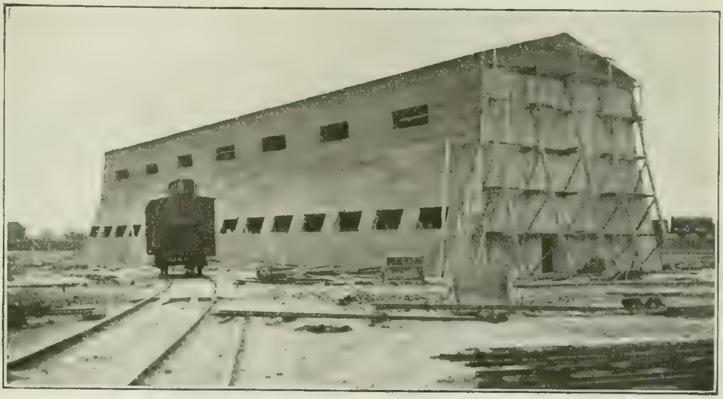
In connection with the latter job this incident is related: The officer who wanted the work done—it consisted of two 50 x 250 ft. warehouses and a 50 x 250 ft. painting shed—went to Colonel B——, of the engineers, to explain his needs. The colonel agreed to help him. In concluding his interview the camouflage officer said, "Colonel, we would like to keep posted regarding the headway your men are making. If convenient, I should like to receive monthly progress reports." Colonel B——, whose men had become adept at just this kind of work as the result of their experience on the depot warehouse sheds, smiled inwardly in acceding to this request. He set his men to work on Monday morning and the build-

C THE RAILWAY RECEIVING AND CLASSIFICATION YARDS ARE THE WORK OF AMERICAN ENGINEERS

ings were completed on Thursday of the *same week.* The camouflage officer is still waiting for his "monthly" progress reports.

On the long warehouses for the depot, 500 x 50 ft., the normal time for completing one building was four days. Much of the timber employed on this construction was the product of American forestry companies which are now operating in France. There was nothing elaborate about the job. It was just a case of putting in the base blocks, erecting the timber frames, sheathing the sides and putting on the roof. Later, sheets of corrugated iron were used to cover both the roof and the sides.

After my talk with Colonel B—— of the engineers I met the commanding officer of the advance depot, who has supervision of all activities at this site; the regulating officer, whose exacting duty is the control of all train movements, and the chief supply officer in charge of the load-quartermaster department ing, unloading and storage of supplies. "Our job," the regulating officer explained, "boils down to this: It is to keep the fellows up at the front who are doing the fighting from worrying about regular deliveries of food, forage, material and ammunition. No matter what happens, we've got to get the supplies there and get them there on time."



D. THE ENGINEER REGIMENT, ORGANIZED PRIMARILY FOR RAILWAY MAINTENANCE, BUILDS A BALLOON SHED

No one can go through the advance depot and watch the machinery of transportation and storage at work without realizing that the depot commandant, the regulating officer, and the supply officer have a man's size job on their hands. For each combat organization there is a rail-head in the advance zone where supplies from the advance depot are delivered. From the rail-head the army field unit, whatever it may be, is responsible for getting the material to filling points, and thence to the troops, and for this purpose a division, for example, operates its own supply trains, which may be in the form of motor trucks, horse-drawn wagons, light railways, etc. At the rail-heads small reserve stocks of supplies and food are maintained to tide over the non-arrival of a train from the advance depot.

But the regulating officer's duties do not stop with the transportation of supplies and ammunition. He must provide facilities for large-scale troop movements and the delivery of the wounded from the front to base hospitals. The regulating officer, therefore, must keep in close touch with all army activities, not only at the front, but at the ports. For example, he must know the date of arrival of all troopships and supply transports, the character and quantity of their cargoes, the amount of material on hand at the base and intermediate depots, the number of combat troops and their location at the front or in the advance zone, the number of empty beds at each base hospital, the intended movement of forces from one sector to another, and scores of similar data of the most confidential nature. He is one of the few men in France who know the total resources in men and material of the American Expeditionary Forces.

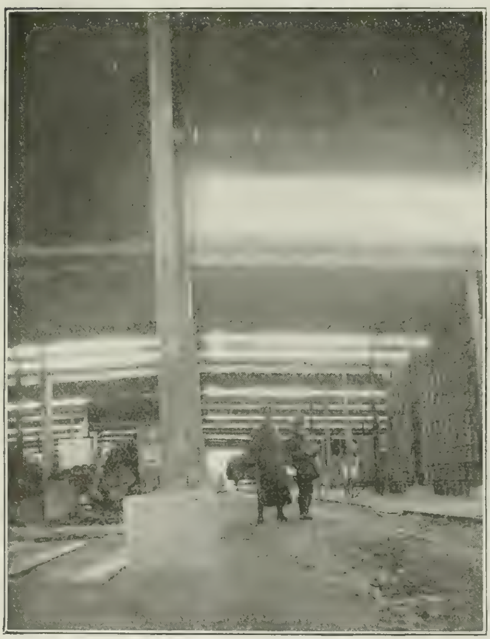
From the very nature of the war-time transport problem, the mechanism of the advance depot must combine properties of great strength and elasticity with the capacity for sudden and tremendous expansion. Even when conditions at the front are quiet the receipt and transmission of supplies and personnel on regular schedule make exactng demands on the organization responsible for this service. Nevertheless, the wires at any time may bring in word of some big activity at the front. Troops must be shifted from one point to another, the supply of ammunition speeded up, supplies diverted from their regular channels, the wounded carried back. These are the times when the advance depot must work at a tremendous overload and it must stand up under the strain—a strain not applied gradually but with the force of impact. In such circumstances, the clamor for railway transportation comes in to the advance depot from all sides, and the depot commandant, the regulating officer, the supply officer and the rest of the staff must keep clear heads and assume the functions of a priority board in the allotment of engines and cars and supplies.

In the ordinary course of events, however, the supplies go forward in what are known as automatic shipments. For example, a certain number of men served by a certain rail-head mean so many pounds of meat, bread, vegetables, etc., every day, and a routine schedule of shipments can be foreseen and established until there occurs a large-scale movement of troops. By keeping a close check on the stock on hand at the advance depot, the amounts available at the intermediate and base depots, and the daily requirements of the troops in the advance zone, it is possible for the regulating officer to exercise a judicious control over the movement of trains and material. Even now, with American man-power here in France far below what it will be ultimately, the advance depot is handling every month something like 20,000 cars (this number including cars arriving, departing, rebilled, loaded or unloaded)—and this volume of business, I may state, is based on data obtained before the German drive developed its present proportions.

E HOW ONE OF THE STEEL-FRAME ORDNANCE BUILDINGS, THE MACHINE SHOP, LOOKED ON APRIL 5

Everything from the rear en route for the front must pass through the advance depot. Of course, in the case of supplies, not every car is unloaded. Sometimes it suffices merely to rebill a car and send it forward. But with the depot authorities rests the decision as to whether a shipment shall be allowed to go onward or shall be held for storage. In the conduct of this work the regulating officer receives and transmits several hundred telegrams daily, to say nothing of telephone messages in equal numbers.

In the case of troop movements the regulating officer receives by wire a statement as to the number of men, animals and tonnage of material, their present location and their ultimate destination. It is then up to him to get them there. At the time of my visit to the advance depot the regulating officer told me that food and clothing constituted the bulk of the tonnage which he was moving for the American forces. Ammunition, of course, varies from week to week according to the extent of the activity in the battle area. At every railhead the regulating officer has representatives, and every train that leaves the depot for the front carries a representative whose duty is to see that the train arrives at its proper destination.



F WIRE GLASS REPLACES CHEESECLOTH IN THE ORDNANCE BUILDING MONITORS

The actual loading and unloading of cars and the storage of supplies is under the direction of representatives of the quartermaster department, engineer corps, signal corps, medical corps, etc., each department having a certain number of warehouses assigned to it. The quartermaster stores form the largest bulk of freight handled by the depot. They include everything in the way of food, fuel, forage, and wearing apparel, and a good many miscellaneous side lines. The captain in charge of the quartermaster stores, who conducted me through his string of warehouses, receives daily from the regulating officer figures indicating the numerical strength of the forces in the advance zone. Adhering to certain prescribed limits for the Army ration, the warehouse officer loads cars with the proper quantity of supplies for the men, and forage for the animals.

To simplify this task, each warehouse is marked off in certain lengths for different kinds of supplies. Starting at one end, for example, there will be a section for flour, next a section for baked beans, and succeeding sections for tobacco, jam, etc. Other warehouses, are similarly apportioned, there being sections for overcoats, shoes, socks, underclothing, etc.

In the storage scheme the total supply of one kind of material is not put under one roof, but is distributed among several warehouses. Thus, in case of fire, or bombing by airplane, damage to one warehouse unit would have no appreciable effect on the continuity of dispatching supplies from the others.

In the loading and unloading of cars, sections of ball-bearing roller tracks are largely used. Boxes and crates are thrown on the roller track, shoved along the warehouse platforms, and removed at the proper places for car loading or storage. A box car containing 570 cases of baked beans was unloaded, delivered into the warehouse and stacked by three men in 1 hour 35 minutes. Both for incoming and outgoing material a checker is stationed in each car and on each warehouse stack. Records are kept to show output, input and the amount of supplies that is on hand in the advance depot.

After making the tour of the sustenance and clothing warehouses, I examined the medical stores and, finally, the engineer supplies. The latter were all grouped by sections, and among the things I noted were stacks of chicken wire, shovels, wheelbarrows, mining timber, trench flooring, water pipe, demountable barracks buildings, wire rope, hemp rope, carpenters' tools, saws, a few electric generators, water tanks, etc.

In contrast to the wood frame warehouses, with corrugated iron siding, which are such a prominent feature of the advance depot, are the two large steel-frame structures for the Ordnance Department. One, 500 x 240 ft. in plan, which is practically finished, is serving as a storehouse for ordnance material, while the other, 240 x 260 ft., which may later be expanded to the size of the first, is still in course of construction, as shown in Photograph E. It will be used as a machine shop and repair plant. Both of these buildings are part of the big ordnance building project which was described in *Engineering News-Record* of Jan. 3, page 23.

G. INTERIOR OF FINISHED ORDNANCE STORAGE BUILDING—COLUMNS SUPPORTED ON CONCRETE FOOTINGS OF DIFFERENT HEIGHTS TO GIVE SLOPE TO ROOF, SINCE ALL COLUMNS ARE OF SAME LENGTH

Since that time there have been a number of important changes affecting this work. In the first place, no such extensive layout of buildings at a single site, as was originally planned, has been carried out. Instead, a few units are being built at one place, a few more at another, splitting the job up. Then, too, in the actual construction, there has been a change from the original policy. The firm of Stone & Webster, which designed the ordnance base structures, was to have handled the construction work also. A number of their men were sent to France early this year, and when a final decision had been reached regarding the sites of the buildings, the job was started by them. However, the Army has now concluded to complete the ordnance building project with its own personnel, and at the time of my visit relations with the Stone & Webster organization had been practically terminated.

The storage building, or larger of the two units, was started with Stone & Webster foremen and a detail of 65 men from the ranks of the ordnance service, while the machine shop structure, now under construction, is being built by a detail of infantry—about 100 men—under the direction of an ordnance captain. The engineer company which built the warehouses and yards at the advance depot assisted in the ordnance work by making a 4-ft. earth fill covered by a 3-in. layer of gravel to form the floor of the storage building.

The buildings are of simple design—light steel members with corrugated iron siding. Bolted connections are used throughout, and all columns are of one length, the roof slope being secured by carrying the concrete foot-

for the columns to different elevations (Photograph G). Bays are spaced 20 ft. apart along the longitudinal axis of the building. On the erection work the practice originally was to handle the steel members singly. Later, however, a steel column and rafter were bolted up on the ground and raised by a gin-pole in a single operation. The purlins, however, were all raised by hand. The progress on the 500 x 240 ft. storage building was as follows: Footings completed Dec. 6, 1917; first steel column erected Dec. 29; all columns, rafters and girders placed Jan. 10.

For the roof the original plans contemplated a thin concrete cover over corrugated iron. This scheme had to be abandoned because of lack of concrete materials; two layers of felt and a layer of roofing paper were substituted. Until very recently the roof monitors were "glazed" with strips of cheesecloth. Now, however, a shipment of wire-glass has been received and has been substituted for the cheesecloth windows as shown in Photograph F.

The machine shop building, unlike the one for storage, is to have a concrete floor. When I inspected the work going on one mixer was delivering the concrete into ordinary wheelbarrows which were moved along plank runways to points of deposit on the floor. The progress of the machine shop structure is shown in Photograph E, which I took Apr. 5.

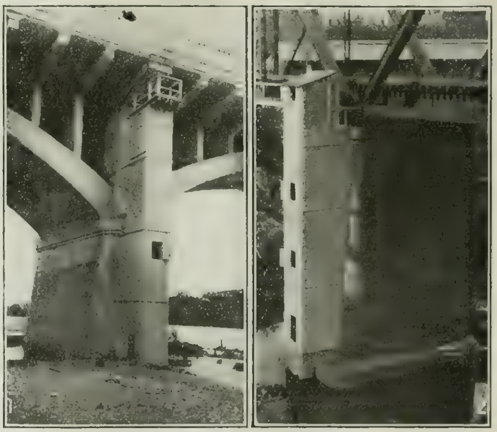
The construction was done under the usual conditions which affected most of our early engineering work in France—difficulties of transport, scarcity of mechanical plant and shortage of labor. Added to these was the fact the job had to proceed in spite of alternate periods of extremely cold weather and rain. For one week the mercury remained at zero (Fahr.) and made it hard for the men who had to handle the steel columns, rafters and girders. Holes worn in their gloves allowed the skin of their hands to come in contact with the cold steel, where it stuck fast and was torn off in patches. Then, in the rainy periods, the fields would become vast seas of mud, and in walking through this tenacious material it was difficult for a man to keep a pair of rubber boots on. The "office," where the administrative end of the job was handled, was opened up in midwinter, and consisted of a canvas tent lighted by a candle. Due to the nonarrival of clips for attaching the corrugated siding to the steel framework, a detail of men was assigned the job of rounding up a supply of wire for this purpose. As a result, much of the corrugated iron siding is now held in place by scraps of wire taken from old crates and boxes and other odd sources. A single small auto was the sole means of delivering food from a town a couple of miles distant. Then, too, few of the men from the ranks of the Army had had any previous experience in construction work of this sort, but owing to the fact that the designers of the buildings had made the work as nearly fool-proof as possible, foreseeing the contingency of erection by unskilled labor—no serious trouble was experienced on the erection work. The officer in charge of the job, appreciating the trying conditions under which his men were working, took special pains to have them supplied with plenty of warm clothing and good food, and this policy was a big factor in maintaining the morale of the force. By the time this appears in print the job will probably have been finished. What these words mean can be appreciated only by those who know of the game fight that has been carried on in midwinter by the ordnance captain and his men, not in the front line trenches, but in the mud and snow of those beet-sugar fields which are now the advance depot.

River-Gages Placed at Bridge Piers

By G. A. Gray
District Engineer, United States Geological Survey, Austin, Texas

WATER-STAGE recorder wells and houses have recently been placed against bridge piers instead of at the usual place on the stream bank. Two such installations have been made by the United States Geological Survey, in coöperation with the Texas Board of Water Engineers, on the Colorado River at Austin and the Brazos River at Waco.

At both stations the installation consists of a reinforced-concrete foundation attached to the downstream side of the bridge pier. The foundation also forms



RIVER-STAGE RECORDERS ORE LOCATED AT BRIDGE PIERS INSTEAD OF BANKS: (1) AUSTIN, TEXAS; (2) WACO, TEXAS

the bottom section of the well, into which the water is admitted through intake holes. The remainder of the structure is timber and is anchored to the bridge pier by 3-in. angle-iron collars. The interior dimensions of the well and house are 4 x 5 ft. and the corner posts of the well are continued through the floor of the gage house to the roof, thus giving the same construction for both the well and the house. The floor of the gage house is about 40 ft. above low water.

At Austin the station is equipped with a Stevens continuous water-stage recorder and its total cost, including supplies, labor, salaries, expenses of engineers, recorder, and incidentals, was $900. The Waco recorder is of the Gurley graph type and the total cost of the installation was $925.

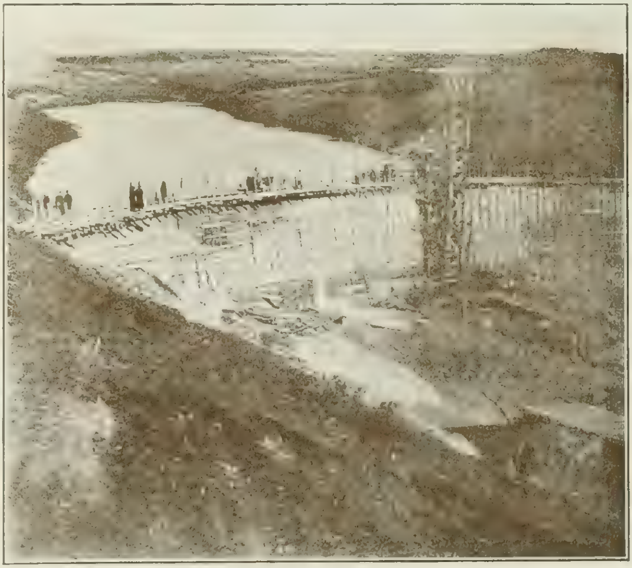
Local interest in the installation of these water-stage recorder wells and houses was shown by material coöperation by the city of Austin and by the Waco Chamber of Commerce.

War Engineering Photographs from America and the Western Front

Building Port Terminal "Somewhere in America" Requires Enormous Number of Piles

© British Pictorial Service

British Driver on Flanders Canal



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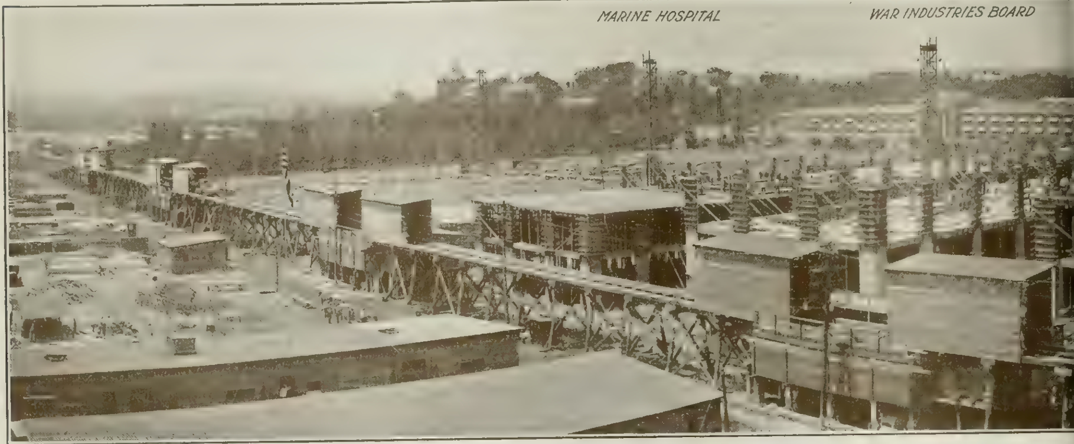
Arch Dam Built By U. S. Engineers Near French Port



Largest Office Building in the World Being Built

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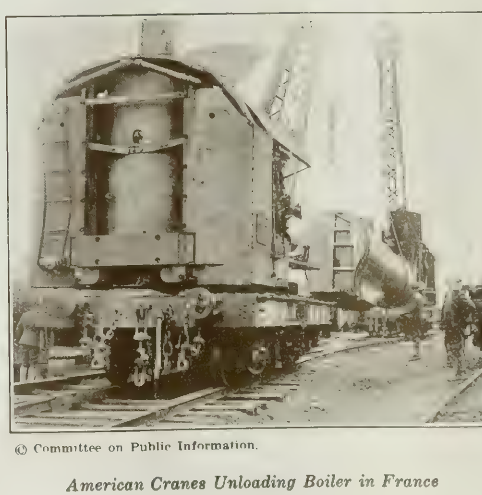
Unloading Motor Trucks in French Port

© British Pictorial Service.

Pneumatic Tired Steam Autos for Road Work—British



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American Cranes Unloading Boiler in France

for the Government in Washington, of Reinforced Concrete in Remarkable Time—Its Construction Is Described In This Issue

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The American Mule Plays a Conspicuous Part in Building Railways Behind the Front

French Official ©, Committee on Public Information

Belt Conveyors Help Dig Trenches

© British Pictorial Service

Narrow-Gage Road Makes Wheelbarrow Bridge

© British Pictorial Service

Type of I-Beam Highway Bridge

Engineer Officer Students at Camp Lee, Virginia, Whose Training Is Described in This Issue, Will Soon Be Engaged in the Sort of Work Illustrated

Engineer Students Learn Rigging at Camp Lee

© British Pictorial Service

Engineers Bring Up Shells on Push Car

© British Pictorial Service

Made from an Old Motor Car by the British

© British Pictorial Service

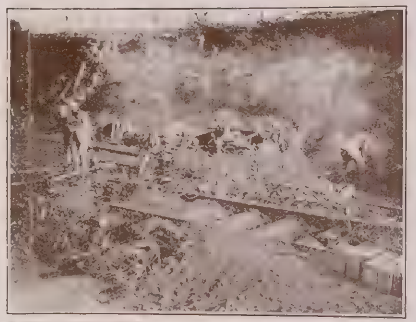
Transporting Work Party by Narrow-Gage

© British Pictorial Service

Clearing Canal du Nord of Wrecked Bridge

© British Pictorial Service.

British Engineers Repair Canal Lock



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Barricade Across Old Main Line Railway Where It Crossed the German Lines

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Engineers Will Use Every Scrap of Steel From This Wrecked Factory

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Military Railway Construction in France Often Involves Heavy Work

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What a Few Shells Did to a British Broad-Gage Line Behind the Front

How American Cities Are Meeting War Problems

Coast-to-Coast Survey by City Engineers—Conserving Capital, Labor and Materials—Bringing Records to Date—Planning for Post-War Work

Letter Sent To City Engineers by Editor of Engineering News-Record

In our issue of Jan. 3, we published an editorial entitled "Municipal War Programs Needed." We defined such a program as "a plan of strictly municipal activities and economies that will contribute the utmost in helping win the war," and said that it "should cover at least three and preferably five years" so if happily the war should end soon the program would extend into the period of reconstruction.

What has your city done in the way of framing and putting into effect such a municipal war program? If it has not done anything comprehensive, what has it undertaken in a partial way—as to either the whole field of municipal activities or because not extending beyond the current fiscal year?

Besides a brief off-hand answer to the foregoing questions relating to your city government as a whole, please let us known what special war problems you have met in your own department of the city, and how you have solved them.

Have you been able to keep your engineering staff at full strength, and if not what is its normal and its present quota? If construction work has been slack have you used your staff to bring records down to date and to plan for the future?

The information requested is desired for a survey of how American cities are meeting their war problems. It is hoped that this exchange of ideas will help cities meet war conditions and contribute to war efficiency.

Worcester, Mass.

Not Competing in Money Market. Labor Supply About Exhausted and Wages Practically Doubled—From F. A. McClure, City Engineer.

Activities of this city are largely confined to such work as may be paid for from the tax levy. I do not understand that borrowed money is being used in any but very small amounts, in order to avoid competition in the money market.

The work in general is limited to those public requests that appear to be necessary. The street, water and sewer departments are doing much less work than in ordinary times. The labor market appears to be about exhausted, few if any men applying for public work, while the forces heretofore engaged have dwindled away in such numbers as almost to check works which have been under construction for some two or more years. The pay of laborers has practically doubled, and none but the older men who have been heretofore employed for a number of years are available.

To my knowledge there are no special war problems to be met by this department except to assist in all possible ways in the requests of the general Government, which have been answered in a most generous manner by all classes of people in Worcester.

The engineering staff is not more than two-thirds full strength, not more than twenty assistants being employed at the present time. Quite a number of the former employees have joined the service, and the rest are being employed in the limited municipal activities.

Pawtucket, R. I.

Only Absolutely Necessary Outlays. War Emphasizes Unduly Low Salaries Paid Municipal Engineers—From George A. Carpenter, City Engineer.

Our 1918 program of municipal expenditures was cut to cover only those which we deemed absolutely necessary, but it so happened that there were many things which we considered absolutely essential and our proposed expenditures amounted to a considerable sum. We have not laid out a program covering three to five years but I think that this ought to be done, and especially in our case, for we badly need a large amount of permanent pavement construction.

The war has seriously affected my engineering staff for, while but one man has enlisted three have gone to jobs paying much better compensation than the municipality offers and consequently the city has lost the services of men it has trained. This, it seems to me, is one of the most unsatisfactory and serious aspects of the municipal engineering problem.

Our municipalities, in general, regard engineering services so lightly, from a financial point of view, that there is very little encouragement for a young man to stay in this line of engineering work. It is a great pity, too, because municipal engineering offers such a variety of interesting problems that it should be made financially attractive to capable men. It is a very short-sighted policy, in my opinion, for a city to train engineers in its particular problems and then, when such engineers are in a position to render the very best services to the city, cause these engineers to become dissatisfied with their positions and seek other fields of labor because of insufficient compensation. At the present time our young engineers are comparing their compensations with those of the carpenter, bricklayer, plumber and even the day laborer, and are finding very little encouragement to remain in a profession where education and mental capacity seem to count for so little.

New Haven, Conn.

Doing Only Work Needed to Help Win War. Property Owners Take Bonds for Assessment Benefits—From F. L. Ford, City Engineer.

No definite steps toward the adoption of a municipal war program have been taken by New Haven, but it has postponed many public improvements, and is only doing such work as will contribute directly

or indirectly to winning the war. For instance, we had complete plans prepared for rebuilding the Tomlinson bridge, at an estimated cost of from $500,000 to $600,000. We had plans also for the development and enlargement of our municipal dock to cost $250,000. The issue of bonds for both of these projects has been authorized, but both projects have been postponed for the period of the war and the city has turned over the use of its present city wharf to the United States Naval Reserve for a naval base.

The city has recently approved the layout for a new highway to the railroad station, now being built, at a cost of $400,000 to $500,000 in damages alone for the taking of private property and buildings. The mayor arranged to have all of the different property owners take their benefits in city bonds, so that none had to be put on the market. During the period of the war the city will not attempt to demolish the many buildings on this approach, but will instead collect rents from the different tenants.

So far as paving work is concerned, we are doing a comparatively small amount and are selecting many of the streets with special reference to their military uses, one of those recently ordered being a highway leading up to the Marlin-Rockwell Corporation, which is manufacturing the Browning guns for the War Department. Sewer construction is practically at a standstill.

Rochester, N. Y.

Holding to Absolutely Necessary Work. Unable to keep Engineering Staff at Full Strength—From E. A. Fisher, Consulting City Engineer.

Rochester has restricted its work to such construction and replacement as is absolutely necessary. I know of no special war problems that have been met in this department. We are engaged in the construction of a bridge over the Rochester harbor that is absolutely necessary in order that the proposed terminal docks which the state expects to have ready for use at the opening of the Barge Canal in 1919 may be put in use. We have not been able to keep the engineering staff at full strength. A large number of the men have entered the service.

Niagara Falls, N. Y.

Improvements Kept at Low Ebb. Following Comprehensive City Plan. Shortage of Engineers—From O. E. Carr, City Manager.

Niagara Falls endeavors always to have mapped out a definite municipal program for one year in advance. Beyond one year, our program is less definite, but, in a general way, is extended for two years in the future. In addition, last year we adopted a comprehensive city plan which gives us an outline of municipal development for ten to twelve years to come.

In accordance with the dictates of common sense and the desires of the Federal Government, our municipal improvements have been, throughout the past year, kept at a very low ebb, only those improvements having been made which seemed to be absolutely necessary in order to maintain public health and welfare, and to keep up in a measure with the demands occasioned by the growth of our city.

It has been extremely difficult to keep the various municipal departments up to their full numerical strength. The most serious shortage is in the Bureau of Engineering. Within the past two months, three engineers have been called for Federal service from that bureau and another is subject to call in the first class, which well nigh annihilates the working force in the engineer's office and presents a most difficult as well as an almost dangerous condition—especially when one takes into consideration the carrying out of as heavy a municipal program as will be demanded at the end of the war. We have endeavored to obtain temporary employees in the bureau to keep things running, but the places vacated cannot be properly filled owing to the shortage of young engineers in the country.

Pittsburgh, Penn.

Improved Thoroughfare to New Ordnance Plant on Neville Island Made Necessary. Engineering Staff has 33 Men in Service—From N. S. Sprague, Chief Engineer.

No definite war program has been prepared by the Pittsburgh Department of Public Works.

We have experienced relatively little difficulty in securing shipments of ordinary paving materials, but, like other communities, have suffered from the lack of sufficient man power to complete work expeditiously under contract.

Pittsburgh, being a great industrial center, has been unusually prosperous since the beginning of the European war. This is reflected in the demand of the people for the improvement of streets and the construction of sewers. Last year the total cost of original street improvements exceeded that of the three previous years by approximately $500,000.

The decision of the Government to build an ordnance plant on Neville Island has created the necessity for improving the main thoroughfare leading to the island. The only street from the city by which the island can be reached is very narrow and badly congested. Improvement of this has been under consideration for several years, but was deferred owing to the war with Germany. It is now essential that the work be done at once. It consists of the widening, elevating and improving of West Carson St. from the Point Bridge to within about 460 ft. of Steuben St., about 4600 ft. The estimated cost, including damages to property, is $640,000.

Our engineering staff has suffered greatly by the draft and enlistments, there being a total of 33 men in the Government service. We have many vacancies in various positions and the men are rapidly leaving to accept other positions in connection with work being done by the Government for the prosecution of the war. We are facing the serious question of maintaining the engineering staff. It is already far below the normal quota, with poor prospects of filling the vacancies.

Richmond, Va.

To Assist Government in Any Way It Can—From Chas. E. Bolling, City Engineer.

Exercised by economical reasons and patriotic feelings, our city council made a very small appropriation for the various departments under my charge for the fiscal year 1918. The appropriation for streets was so

small that we feel justified in expending it for general repair work only.

Another reason why construction work in Richmond has been reduced and is slack is due to the high cost and difficulty of getting materials. Many of the quarries, sand and gravel pits have been commandeered by the Government, and we have had great difficulty in getting material to complete work under construction.

Our purpose is to assist the United States Government in every way we possibly can, and sacrifice our own demands as much as possible to aid the Government in the early ending of this terrible war.

We have given up from our regular staff five assistants, all of whom went to training camps or colleges and now have commissions. We have not filled their places. Besides this, we have lost or released six inspectors on our work. Our force for street repair work has been greatly reduced, and we have made no efforts to fill these vacancies, as the demand for labor has been particularly acute for use in cantonments and munition plants near Richmond.

We have a very small force engaged in surveying and platting territory annexed in 1914, covering some 12 or 14 square miles. That force, while small, is absolutely essential for making these surveys, maps, profiles, grades, etc., and preparing plans for a future sewerage system.

Atlanta, Ga.

Expenditure Well in Hand. Water-Works and Paving Extensions to Serve Camp and Fort—From H. L. Collier, Chief of Construction.

It is the policy of the municipality at this time to hold its expenditures well in hand. Since we are in the midst of the war we must yield to Government requirements.

In connection with the War Department, we can report the laying of six miles of water pipe at a cost of $200,000.

Fulton County, in which Atlanta is located, is now constructing about nine miles of asphaltic concrete pavement, connecting Camp Gordon with the city, and the city is repaving Peachtree and Whitehall Sts., connecting links between Camp Gordon and Fort McPherson, with sheet asphalt.

The city is also contemplating leasing from 60 to 100 German prisoners to do street and quarry work for the city.

Savannah, Ga.

How to Increase Revenue Without Bond Issues Being Studied. Bringing Records Up to Date—From E. R. Conant, Chief Engineer.

Savannah completed certain extensive work within the past year, and was more fortunate than some of its sister cities in getting the work done before prohibitive prices for material and labor troubles seriously interfered. We made an expenditure of over $1,000,000 for storm-water and sanitary sewers. We constructed our auditorium and public library just in time.

The comprehensive plan I had mapped out for paving is interrupted for the time being, on account of labor conditions more than the cost of material. Port cities, especially where extensive shipbuilding plants are located, draw from the city practically all the skilled and even ordinary labor.

Although we have necessarily raised wages, all operation work is carried on with serious difficulty. The city administration foresees increased cost of operation for the coming year—or years, should the war continue. This is being carefully considered and meetings are now being held to determine the best method of increasing the revenue by taxation or by extension of the present corporate limits of the city.

As regards my engineering staff, my heavy work of construction ceased at just the right time. All men not needed for the operation of the department readily found situations or went into the reserve corps of engineers. I have all the necessary force required and during the dull period am bringing all records up to date and preparing data to revise our city map.

Whatever available money can be spared after operating the city is to be used principally in improving our system of water-supply. A comprehensive plan for water-works improvement has been worked out and, as soon as conditions permit, work will be taken up.

Birmingham, Ala.

Has Curtailed Public Improvements. Men Who Have Left Engineering Staff All Went Into War Work—From Julian Kendrick, City Engineer.

Early in the war Birmingham adopted the policy of curtailing public improvements as far as possible, and only completing such work under construction as could not be stopped without considerable loss to the contractor or the city. The only work now ordered is of very minor nature, usually consisting of short extensions of sanitary sewers, where recommended by the Board of Health.

The Engineering Department has been reduced to a minimum, and I am glad to say that, without a single exception, the men leaving this office are either in Government employment, or in the employ of industries directly connected with war manufacturing, or have joined the army direct.

As is probably the case in almost every municipality in the country, our great problem is that of labor—it being not only hard to get competent labor, but the scale of wages has so advanced that to undertake new construction is almost prohibitive. This is true as well in regard to materials.

Memphis, Tenn.

Heavy Construction in Past Has Created Maintenance Problems. River Terminal Bonds Voted and Work Probably Will be Undertaken Soon—From Horace H. Hull, City Engineer.

Between 1909 and 1914 Memphis did about as much paving, sewerage and drainage work as any city in the country of its size. Every maintenance bond has expired. We feel, therefore, that we have done all that can be expected if we successfully maintain such improvement as we have.

Memphis has voted $500,000 bonds for the construction of a river terminal, and it is not unlikely that this much-needed project will be undertaken within a comparatively short time.

Our engineering staff is now quite small. We have enough work planned ahead to keep us busy for some time should prices return to normal.

Nashville, Tenn.

Following Engineering News-Record War Program Editorial. Expects To Be Ready for Public Works Expansion After War—From William W. Southgate, City Engineer.

The 1918 policy and program of Nashville has conformed in a general way to the suggestions and spirit of the "War Program" editorial in *Engineering News-Record* of Jan. 3, 1918. There has been a pruning down of public undertakings and a limitation thereof to things that are considered absolute necessities. Highway work has been confined strictly to the maintenance of roadways in proper condition for traffic and no new street grading or paving has been undertaken.

During 1917 legislative authority had been obtained for the issuance of $1,000,000 bonds for the expansion of the city's sewerage system, and surveys, plans and estimates had been made for undertaking the work on a very large scale. Early this year the commissioners decided to market less than a third of the sewer bonds on account of the war conditions. The $300,000 of sewer bonds were sold at a satisfactory price last February and we fully expected to proceed at once with our sewer work. But just then the United States Government decided upon the location and construction of one of the largest war munitions plants in the world about ten miles above the city, on the Cumberland River, and instantly an abnormal demand was created for labor. The price of labor considerably more than doubled. The commissioner of streets and sewers wisely concluded not to compete with the Government powder plant for labor and deferred undertaking the sewer construction work on a large scale until after the Government's requirements at the powder plant have been accomplished. As a result, the city is only undertaking such sewer extensions as are absolute necessities. In the same spirit, water-works undertakings are limited strictly to maintenance service now existing.

The work of the Engineering Department has been greatly curtailed. Our field force has been cut down to one corps and the office force reduced strictly to necessities. The field corps work is largely devoted to surveys for future street and sewer extensions and the office force is engaged in catching and platting field notes. When the tension of war conditions is relaxed the Engineering Department expects to be ready for such expansion of public works as the city may require.

Akron, Ohio

Has Municipal Retrenchment Program. Plans for Post-War Improvements Being Made—From H. S. Morse, Director Public Service.

Akron has experienced an extremely rapid growth. With the possible exception of Detroit, it is the fastest growing city in the United States. Consequently, the need of extensive public improvements of all sorts is very great. Under such conditions it means more for Akron to curtail its program of public improvements than is the case in most cities. Nevertheless, Akron is following a municipal war program. Briefly, this program is retrenchment in permanent improvements coupled with preparation of comprehensive plans for future work.

The City Council has passed a resolution that with the exception of two thoroughfares, which are in extremely bad condition, no new street pavements will be laid this year. Meanwhile we are establishing grades on all new streets, adopting standards and bringing our records up to date. We are also expanding our work on street repair in order to meet the lack of new construction on unimproved streets, of which Akron has many miles. We are cutting the gutters and crowning with graders pulled by tractors, following this work with a covering of cinders. As a makeshift, this method produces a very good street. This program, in addition to meeting war conditions, possesses this advantage—the development of our water and sewerage systems and other underground construction will precede the laying of pavements.

Separation of street and railroad grades has been postponed. The development of parks is also considered unessential just now, although our park system is altogether inadequate. Recreation facilities in existing parks and on private property are being increased.

Our water-works program alone is proceeding, in so far as possible, regardless of the war. This is necessary because not only our people but our industries are dependent upon the water-supply. We are now extending the water-works system under a bond issue of $1,000,000, authorized last year, and are about to ask the people in the August election for an additional bond issue of $2,000,000.

Our sewerage system is also altogether inadequate. Under a $50,000 bond issue voted by the City Council last February, we are making a survey and record plans of existing sewers as the first step in the preparation of a comprehensive plan of sewerage.

We are having difficulty in maintaining our engineering staff because of a lack of men due to the draft and enlistment, but more particularly because of offers of higher salaries than we are able to pay—an experience not confined to Akron.

Cleveland, Ohio

New Projects Discouraged or Prohibited. Planning for Future—From Robert Hoffmann, City Engineer.

By reason of financial limitations the carrying out of new projects by Cleveland has either been discouraged or prohibited. Most of the work still in progress is such as had its financial provisions made before we entered the war. New projects will be restricted to those absolutely essential.

The engineering staff has been subjected to numerous changes and at present is somewhat smaller than normally. It is the intention to continue engineering studies in connection with proposed improvements, even though construction work does not seem immediately possible. There is ample opportunity for such work, and it seems quite consistent and proper that it should be done. Our city plan commission is busily studying local problems, and a rapid transit commission is working on a subway plan. Although construction work cannot proceed in connection with either of these projects, yet planning can well be done now, so when the time arrives to proceed with the work, the usual time spent in preparation can be saved.

Toledo, Ohio

Will Be Ready to Employ 15,000 Returned Soldiers After War. Has 13 Engineers in Service—From H. C. McClure, Commissioner of Engineering and Construction.

Toledo's Department of Public Service has prepared plans for some 65 paving jobs at an approximate cost of $1,500,000; for local sewers at an estimated cost of $200,000; and for an intercepting sewer system at an approximate cost of $3,000,000. Special items, such as street intersections and grade separations, amount to $1,500,000. The same general situation exists in the park department as regards park and boulevard improvements. The safety department should also build at least three new safety buildings. On account of the present national situation, we do not contemplate awarding contracts for any of these improvements with the possible exception of local sewers. The street department must assume the additional burden of keeping streets in repair which would ordinarily be properly paved.

The only issue on which we have asked the approval of the Federal Reserve Board covers sidewalks, local sewers and some local health measures.

From the present indications, if the war extends over a period of two or three years, Toledo will have at least $10,000,000 worth of work ready to proceed with immediately. We feel that this will give an opportunity for the ready employment of the 15,000 men who have already gone from this city, which number, of course, will be materially increased before the end of the war period.

We have lost from this department, mostly by enlistment, 13 men. These include one major, four captains, four lieutenants and four privates. We have not attempted to replace the men except in one or two very necessary instances. They have been given extended leaves of absence and will be reinstated at the end of the war, if it is their desire to come back. Our present force is operating at just about half its regular quota, getting up records, maps and data which have been neglected in times past.

Youngstown, Ohio

All Expensive and Unnecessary Improvements Suspended. Chief Engineer Gives Part Time to War Housing—From F. M. Lillie, Chief Engineer.

Youngstown has suspended all of the more expensive improvements, and those not necessary to the health of the city.

Three assistant engineers and three inspectors have resigned, leaving three assistant engineers and nine inspectors. On account of slack work it will not be necessary to fill the staff at this time. The chief engineer is using a part of his time with the Government, planning housing.

The records have all been brought pretty well up to date

Chicago, Ill.

Water-Works and Bridge Programs Worked Out Before War. City Council Refuses to Raise Engineering Salaries Fixed 20 Years Ago—From John Ericson, City Engineer.

Water-works and city bridge construction programs in the City of Chicago cannot in any way be altered as a result of war, except, of course, to curtail progress on account of the lack of materials and labor. What I mean to say is that we have sufficient definite programs, planned ahead previous to our entering into the war, to keep us busy for a good many years to come if the necessary finances are forthcoming. We are earnestly in hope that some remedial legislation will be granted, as a result of which the City of Chicago can increase its income and carry on some of the urgently needed improvements, both in our bridge building program and in the extension of the water-works system—which are the only public improvements under the city engineer.

Our engineering staff is greatly depleted, we having lost many of our former employees either through entering the Army or Navy or accepting more lucrative positions elsewhere. The city council, notwithstanding repeated requests, has not as yet seen fit to increase the salaries of engineers, which have been stationary for about twenty years, with the result that there is no particular inducement for any engineer of any capabilities at the present time to enter the city's service.

Davenport, Iowa

Conditions Normal But Plans for Future Work Deferred—From Roscoe Sawistowsky, City Engineer.

Construction work in Davenport is of the same amount as usual and promises to keep up to normal for the year. We also have prepared preliminary plans for improvements totaling about $500,000, which will not be attempted until the war has ended, because of the desire not to put an expense on property owners for improvements that are not absolutely necessary at the present time. Two of the engineering staff are serving their country. I have had no trouble in keeping the engineering staff at full strength.

Fargo, N. D.

Long-Time Construction Program Checked by War. Has 22 of 23 Engineers in Service—From F. LaF. Anders, City Engineer.

About the beginning of the European war Fargo adopted a progress plan of construction for sewers, water mains and paving, to cover a period of from five to ten years. For about three years we were able to follow the program, but naturally it is now becoming somewhat disjointed and limitations are being placed upon its rate of progress. Work is being limited to present necessities and to the completion of contracts let about a year and a half ago.

In 1917 I employed 23 engineers, of whom 22 are now in the United States service. Most of these men have gone into the engineers and infantry; some into the coast artillery, the signal corps, aviation and balloon sections. The 23rd Engineers took quite a bunch of my men last fall, all of whom are now serving in France. I want to say, however, in spite of their anxiety to get to the front, they took into consideration the war conditions and did all the work that it was possible for them to do, covering all the contracts that were to be completed this year. The present staff will be used to bring our records up to date and for other work that is at times neglected for various reasons.

St. Joseph, Mo.

Construction Cut to Minimum. Planning to Bring Records to Date and Make Resurvey of City—From H. D. Judson, City Engineer.

St. Joseph has no definite war program. We have discontinued all construction work except that which it is thought impossible to let go indefinitely. We are doing far more repair work than usual with the view to making the pavements or other much-needed improvements serve until after the war. This is particularly the case with many miles of macadam streets which, a year ago, were so badly in need of repairs as to be on the waiting list for new pavements. We repaired and oiled about 250,000 sq.yd. of macadam pavement last year and expect to continue the good work this season.

It is the policy of this department to go right ahead with all street grading work which can be done and to construct sidewalks on these newly graded streets; but the paving on streets for the most part will be deferred until after the war.

Owing to the large curtailment in construction work, our engineering force has been reduced about 30%. The salaries of the employees remaining in the department have been slightly increased.

We plan to bring up to date all records which have been neglected, and to work up some new and long-needed records. We have also arranged to take advantage of the lull in construction work to make a complete resurvey of the city, which we do not expect to complete in less than three years.

Houston, Tex.

Has General War Program. Extending Services to Government—From E. E. Sands, City Engineer.

Houston's municipal economies, designed to contribute to the utmost in helping win the war, may be divided into two parts: (1) Activities which directly assist the Government; (2) Curtailments of municipal activities, for the purpose of indirectly assisting in winning the war, in the following manner, by (a) reducing the cost of municipal activities to the tax payers, in order that they may be in better condition to aid the Government financially; (b) reducing the consumption of labor and material so that such labor and material will be available for governmental work.

Regarding direct coöperation with the Government, the City of Houston tendered its entire engineering organization to the Government for use in the construction of Camp Logan and Ellington Field, both of which are located near Houston. The city has put in at its own expense an auxiliary water-supply for the purpose of supplying Camp Logan with water. It has tendered the use of one of its activated-sludge sewage disposal plants to the Government, thus eliminating the necessity of Camp Logan installing its own plant. The city also built certain roads and pavements especially for the benefit of the military camps near Houston, and has turned over to the Government, for its use, the municipal warehouse with an area of 200,000 sq.ft., and Wharf No. 4, with a frontage of 777 ft. and an area of 68,000 sq.ft. Both these latter facilities are located at the terminal of the Houston Ship Channel. For these various services, the city is to receive a nominal sum from the Government, in every case the amount received being considerably less than the amount that individuals or industries would be charged for the services rendered.

As to the second proposition, namely, the curtailment of municipal expenses to reduce the consumption of labor and material, the city has curtailed every construction activity that it was possible to curtail. We have delayed, until after the war, any additional wharf construction. Street paving has been reduced to the very lowest minimum, and at the present time it is practically at a standstill. It is expected that maintenance work will be the only line of paving activities carried on by the city during the remainder of the war, and that no new projects will be undertaken. Extensions of sanitary and storm sewers have been indefinitely postponed, except in certain small areas where the expenditure has been recommended by the United States Public Health Service. Sidewalks in Houston are built by individuals and not by the municipality. The city is requiring only a very small amount of such work to be done.

Spokane, Wash.

Using Local Materials. Engineering Force Monumenting City—From Alfred D. Butler, City Engineer.

The City Council of Spokane has made it a policy to postpone all public improvement work that is not deemed absolutely necessary; and where such improvement work is felt to be necessary, local materials are specified, thus relieving the necessity for shipping in material by rail.

Where pavement is contemplated, we have been laying one-course concrete to a great extent. But in a majority of cases, instead of paving the street, it is planned that the city shall gravel these streets and thus put them in passable condition until after the war.

The work in our department has been materially decreased by reason of the fact that so much of the improvement work has been eliminated. We have thrown our organization into the monumenting of certain sections of the city where property lines are becoming harder to find year after year.

Only one member of our organization has gone into the Government service, and we have distributed his work among the other members of the department.

Alameda, Calif.

Postponed All Construction Projects Except Belt Line to Serve Shipyards—From B. Hamilton, City Engineer.

Alameda has not done anything definite in the way of a municipal war program but, with one exception, it has postponed all new projects for the period of the war and reduced its activities to those of necessary maintenance. The exception is the installation of a mile and a quarter belt line to serve shipyards handling Government contracts.

The labor question gives us more or less trouble due to the fact that the men can get much better employment in the shipyards and ironworks hereabout.

Los Angeles, Calif.

Thorough Study of Proposed Improvements Being Made. Force Reduced by Half. Bringing Records to Date—From A. C. Hansen, City Engineer.

Los Angeles is making a thorough study of its proposed improvements, and is holding up all work that

is not absolutely necessary at this time. An effort is being made to keep the maintenance work nearly up to the standard of the past year.

Office forces are being reduced nearly one-half from what they were a year ago. All spare time of engineering employees is utilized in bringing records up to date and making precise surveys, district maps, etc.

Like all other cities of the country, San Francisco has had to adjust its construction program to the needs of the times. All new enterprises involving capital expenditure have been postponed and all construction work, such as beach protection, large arterial sewers, and other projects which can be delayed without impairing the nation's necessities, have been discontinued. The engineering department has been automatically adjusted to national conditions. About 28 members of my staff have voluntarily joined the service in the Army and Navy. About a dozen others have entered the employment of shipbuilding and other industrial activities, so that the readjustment of staff will enable us to handle comfortably the limited amount of work now being done.

For the past five years the city has had an epoch of great engineering activities. Over $20,000,000 have been spent, through this department alone, on municipal railways, sewers, high-pressure fire protection, boulevards, and other like work. Many of the records of those activities have not yet been worked out into final shape, but such is now being done with the employees who remain in the city's service.

Our largest and most important project is the Hetch-Hetchy water-supply, which has been slowed down due to the difficulty of selling bonds, but as this project will bring into use about 50,000 hydro-electric horsepower, it is hoped the national authorities will aid us in speeding up this unit of the work, which will take about $12,000,000 to complete. As there is an annual demand for about 60,000 or 70,000 hp. in northern California such a program will conform with the nation's requirements, as it is a criminal waste of natural resources to use oil and coal when the streams in the mountains are flowing wastefully to the sea, without that power being put to a useful purpose.

The spirit of this city is that everything must be done to win the war and all other activities must be subordinated to this purpose. Protection of health and life, industrial activities and some municipal work are indispensable. Our policy is to put the nation's needs first and everything else in a secondary position.

Salt Lake City, Utah

War Economy Practised. Bringing Records to Date. Making City Planning Survey—From Sylvester Q. Cannon, City Engineer.

Salt Lake City has done nothing directly in the way of laying out a definite plan covering a period from three to five years looking toward the winning of the war.

On account of the war, and also because of prohibition going into effect in this state, with a consequent decrease in licenses and revenues generally, the city has found it necessary to reduce its improvements to a minimum in order to avoid the necessity of increasing taxation, or the issuance of bonds.

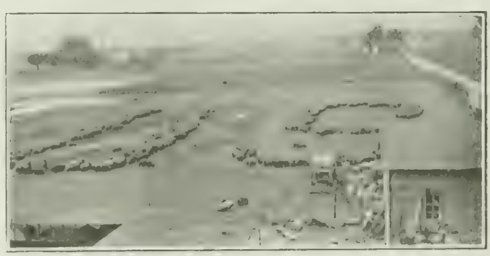
Prior to or shortly after the entrance of the United States into the war, this department had prepared preliminary plans and estimates for quite extensive improvements in the city covering paving, curbing and guttering, water mains and water-supply improvements and sewerage, as well as park and other improvements, so that we are forehanded in the matter of preparation for such improvements when the proper time arrives. The city government is, however, committed to the policy of strict economy and the reduction of expenditures in every possible way during the period of the war.

The force connected with this department has been very greatly reduced. At the present time the number of employees is less than half that prior to the war. In order to effect additional economy the undersigned was also appointed superintendent of water-works recently. Besides attending to the engineering and inspection work on the few improvements now being undertaken and performing the necessary maintenance work of the department, our force is engaged in making all of our records complete and bringing everything connected with the department up to date.

The city commission has recently undertaken a survey of the city for the purpose of preparing a city plan which can be carried out as conditions will warrant. This work is under the direction of the city planning commission, consisting of a body of six citizens with whom are associated the commissioner of water-supply and water-works, who acts as chairman, and the city engineer. This commission has secured the services of George E. Kessler, of St. Louis and Kansas City, for the purpose of preparing a city plan.

Patriotic Hogs Help in War Time By Eating Camp Garbage

At the entrance of the United States into the war *Engineering News-Record* printed an editorial entitled "The Hog Volunteers to Utilize Municipal Food Wastes" (Apr. 26, 1917, p. 217). Since then the practice of



HOW PATRIOTIC HOGS ARRANGED THEMSELVES

feeding garbage to hogs has been extended to many additional cities and has become quite general among contractors who are disposing of the garbage from army camps. The accompanying view shows the patriotic lines in which the hogs at one of the military camps grouped themselves one day when disposing of the camp garbage. The original photograph was taken by J. L. Snypp of Henry Knight & Son, Louisville, Ky., contractor for garbage disposal at a number of cantonments.

Rapidly Growing Ship Production Speeded by the Emergency Fleet Corporation

Shipbuilding Program and Launchings—Expediting the Steel Supply—District Officer with Technical Staff Supervises Yard Work—Central Office Studies Maximum Yard Capacities Far in Advance

RAPID increase of ship production is being recorded. In the months of May and June American shipyards equalled and surpassed the greatest prewar ship construction of any country in the world, and the building curve, in Fig. 1, continues to slope sharply upward. The curve of hulls launched and vessels completed ready for sea service, in Fig. 2, is so far exceeded by the curve of new keel laying that we are likely to see, in another two or three months, a ship output of vastly increased magnitude.

That an enormous shipbuilding program has been built up is exhibited statistically by the figures of the accompanying table. In carrying it out, the vital consideration is rapid construction, represented in tons turned out per month. The significance of rapid-quantity production will be emphasized and symbolized on the Fourth of July by the launching of possibly 85 to 90 hulls at various shipyards throughout the country, representing a total tonnage of nearly a half million—far exceeding the launchings of any prior month. American ship construction thus will enter a radically new phase with the second half of the year.

More than 13,000,000 tons of carrying capacity have been contracted for or requisitioned during construction. While only a small part of this tonnage has yet been completed, the entire quantity is to be delivered within the next eighteen months, according to the program. In performing this work the producing facilities of the shipyards and their supply sources will be fully taxed. On the Emergency Fleet Corporation rests the duty of developing maximum output, by speeding up the shipyard work and by coördinating material supply with shipyard needs.

TABLE I. THE SHIPBUILDING PROGRAM AND PERFORMANCE TO DATE

	Contracted and Requisitioned		Launched		Completed		Under Construction*	
	No.	Tons	No.	Tons	No.	Tons	No.	Tons
Steel (Req.)	404	2,796,798	222	1,396,207	164	1,079,032	103	717,611
Steel.......	1,255	8,248,230	38	265,950	15	105,750	190	1,242,600
Wood......	480	1,645,650	73	260,200	1	3,500	268	904,750
Composite..	32	116,000	*6	23,000	..	..	25	89,500
Concrete...	42	298,500	00	..	.	...	1	3,500
Total....	2,213	13,105,178	339	1,945,357	180	1,188,282	587	2,957,961

* These figures include ships actually on the ways. Data as of June 15th, 1918

PRESENT RATE OF CONSTRUCTION

Steel diverted to ship work.......................... 200,000 tons per month
Ship tonnage corresponding.......................... 600,000 tons per month
Number of ships, about.......................... 50 per month

SPEED-UP IN SHIP WORK SHOWN BY RIVET-DRIVING FIGURES

Rivets driven per day on all Emergency Fleet Corpn. Steel ship work.

April (4 weeks).......................... 642,351
May (4 weeks).......................... 734,726

TABLE II. STATUS OF SHIPYARD PLANTS, JUNE 1, 1918

Dist.	No. Yds.	For Steel	For Wood	For Comp.	For Conc.	Complete	Ways Total	E.F.C.	Completed* For Steel	Completed* For Others
1.....	12	4	8	0	0	9	68	50	15	35
2....	17	9	8	0	0	9	100	97	60	33
3.....	13	7	6	0	0	8	59	51	24	17
4....	12	3	9	0	0	9	50	48	15	27
5....	12	4	6	2	0	4	39	39	2	29
6......	10	0	10	0	0	10	53	48	0	48
7...	18	11	7	0	0	15	82	68	37	25
8.....	24	10	14	0	0	22	113	111	42	64
9......	16	15	1	0	0	12	71	72	67	1
10......	6	6	0	0	0	5	56	35	32	0
11........	12	0	11	1	0	12	53	53	0	53
Fabricating	3	3	0	0	0	0	68	68	33	0
Concrete plants...	4	0	0	0	4	0	6	6	0	11
Total H.	159	72	80	3	4	115	819	750	327	333

* New ways completed, excluding naval and private. 383.

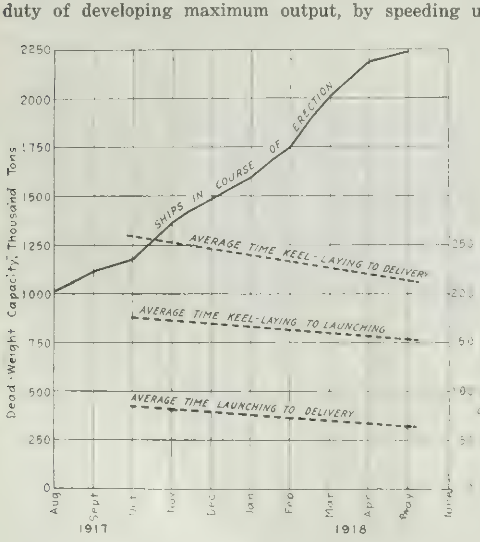


FIG. 1. SPEED-UP IN QUANTITY AND EFFICIENCY OF SHIPBUILDING SHOWN IN CURVES FOR STEEL SHIPS

Present production figures, as given graphically in the curves of Fig. 2, represent only an early stage in the drive for ships. During May and June launchings averaged about 70 ships monthly, with a tonnage of 350,000. In the same period, however, 50,000 tons of steel were going forward from mills to shipyards each week. This rate of supply means, in the ratio of three tons of shipping capacity per ton of steel, that a monthly launching rate of 600,000 tons will be attained soon. In the record year of American shipbuilding, 1901, vessels of 402,336 dead-weight tons were launched. A greater tonnage wil go into the water on the single day of July 4.

The Shipbuilding Program—Steel Ships Far in the Lead

In May, 1918, 39 steel vessels of 228,750 tons, and 32 wooden vessels of 115,700 tons, a total of 344,450 tons dead-weight capacity, were launched; the tonnage of ships completed and delivered to the Government was 263,571. The total of completions since Jan. 1 was thus brought up to more than 800,000 (the figures for the five months are 88,507, 123,625, 172,611, 160,286, 263,571). In the first two weeks of June 89,162 tons were delivered complete and by the first of July the 1918 tonnage completed may reach or exceed 1,000,000 tons.

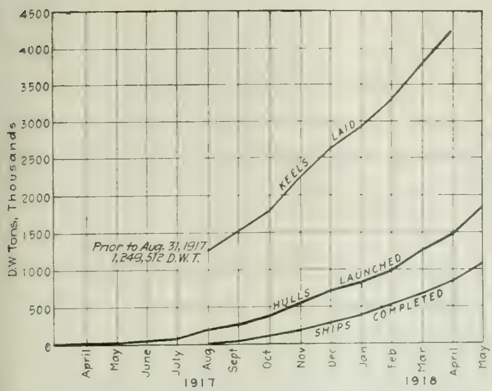


FIG. 2. INCREASINGLY RAPID PROGRESS IN CARRYING OUT THE SHIP PROGRAM

Figures briefly summarizing the shipbuilding program are brought together in the accompanying table. In the total of 2213 ships, of 13,105,158 tons capacity, under contract or requisitioned on the ways, steel ships constitute by far the largest element—11,045,028 tons. Deducting from the steel ship tonnage about 25% representing requisitioned hulls, leaves 8,250,000 tons of contract ships.

Fabricated ships make up 4,647,000 tons of the total of steel ship construction. These vessels are assembled of parts fabricated in bridge shops. The other 6,400,000 tons represent vessels built in the shipyards without the coöperation of bridge shops. The type of vessel in which civil engineers and the civil engineering industry are essential contributing factors will thus play an important part in ship production during the coming months. So far only five or six vessels of the type have been launched, but when the tonnage output of 600,000 per month, already mentioned, is reached, with 100 or more launchings per month, fully half of these will be fabricated ships.

Expansion in Yard and Shipway Capacity

Shipyards have been increased in number and in way capacity to carry out the program. Since the war began 53 new yards have been established, and the number of ways has been more than doubled; 383 new ways added to those formerly existing gives a present number of 660. Construction now in progress will increase the number of shipways to 819, nearly all of which, 750, will be under the direction of the Emergency Fleet Corporation.

How the shipyards stood on June 1 of this year is set forth in Table II. The figures clearly show that the country's shipbuilding machine is not far from the stage of full capacity operation.

Speeding Steel Ship Construction

Since steel ships make up the bulk of the building program, its development is closely tied up with the steel supply. To this extent it is dependent upon the director of steel supply of the War Industries Board, at Washington, who administers the country's steel resources. Through his office the steel needed for ships and that needed for other war purposes is coördinated with furnace and mill production; quantities are allotted to the different industries in accordance with their importance. In the expansion of yard facilities more and more steel has been given to shipbuilding, until now a tonnage exceeding 200,000 per month is being devoted to this purpose.

Two-thirds of the steel needed for the hull of a ship is plates, while about one-third is rolled shapes. The steel producing capacity of the United States, over 37,000,000 tons per year, is ample, in the opinion of steel men as well as of the Fleet Corporation officials. The country's plate mill capacity, however, totals only about 4,900,000 tons per year, and not much over half of this is ship plates. Official statements indicate that nearly all available ship steel is being devoted to the needs of the yards. During recent weeks about 52% of the plate capacity has been turned to shipbuilding. During the rest of 1918 the flow of steel to the shipyards is likely to be increased, but not greatly.

To secure every ton of available steel, the Emergency Fleet Corporation is steadily at work determining the full requirements of the various shipyards, and each month it makes claim for the amount so determined, upon the Director of Steel Supply. By this process it exerts pressure constantly to supply the shipbuilding industry with material as plentifully as the country's resources make possible. The tonnage requirements to meet the contract program have been compiled for months ahead. The present trend of the draft upon the steel mills is indicated by the curve in the diagram, Fig. 3, averaged from the figures of ship steel deliveries of the present and the past few months. As indicated by figures recently made public by Edward N. Hurley,

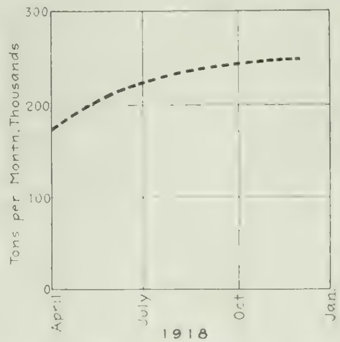


FIG. 3. STEEL FURNISHED FOR SHIPS IS INCREASING

Chairman of the Shipping Board, we shall soon have a shipbuilding capacity considerably in excess of the supply indicated by the curve in Fig. 3. Chairman Hurley's estimate of more than 13,000,000 dead-weight tons of shipping that can be built in one year means 4,250,000 tons of steel furnished in a year, or 350,000 tons per month.

Supply Division Handles Steel Orders

Two departments of the Emergency Fleet Corporation work on the problem of steel supply: the steel ship division and the supply division—a consolidation of the

production division and the purchasing division. The supply division handles directly all demands for ship steel, and, after orders are allocated by the Director of Steel Supply, it also handles the orders. Subsequently it follows up steel deliveries and expedites them wherever shipyards needs make such action necessary.

More than a month in advance, every steel shipyard sends to the supply division a detailed list of its steel requirements for a month. These lists represent the steel which must be delivered during that month, either to the shipyard shop or to bridge shops where parts are to be fabricated; thus they antedate by possibly six or eight months the completion of the ships, depending on the kind of material involved. The supply division has a double check of these lists, first, through comparison with the results of advance calculations of steel needed to meet the contract program (a forecast curve on a diagram like that of Fig. 3), modified as necessary where a yard is ahead of its program or the contrary; second, by checking against yard progress reports records of steel consumption compiled by the corporation's resident agents. These records center in the steel ship division. By using these two checks, the supply division when it presents its list to the Director of Steel Supply at Washington is enabled to give definite assurance that the listed material is indispensably necessary if the shipyard work is not to be slowed up.

At the present time the yard requirements have been so adjusted to the available steel producing capacity

FIG. 4. DISTRICT SYSTEM FOR EXPEDITING MATERIALS AND DIRECTING SHIPYARD WORK

(Numbered black areas are Ship Construction districts: Lettered areas are Supply districts)

that the shipyards' demands are being met by the steel authorities approximately in full.

Following up steel deliveries and seeing that they correspond to the orders based on the allocations of the Director of Steel Supply form one of the most important activities of the production division. This work is done through expediters, men in the field who keep track of the material as it goes through the mills and when necessary issue instructions to push ahead this or that kind of material, to meet the schedule. These expediters form part of a complex field organization of the supply division, handling the pushing or expediting of all kinds of equipment and supplies for ships. An organization of district expediting offices covering the entire country is maintained by the division; their territories are arranged as indicated in the map, Fig. 4.

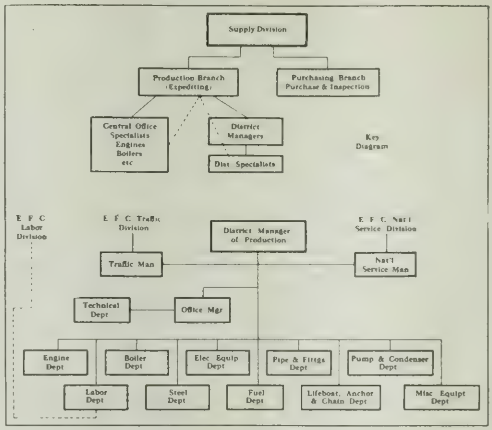


FIG. 5. FIELD EXPEDITING ORGANIZATION OF THE SUPPLY DIVISION

These offices deal with boilers, engines, chain, lifeboats, tableware, compasses and materials of many other kinds. The organization of a typical inspection district is built up on the scheme outlined in Fig. 5. The key diagram in the figure indicates by the dotted line a correlation between the field expediting done through the district offices of the production branch, and the field quality inspection done by representatives of the purchasing branch. In the main diagram the district manager of production directs the district heads for each separate class or group of supplies and is in correlated contact with the representatives of the Fleet Corporation's traffic department.

The functions of the separate bureaus under the district manager are explained by the names given on the diagrams, in general. The technical department gathers information of the workings of all parts of the district office, and keeps such records of them that the information can be transmitted to the central office of the supply division in Philadelphia. The labor investigator reports through the district manager, but is in close touch with the labor department of the Fleet Corporation. The fuel man, by way of the central office, keeps in contact with the national fuel administration at Washington.

The whole organization of the district office is in a sense mirrored at headquarters of the supply division, in that each branch of the field work is represented by a department head in the Philadelphia office.

The head of the engine department or of the steel department maintains constant contact with the district engine representative or steel representative, not by direct correspondence but by reports and correspondence routed through the district manager and the head of the supply division (M. C. Tuttle). The system of centralization of all field activities territorially and centralization of all headquarters activities, while maintaining full subdivisions on technical and functional lines is considered fundamental to the success of the production division.

In view of the great scope of the district activities, success of the field organization has been held to be dependent on the qualifications of the district manager.

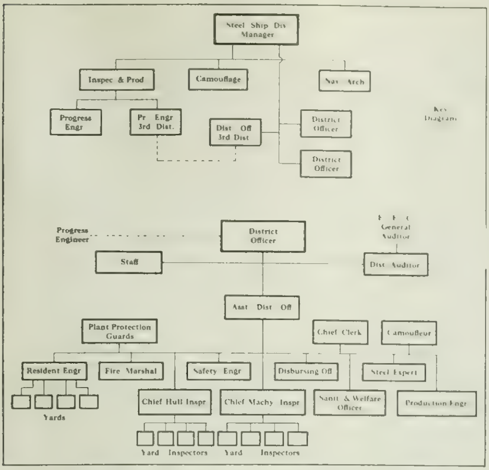


FIG. 6. DISTRICT OFFICE ORGANIZATION, STEEL SHIP DIVISION, EMERGENCY FLEET CORPORATION

The type of man required for this position is defined as follows by an official of the division: "A successful man well and favorably known in the community where his headquarters are located, and either possessing technical training or in his prior experience closely in contact with engineering or technical activities."

Speeding up yard performance is one of the principal functions of an elaborate field organization which the steel ship division of the Emergency Fleet Corporation maintains. The districts of this organization are indicated by black areas in the map, Fig. 4. The district officer with a technical staff, which in an ideal case would be organized according to the diagram, Fig. 6, carries on the field operations. He is able to maintain detailed contact with progress in plant and ship construction at each of the yards in his territory, ranging in number from ten to twenty-four.

Plant construction, proposed improvements, expansion of facilities, inspection of quality of work, fire protection, and in some measure expediting of equipment, are among the functions taken care of by the district offices in addition to the principal one of driving ship construction at maximum speed. A full report on all parts of the inspection and supervision is returned to the central office semi-monthly. Such a report is a thick volume of tabular statistics, comment and recommendations, photographs, curves and the like. To insure its receiving detailed attention in the central office a district organization is maintained there, each district being represented by a progress engineer.

The progress engineer of a given district is the personal agent of that district and is intrusted with the duty of keeping himself informed in detail on all matters in his district, of following through the semimonthly reports and of carrying forward such matters as require central office attention or action. He is in contact with all correspondence between the districts and the central office, studies the recommendations made by the district officer in his report or directory, and lays them before the executive officials of the steel ship division.

The progress branch of the division, to which these progress engineers belong, is thus the source of initiatory action in a great many matters relating to yard construction and shipbuilding. It does not exercise its functions directly, however, but acts through the executive head of the division.

The steel supply situation of each yard is reported on by the district officer separately from his regular progress report. From the yard statistics he keeps a record of the steel received, fabricated and erected, and the reserve supply. These figures, collected in the central office, are utilized in checking up the requirement list which the supply division lays before the War Industries Board each month. In conjunction with the tables of anticipated steel requirements, prepared months in advance by the steel ship division, and with performance charts of the various yards summarized from the progress reports, and showing at a glance whether any given yard is behind its schedule or ahead, an accurate estimate of the steel needed can be made.

Performance records of the shipyards are compiled by the steel ship division on semi-graphical tabulations, a small piece of one of which is represented in Fig. 7. These sheets are so arranged that two lines are devoted to each ship under construction at a given yard; on another sheet two lines are given to each yard in a given district; on another sheet two lines are given to each district in the country, with a separate section for the country as a whole. On all of these sheets yard performance is represented by the number of rivets driven, summarizing ship erection, and the percentage of equipment installed. In each monthly column are entered two figures for rivets, one representing the number of rivets which at normal performance should be driven during that month, and the right-hand figure representing the summation, to the end of that month, of normal or allotted rivet performance. Just below this is drawn a thin line which from the report of that month represents the percentage of the allotted task

TOTAL PROGRAM—STEEL SHIPS—1918

DISTRICT	D.W.T	JAN		FEB		MAR		APR		MAY		JUNE		JULY	
All Districts		16.827	129.31	19.963	149.28	22.709	171.99	25.381	197.37	25.221	222.59	25.968	248.56	23.144	271.70
530 Ships	3639.74	2.793	10.759	2.937	13.696	3.592	17.288	4.160	21.448	3.948	25.396	4.216	29.612	4.051	33.663
District No. 1		.774	7.076	925	8.001	1.025	9.026	1.193	10.219	954	11.173	1.042	12.215	988	13.203
22 Ships	214 20	32	412	69	481	99	580	165	745	146	891	112	1003	106	1109
" No. 2		1091	5.478	1.196	6.674	1.703	8.377	2.162	10.539	2.832	13371				
42 Ships	303 90	58	322	96	418	129	547	200	747	216	[illegible]	268	1231	293	1524

FIG 7. PERFORMANCE SHEET OF YARD WORK GIVES ACCURATE SPEED COMPARISON OF YARDS AND DISTRICTS

which was actually performed, 100% being the full width of the monthly column. Below this, again, is drawn a heavy line which begins at the laying of the keel of the ship or at the start of operations of the yard, or, in the case of a district, at some other fixed date, and represents by its length the percentage of total allotted performance to date which the ship, yard or district can show; for this line 100% represents the distance from the start to the end of the monthly column.

The line below represents machinery installation by figures and horizontal lines in just the same way. The rating here is on the basis of percentage of completion, instead of in number of rivets driven.

A general gage of the speed-up attained in steel ship construction is furnished by the figures for rivet driving in April and May, four weeks of each month being counted. The figures are 642,351 and 734,726, respectively, the two figures covering practically the same number of yards and shipways. A gain of 15% is shown, which is a gain in intensity and speed of working, in the opinion of Fleet Corporation men.

Study for Full Utilization of Yard Capacity

Apart from its regular field work, the steel ship division is carrying out a study of yard capacity with respect to all existing shipyards in the country. Its purpose is to determine the output capacity of each yard, as developed to its maximum, with a view to employing the full capacity of every yard up to 1920. Future contracts are allotted in accordance with the findings of this study.

By collating th results of the work of the inspectors on this study with the performance reports of the district officers, and with recommendations for improvements made by them, precise information is being secured to guide expansion of shipyard shop facilities and other steps that may be necessary for speeding shipbuilding to the utmost.

What the fabrication of ship parts outside of the yards may accomplish has in part been indicated, but estimates of total capacity show that the possibilities in this field still make a large reserve available. Estimates based on reliable information and judgment place the fabricating capacity outside of the shipyards—bridge shops, car shops and related establishments, including new developments—at about 200,000 tons of ship parts per month. This total is made up of many items, the capacity of the country's largest fabricating group being put down at about 30,000 tons. The steel demands for the entire fabricated ship program, existing and proposed, amount to 1,500,000 tons, about two-thirds of which approximately must be done during the coming ten months. From the figures applicable to the subject, officials of the Emergency Fleet Corporation have deduced that the fabricating resources are used to the extent of about 50% at present. The remaining 50%, only part of which is occupied by bridge and steel building construction, is available for speeding up the production of fabricated parts if this should prove desirable.

With 45,000 men in the shipyards a year ago and more than half a million in shipyards and contributory trades today (300,000 in the shipyards alone), a steadily increasing shipyard activity was predicted recently by Edward N. Hurley, chairman of the Shipping Board:

"From all present indications it is likely that by 1920 we shall have close to a million men working on American merchant ships and their equipment."

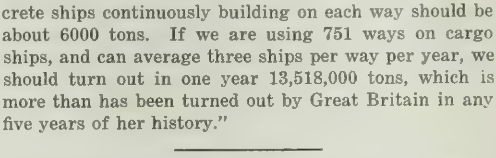
Long before this great army is in service, however, the United States will be producing ships at a greater rate than all the rest of the world combined. The total ship production in 1918, according to Chairman Hurley, will be about 4,000,000 tons in countries outside of the United States, and more than 3,000,000 tons in this country; and, he states, "our tonnage output will continue to increase until before this year closes we will be turning out half a million tons each month.

"In 1919 the average tonnage of steel, wood and concrete ships continuously building on each way should be about 6000 tons. If we are using 751 ways on cargo ships, and can average three ships per way per year, we should turn out in one year 13,518,000 tons, which is more than has been turned out by Great Britain in any five years of her history."

Railway Crossings Have Concrete Base

PAVED street crossings on the Atchison, Topeka & Santa Fe Ry. frequently have the tracks supported on a 12-in. concrete base, and have concrete filled between the ties to carry the paving. Brick is used mainly for the paving, as it more generally conforms to the street construction, but a concrete surface is used in some cases. The general design of the brick-paved crossings is shown in the accompanying drawing.

To reconstruct a crossing on this plan, excavation is first made along and under the ends of the ties to a depth of about 13 in. On each side two timber stringers are placed, just outside the rails, and are wedged up to give the ties a firm bearing. In the middle of the



RAILWAY USES CONCRETE BASE AT STREET CROSSINGS

track excavation is made between and under the ties to a depth of 12 in. This space is filled with concrete, which is packed under the ties and is then allowed to set for two weeks before the load is transferred to it.

The timber stringers are then removed, and concrete is filled under and between the ends of the ties. A small rib or stringer of concrete is laid along the inside of each track rail to carry the steel angle which forms the flangeway guard, this angle being anchored to the concrete. A 1-in. sand cushion is then spread on the concrete base and the brick paving is laid and grouted.

Traffic is maintained without interruption, but all trains are required to slow down in passing over the work. It is stated by C. M. Buck, division engineer at Topeka, Kan., that as the adjacent roadbed has 12 in. or more of stone ballast, the concrete crossing does not make a noticeably hard-riding spot in the track even though trains often pass over outlying streets at a speed of 20 miles per hour.

Industrial Research for War and Reconstruction

Abstracts of Two of the Papers Presented at Meeting of American Society for Testing Materials During Topical Discussion

The topical discussion on coöperation in industrial research at the A. S. T. M. convention last week was introduced by Henry M. Howe, whose paper follows, while the paper by Arthur D. Little, largely reprinted below, also featured the meeting. Dr. John Johnston, Secretary of the National Research Council, outlined recent developments in Great Britain and Dr. Charles L. Reese told of the results attained by the du Pont de Nemours Co., while practical aspects were discussed by Dr. W. D. Bigelow, J. S. Unger and D. A. Abrams. Doctor Johnston brought out the important fact that the cost of industrial research is only a small fraction of fire insurance cost.

Industrial Research for Sharp Answers to Definite Questions

By Henry M. Howe

Chairman, Engineering Division, National Research Council

A VERY great advance towards coöperation in industrial research was made in 1868, when, on the initiative of Sir Lowthian Bell, the Iron and Steel Institute came into being, and replaced the habitual secretiveness of the British iron master with discussion of the principles and practice of his art. Only three years later, in 1871, the American Institute of Mining Engineers was founded under the stimulating leadership of Holley, Drown and Raymond for a like but even broader effort to replace secrecy with discussion.

Another great leader, Judge Gary, took an important step when he started his steel-makers' dinners, and brought those who had been intent chiefly on cutting each others' throats into aiding each other. And now we propose another step, that wherever feasible, the industries shall not only permit such disclosure and discussion of their discoveries as occur at the meeting of technical societies, but shall coöperate in making their discoveries.

Small manufacturing companies so fortunate as to feel that they can trust each other may well look at coöperative research as simply one step in the inevitable enlightenment of human ways. Each step has seemed visionary and Quixotic to those who lack vision, but to the natural leaders it has seemed an obvious extension of the displacement of antagonism by coöperation. The setting up of specifications and standards of reasonableness by this society is one example. Another is the formation of conferences between the selling departments of the competitors in a given industry.

Though the immediate motive for founding an industry is to make money, yet in another sense each exists primarily to serve the public and incidentally to gain for its projectors and managers a just reward for their courage in supplying funds and for their skill and energy in using them, for their product can be sold only as the public profits by buying it. The pecuniary reward should be roughly proportional to the benefit given the public. Clearly John and James can jointly serve the public better, and hence can command greater pay from the public, that is, greater profits, if each serves the public not with his own knowledge alone but with that of his competitor as well.

Four Parts in Research

Every research consists of four tolerably distinct parts: selection, planning, execution and interpretation.

First, out of the immeasurable area of our ignorance we select a certain limited field the exploration of which promises the greatest profit. The problem to be solved should be enunciated with perfect sharpness. The selection of this field demands to-day first a knowledge of the problems which are pressing on our military and other departments, and second, very sound judgment. In other times the pressing needs of the industry dictate the selection. How much good energy has been wasted in the desultory exploration of some little plot which has happened to catch the young investigator's fancy?

Next, the research should be so planned that its results will have the greatest promise of yielding a clear and decisive solution of the problem, a sharp answer to a sharp question. Every kind of test which throws light on service fitness should be used. The consideration that new and unforeseen services are constantly developing argues for widening the range of tests for any given product.

Third, the process itself and these several tests should be made by those thoroughly familiar with them, each detail going to an expert.

Fourth, the results should be interpreted in a strictly philosophical spirit, without bias or reference to preconceived hypotheses. This work of interpretation should indeed be open to all connected with the research. Yet because what is everyone's duty is no one's, certain men should be charged directly with this vital task, knowing well that their inferences are subject to review by all their colleagues and will be accepted only as they are just and reasonable.

Each of these four phases of research needs special qualifications: For selection, prophecy and breadth of view; for planning, imagination and administration; for execution, skill and trustworthiness; for interpretation, philosophy.

Demonstrates Need of Coöperation

This mere recitation of the needs of research is a demonstration of the need of coöperation, for it is only a few of the laboratories of the very great industries that have either the various kinds of men with these various gifts, or the means to experiment on so wide a scale. Scattered through the many institutions of learning and the laboratories of the smaller industrial works there are innumerable investigators, each with certain intellectual gifts, each skilled in certain kinds of tests, but few with broad knowledge of the needs of the Gov-

ernment or of any given industry to guide them in their selection; relatively few with the breadth of view needed for wise planning; very few if indeed any with skill in all the different kinds of tests needed; and relatively few endowed with the philosophical spirit needed for interpretation. Yet these men collectively have enormous potencies for research, if their several gifts and skills can be brought into broad coöperation. How often do we see results reached with extraordinary patience and accuracy not utilized but prostituted to support a preconceived hypothesis which, rightly viewed, they discredit?

It is our defect as a race that this sort of team play comes less naturally to us than isolated individualistic research, in which each man obeys his own impulses, and is a law unto himself. But as with men so with nations, development implies first of all the cure of our inborn defects. That the unmitigatedness of our individualism is a defect we are reminded sharply by the present grave threat of our national enslavement by a people far less intelligent, energetic, and self-controlled than we, but as coherent as we are incoherent, as given to team play, as desirous of support, as we are self-reliant and detached. Distasteful as it is to us to act on our motto of "United we stand, divided we fall," if we are to survive, our strong units must learn to cohere.

Experience with coöperative research has proved abundantly that, wisely directed, it may stimulate instead of lessen individual initiative, which is of the first importance.

One of the aims of the National Research Council is to induce the coöperative spirit wherever possible in industrial research, and research for the immediate benefit of the Government. The Engineering Division of the Council expects to devote part of its energies to this work, and here it counts confidently on your support.

Organization of Industrial Research

THE war, which has changed everything, has given a new aspect to research, said Arthur D. Little, president, Arthur D. Little, Inc., Cambridge, Mass. Hereafter the nation which would live must know.

Through the wreck and peril of other peoples, Americans have learned with them that research has something more to offer than intellectural satisfaction or material prosperity. It has become a destructive as well as a creative agency and in its sinister phase the only weapon with which it may be fought is more research. The organization and intensive prosecution of research has thus become a fundamental and patriotic duty which can neither be ignored nor set aside without imperilling our national existence.

In considering any plan for the organization of research, one is immediately confronted by the difficulty that science in its highest expression is essentially individualistic and democratic. It resents autocratic control, languishes and becomes sterile under minute oversight and direction from outside. The great advances in human knowledge have almost invariably been due to individual effort set in motion by the scientific imagination and sustained by a consuming desire to ascertain the truth. Pasteur, Curie and Rutherford were not dependent on organization for their results. They worked to the best advantage in proportion as they were free to follow the vision which moved before them. No amount of organization can make a Faraday. It may, perhaps, discover one and is then privileged to provide encouragement, working facilities, and recognition. With these assured it is the part of wisdom to leave him as much alone as possible.

Provide for Exceptional Man

Any really effective plan of research organization must provide for the exceptional man, the man whose angles have not been ground down, who is sometimes not comfortable to rub against, but who has the spark of genius. He is usually a man who hates rules and systems, regular hours, time slips and all the paraphernalia of organization. Organization can help him none the less by relieving him of burdens, making him master of his own time, furnishing equipment, providing organized and immediately available library facilities and by directing his attention to specific problems.

While the superlative work in science, like the superlative work in art, must always be an expression of the genius of the individual and quite beyond the power of organization to ensure, there remains a vast deal of what may be called the secondary work of rounding out the great discoveries and especially of giving them an industrial application which may be rendered most effective only through proper organization. The nimbus which, just at this time, surrounds the word "research" should not blind us to the fact that research involves a great deal of hack work, work for good honest plodders who accumulate the data which permits or confirms the generalization or which is required to give it practical effect.

Aims of Research Organization

Broadly stated, the aims of research organization should be:

1. To find, develop and train men.

2. To create such a background in the public mind as shall ensure support for research and the industrial utilization of research results.

3. To secure coöperation between different branches of science, as for example between chemists and mathematicians. The fortuitous combination of the mathematical mind with the viewpoint of the chemist in Willard Gibbs laid the basis for physical chemistry. But such a combination in a single individual is very rare.

4. To avoid repetition and duplication of effort, first by rendering present knowledge readily available to research workers, second by applying clearing house methods to research projects.

5. To stimulate research by emphasizing the importance of specific problems, making special grants, rendering material and facilities as generally available as possible.

6. To furnish a sort of general staff for research which shall work out the plan of attack for major problems, assign the several lines to competent workers and coördinate and focus the whole.

7. To bring home to manufacturers the advantages of research with the view of promoting the establishment of private, corporation, and group laboratories.

8. To make and publish a census of available research facilities in men and equipment.

9. To survey the natural resources of the nation and direct research toward their development.

10. To appraise our great industrial wastes and develop plans and methods for turning them to profitable use.

Councils and Committees Not Effective

There is a nearly universal tendency to attempt the accomplishment of these results through the agency of councils and other forms of committee organizations, the members of which are almost without exception unpaid and involved in other activities which have prior claims upon their time. While such systems of organization may be temporarily efficient and even the only ones immediately available in times of sudden crisis, they do not lend themselves effectively to the slow, constructive work of years without which it is impossible to establish research in its proper place in the industrial and other activities of a nation.

There is danger in an organization chart: danger that it be mistaken for an organization.

The work of committees is notoriously cumbersome and slow. The capacity of a committee to achieve results is usually determined by its chairman and is somewhat below his normal working ability as a unit. The reference is of course to executive capacity and ability. In the initial discussion and formulation of plans and policies committees play an essential and most useful part.

As the committee organization is extended to cover the diverging ramifications of a many-phased activity the inherent weakness, for executive purposes, of this form of organization becomes increasingly apparent. More and more power must be developed by the central body to overcome the inertia of the augmented mass. The whole may ultimately break down from its own weight.

Evolve Permanent Organization

It appears then that we may have still to evolve a permanent, coherent and progressively effective form of organization for the promotion and coördination of research. This may perhaps appear in the shape of a great foundation closely affiliated with the government, the universities, the technical societies and the industries, which shall have its broad policies directed by a board, wholly divorced from politics, yet intimately in touch with the trend of science and the needs of industry, and which shall depend for the execution of its plans upon a permanent executive scientific staff.

Any permanent research structure of national dimensions must of course have its foundations in the universities and technical schools. Unfortunately in this time of greatest need these institutions are seriously handicapped by the very generosity of their response to the demands already made upon them. In the scientific departments the instructing staff has been heavily drawn upon for special service and those who remain are carrying a greatly increased burden. Students are distracted by war interests and are constantly being diverted into military activities.

While recognizing the exigencies of the period and applauding the splendid response of American institutions of learning, it may not be ungracious or premature to indicate some of the directions in which these institutions must ultimately move if they are finally to meet the augmenting demands for research and for graduates fitted to cope with industrial research problems.

It is beginning to be recognized that there is no valid distinction between scientific research and industrial research. Both employ the same methods and the same equipment. The demands of either may involve and tax the highest intellectual faculties, and industrial research frequently necessitates that nicety of refinement and subtlety of attack which characterizes the highest scientific effort. There remains only the shifting and uncertain line of demarkation which may indeed be found in motive. In the selection of thesis subjects and minor research problems greater prominence may therefore well be given to those having a direct industrial application.

Industry must, however, continue to look to the higher institutions of learning for the determination of fundamental facts and constants, the development of theory and the establishment of general principles. Any adequate response to this demand requires that professors and assistants should have far more time available for research than is now at their disposal. They must have some substantial measure of relief from routine and administrative detail. They should and undoubtedly will have more direct contact with the industries. As a consequence more and more of them will undoubtedly be drawn into industrial positions. This will mean no ultimate disaster to the cause of scientific education provided university authorities recognize the patent fact that the day has come when much larger salaries must be paid and greater distinction accrue to capable men of science who are to continue as professors.

Broader Culture Needed

The expanding recognition of the part which applied science is destined to play in our national development would seem to ensure an adequate supply of scientific students and especially of candidates for degrees in chemistry and chemical engineering. Let us see to it at the start that they are provided with a broader culture than has heretofore obtained in many places, lest they be incapable as scholars of meeting their great responsibilities. Concurrently we must provide means for correcting the recognized deficiencies in their professional training which have been pointed out times without number in the hundreds of papers on the education of the chemist and chemical engineer which have been published during the last few years. Bacon, for example, reports that 70% of the directors of important industrial laboratories express dissatisfaction with the type of instruction which their assistants have received. They find the graduates coming to them ignorant of chemical literature and how to use it, lacking initiative, perspective and sense of proportion, failing in optimism, without knowledge of the simplest industrial equipment. Some of these deficiencies are obviously due to the drying up of inspiration at its source; to the displacement of the quickening influence of master minds by the cut and dried methods of pedagogy. Others, more easy of correction, result from inadequacies of the curriculum itself.

It was with the hope of remedying some of the more

glaring of these that I made the proposals which led up to the foundation of the school of chemical engineering practice of the Massachusetts Institute of Technology. Recognizing that each process of industrial chemistry may be regarded as nothing more than a coördinated series of unit operations like grinding, roasting, leaching, evaporating, crystallizing and so on, and that knowledge of these unit operations postulates the ability to combine them as required, the school established a number of stations at large industrial plants selected for the variety of unit operations carried out within them. Groups of third-year students passed in turn through each of the stations, studying practice and illustrating theory in the plants themselves. The reaction of the course upon the students went beyond all expectations and it is one of the minor disasters of the war that the school was obliged to suspend by the requisition of its teachers and the diversion of its students into war activities.

Since the frontier of knowledge is the starting point of research, the energy of the explorer must be conserved on his way to the frontier. In no way, therefore, can organized coöperation render more effective service to research than by making readily accessible those vast stores of specialized knowledge which research has already accumulated but which still require to be brought into that systematized and orderly arrangement which characterizes science. The research laboratory should be built around a library. These special libraries should be linked together and closely affiliated with the great libraries of the world. Such admirable journals as *Chemical Abstracts* should be substantially endowed, the publication of monographs encouraged and assisted, while systematic reviews and reports of progress covering limited special fields in science and technology should appear far more frequently. The intensive collection of scientific and technical information throughout the world, its codification and its distribution, might well be made a governmental function to an extent not now approached.

The natural place for industrial research is in the laboratories controlled or supported by individual corporations, or which are otherwise for the time being working in their interest, or else in group laboratories maintained by trade associations for the common benefit of their membership. It can only be established firmly on a basis which recognizes that people are in business to make money and that for the long pull personal interest must be enlisted. Those of us, therefore, who believe that every waste that is prevented or turned to profit, every specification which gives better control of raw material, every problem solved, and every more effective process which is developed makes for better living in the material sense and for cleaner and more wholesome living in the higher sense, can render no more effective service than by aiding the American manufacturer to understand what research is, what it costs, why it pays.

Tests Give New Information on Concrete Behavior

Abstracts of Some of the Papers Presented at the Meetings of the American Society for Testing Materials and American Concrete Institute

Valuable data on concrete strength, wear and manufacture were included in the papers delivered at Atlantic City last week at the meetings of the American Concrete Institute and the American Society for Testing Materials. Of the papers abstracted below that by Captain Edwards on proportioning concrete was a Testing Materials paper, the remainder were presented to the Concrete Institute.

Proportioning Concrete From Surface Areas of Sand

That the strength of cement mortars, and consequently of concretes, is dependent upon the quantity of cement in relation to the surface areas of the aggregates, consistency and physical qualities being equal, is the novel theory advanced by Capt. L. N. Edwards, U. S. E. R., in a paper presented to the joint meeting. Captain Edwards' theory is substantiated by a most elaborate and painstaking series of experiments in which the number of sand grains per gram, over 125,000 in some cases, were actually counted for many samples. The long paper contains much other valuable information on concrete composition, but its main purpose is to demonstrate that as the strength of mortar is primarily dependent upon the character of the bond existing between the individual particles of the sand aggregate, the optimum quantity of the cementing material depends upon the total surface area of the sand. Accordingly a number of sands were counted as to grains, and a mortar made from each on a standard basis of cement to sand area, that area being figured from the number and size of the sand particles. It was found that mortars mixed on this basis, though varying in cement-sand ratio from 1: 1.12 to 1: 3.11, gave compressive strength of surprising equality.

As a practical application of the method Captain Edwards stated that diagrams could readily be made showing the relation between granularmetric analyses of sands and their surface areas. To do this actual counting of particles would have to be made at the beginning. With these diagrams the proper quantity of cement for any given sand could readily be taken off.

In the discussion Prof. D. A. Abrams of the Lewis Institute at Chicago, pointed out the resemblance in ultimate results between Captain Edwards' method and the "fineness modulus" method he has developed. In this method an aggregate is passed through a fixed number of sieves and the percentage passing through each sieve noted. These added up give what is known as the "fineness modulus" and it has been found that strength of concretes, conditions of material, water content and mixing being equal, is dependent upon this modulus. That is, the sum of the aggregate gradations is critical and not the distribution of these grada-

tions along some such line as the Fuller standard curve. The method has been tested in a number of practical applications to field aggregate and is proving successful.

Nathan C. Johnson stated that he considered that in effect the surface area of aggregate was in effect a function of the sieve analysis and that probably Captain Edwards' method could be utilized by an application of the latter instead of requiring the laborious investigation into the actual number of particles. He called attention to the enormous quantity of such particles in a cubic yard of concrete—running up into the two hundred billions—and said that proper mixing of concrete so as to thoroughly scour the sand particles clean and insure their juncture with cement particles would undoubtedly result in a stronger concrete than is now common. A. T. Goldbeck (Office of Public Roads) called attention to the limited application of a similar surface area method used by himself some years ago with success and P. H. Bates (Bureau of Standards) said that the principle was an old one in ceramics.

Long Time Tests on Slag for Concrete Aggregate

TESTS on the value of blast-furnace slag for the coarse aggregate in concrete have been started in Pittsburgh. The tests will extend over a five-year period. P. J. Freeman, of the Pittsburgh Testing Laboratory, describes the first year's results in a paper. The most important feature of the investigation is that slag coming from furnaces many hundreds of miles apart, varying quite widely in chemical analyses, and also varying considerably in weight per cubic foot, do not vary in strength in proportion to either the weight or the percentage of any chemical constituent. Tests will be made at the end of two weeks, one month, three months, six months, one, two, three, four and five years. Investigation is to be made upon the crushing strength of cylinders using air-cooled blast-furnace slag, limestone, granite, trap rock and gravel, and of coarse aggregates in the concrete. A determination of the corrosive tendency of sulphur in slag is to be varied by an investigation at various times of the corrosion of embedded steel, and study is also under way to ascertain the effect of sulphur and other elements on the durability of concrete. The relative strength and durability of concrete made of high-magnesia low-lime slag and low-magnesia high-lime slag are also to be tested.

Aggregate is Critical Element in Fire Resistance of Concrete Columns

TESTS of reinforced-concrete columns under simultaneous load and extreme heat have been made by the United States Bureau of Standards at its Pittsburgh laboratories. In a paper entitled "Fire Tests for Concrete Columns," Walter A. Hull, of the bureau, indicates that the results so far obtained show beyond doubt that the design of a reinforced-concrete column, that is, the amount and disposition of the steel, is not nearly as important a factor in fire resistance as is the nature of the aggregate. Gravel, particularly the Pittsburgh gravel with which the tests were made, proved to be poor material to withstand load tests under high temperature.

Tests were made on 18-in. round and 16-in. square columns. Round columns of 12-in. diameter were made from one aggregate with one type of reinforcement. Two kinds of reinforcement were selected; 2% vertical steel with 1% spiral steel and 2% vertical steel with no spiral steel. For comparison, columns without reinforcement were included. In all columns the steel had a covering of 1½ in. of concrete and in some a plaster coating was applied. This latter served admirably to protect the columns against heat failure. Pittsburgh river gravel, of a maximum 1½-in. diameter, and Pennsylvania high-calcium limestone, ¾-in. diameter, made up the aggregate. Three columns of each kind were made up, giving check fire tests with one cold test.

Tests were made in a special apparatus having a gas-fired furnace capable of raising the temperature to 1200° C., and of giving a load of 600,000 lb. If the column stood the 600,000-lb. load hot it was permitted to cool and transferred to a 10,000,000-lb. machine and tested to destruction.

In the gravel-concrete columns there was a marked tendency in the concrete to break up early in the fire tests and for the resulting slabs to separate and fall off, exposing the load-bearing portion in the column. The steel was exposed. Round columns with vertical reinforcement only suffered much less than those with spiral steel. Square columns vertically reinforced chipped badly. Round columns with no reinforcement showed an intermediate behavior between that of round columns with spiral steel and those without such steel. Strength tests made at the end of the four-hour fire test showed the gravel-concrete columns with spiral reinforcement had retained from less than 15% to approximately 18% of the strength of the column test without exposure to heat. A round column with vertical rods and no hooping retained approximately 30% of its strength; square columns from 15% to 20%, and a plain column approximately 23%. In the limestone column there was no surface cracking during the fire test, either in the square or the round type. The columns after cooling showed a strength approximately 77% of the maximum of the unfired column. Each of the vertically reinforced columns, both round and square without spiral steel, tested while hot at the end of the fire test, showed a maximum strength approximating 50% of that of the unfired column of the same class.

Effect of Time of Mixing on Strength and Wear of Concrete

Results from a series of tests made by Prof. D. A. Abrams (Lewis Institute, Chicago) show that little additional strength can be attained by mixing concrete over 1 min. The tests were most elaborate and involved the investigation of 3800 specimens. Examination was made on the compressive strength of 6 x 12-in. cylinders and on the wear, in a rattler, of specimen cubes, the concrete varying in consistency, cement content and grading of aggregate.

It was found that while there was a certain increase

(Concluded on page 53)

Edgar Marburg
1864–1918

EDGAR MARBURG, professor of civil engineering in the University of Pennsylvania, secretary-treasurer of the American Society for Testing Materials, died in Philadelphia, June 27. He suffered a nervous breakdown more than a year ago, from which he never fully recovered, though his condition did not again become serious until two months ago.

Graduated from Rensselaer Polytechnic Institute in 1885 with the degree of civil engineer he served successively in the engineering departments of the Keystone Bridge Co., the Phoenix Bridge Co. and the Edge Moor Iron Co., and the Carnegie Steel Co., his transfer from company to company being due to a determination to secure a well-rounded experience early in life. In 1892 a committee of eminent engineers, having been asked to name a candidate for the headship of the civil engineering department of the University of Pennsylvania, suggested Edgar Marburg, then working in Chicago for the Carnegie Steel Co. He accepted the position, and at once gave evidence of the organizing ability, grasp of situations and ability to get things done for which he later became distinguished. He had already displayed in ample measure his thoroughness and excellent engineering judgment.

Early Days of the A. S. T. M.

In 1898 there was formed at Philadelphia the American Section of the International Association for Testing Materials. Professor Marburg was one of the organizing group; others in the little party were Mansfield Merriman, Henry M. Howe, Charles B. Dudley, W. K. Hatt, Richard Moldenke, R. L. Humphrey, W. R. Webster and Robert W. Lesley. The new section, composed as it was of extremely able men, found much to do but with the hampering condition set by the aims of the parent society made only fair progress. The real accomplishment was the development of a clear conception of what American needs in this field really were.

Early in 1902 Professor Marburg was elected secretary of the section. Within a few months he had written to the executive committee such a clear statement of the purposes which an American testing society should fulfill that the committee decided to recommend the termination of the existence of the section as such, and the establishment of a new society, which would hold membership as a body in the international association and, while affiliated and forming the American branch, be free to set forth its aims independently and adopt its own mode of procedure. The plan for the new society was drawn up on the lines laid down by Professor Marburg—which are those followed today—and the new body formally launched as the American Society for Testing Materials in June, 1902.

Dr. Charles B. Dudley was the president of the society, and Edgar Marburg its secretary-treasurer. A happier combination could not have been found. Both were men of vision, of courage, of sterling standards. They set a high goal, and under Marburg's effective handling an organization quickly rounded into shape and results began to show.

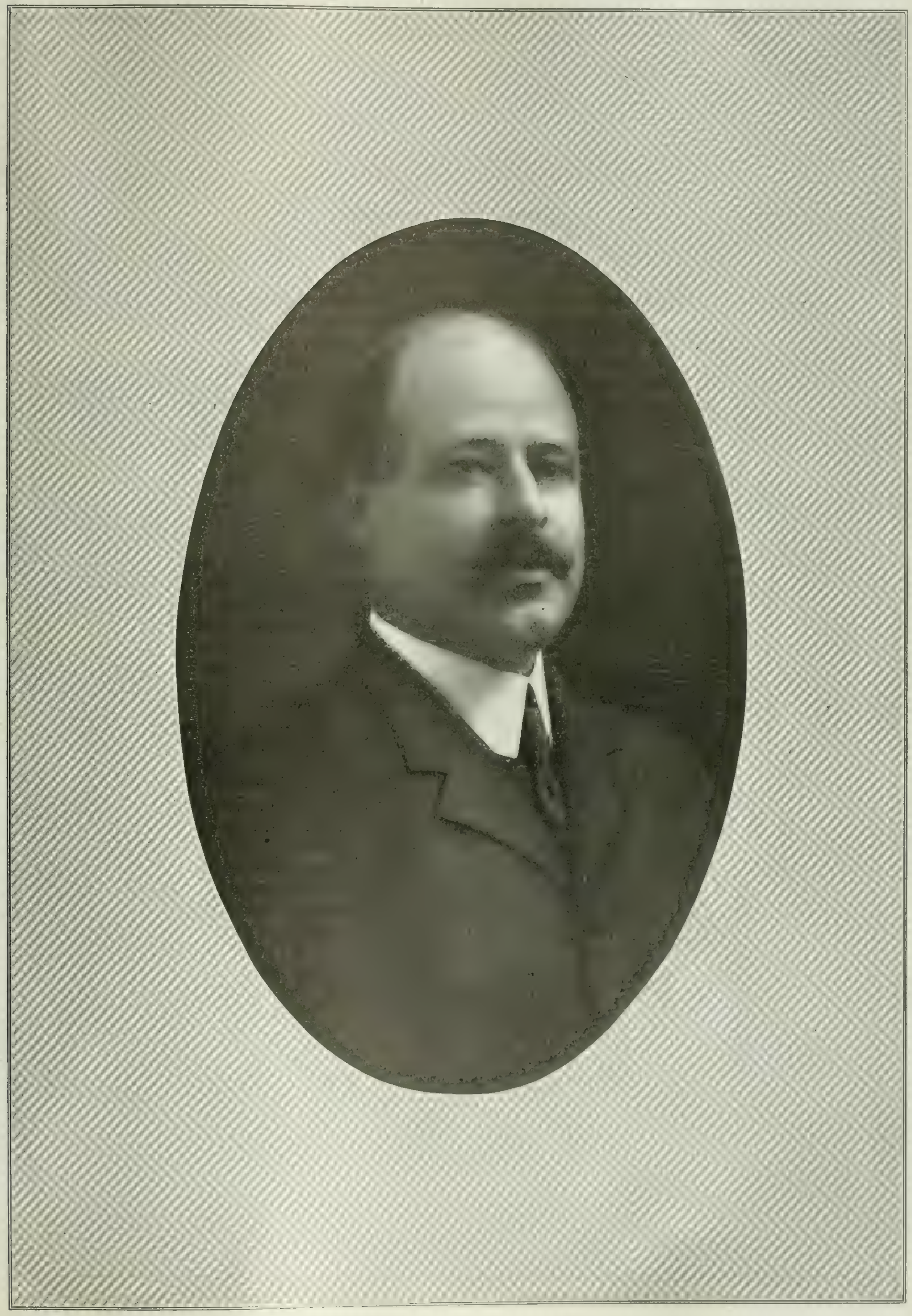
Dudley and Marburg, Marburg and Dudley drew support from quarters hitherto uninterested. The membership increased rapidly, a membership of strong men, capable technically, with a strong realization of the need for results, responding, too, to the high ideals upon which the leaders were constantly placing emphasis. The body as a section of the international had naturally inclined toward the purpose of its parent—the development of the science and methods of testing. The new organization was interested in methods only as a means; its primary object was the development of specifications, and more specifically still the development of specifications which while giving the user materials suited to his needs were at the same time commercially practicable. That this might be accomplished it was laid down as fundamental that both producers and consumers were to be represented on committees, but that the producers should not be in the majority. This procedure marks the society as unique and the great success of the method is full proof of the vitality of the underlying idea.

What the success of the society has been need not be recounted in detail here. Suffice it to say that the membership is now 2261, the annual receipts $39,687, while the standards adopted number 107. One steel producer, to quote only one field, estimates that 75% of all steel bought in this country is purchased either under A. S. T. M. specifications or under slight modifications thereof. While the strongest of the early work was in steel, practically every major engineering material is now covered—the non-ferrous metals, protective coatings, cement, clay products, gypsum, asphalts and tars, and even rubber. So excellent has been the work that the Government has in the last two years translated certain of the specifications into foreign languages, thus making the society work a helpmeet in the extension of American foreign trade.

Professor Marburg's Influence

What Marburg's influence has been on the society's work cannot be exaggerated. Until Dr. Dudley's death in 1909 the two were as one in directing the body. By that time the principles on which the organization was based were well established, but the very rapid extension of the society since then has raised grave problems which have made the conduct of the organization no less trying than in its earlier years. Supported, it is true, by strong men, Marburg nevertheless bore the brunt of the handling of these situations, and it can be truthfully said that the society was his—his in the sense that his personality more than that of any other individual was determinative of its methods and of its work. His organizing genius, his sound judgment as to the problems to be attacked, his thoroughness, his honesty, are indelibly stamped on the organization, its committee work and its publications.

A good fighter, he was nevertheless openminded. Both qualities sprang from his high standards of honor. Many differed with Marburg; no one ever doubted his honesty. More than once important points, bitterly contested, were settled quickly because he expressed his



view. Time and again tense situations were relieved by his word.

His honesty, too, was the quality which saved him from difficulties which ordinarily would come to a man of his temperament. He would hardly be called a diplomat. He was too impetuous, too anxious to get results, too full of energy to use indirect or slow methods.

His energy and enthusiasm, qualities which counted heavily in his work both at the university and in the society, are responsible for his untimely end—he was but 54 years old. He threw himself with vigor into every task he took up. He never saved himself, and his strength was unequal to the strain he willingly imposed.

As a Teacher.

While the profession knows him chiefly for his work in the society, he was no less successful as a teacher. Strict in his handling of students, he turned out thorough men, imbued with high ideals and a sense of their professional responsibility. No man who was in school under the "Duke," as they fondly called him, but will feel that he has suffered a heavy, personal loss. In conjunction with his colleague in mechanical engineering, the late Prof. Henry W. Spangler, he deserves credit for having planned the excellent engineering laboratories of the university.

The principal of his writings was his book on "Framed Structures and Girders," published in 1911. This volume, on stresses, was to be the first of three under the general title named, but he never found time to complete the work. For years he was a contributor of editorials to the *Engineering Record*, and was one of that journal's most valued advisers.

He was a member of the American Society of Civil Engineers, past president of the Engineers' Club of Philadelphia, past secretary of the Society for the Promotion of Engineering Education, and past chairman of the committee on science and arts of the Franklin Institute. He was honored with the degree of doctor of science by the University of Pennsylvania and of doctor of laws by Franklin and Marshall College.

Few men have done more for American engineering than Marburg. None has carried to his grave greater affection or more sincere admiration. His departure creates a great void in the engineering world.

E. J. M.

Appreciations.

[The following appreciations are from men who had the privilege of working with Professor Marburg and of observing him at close range.—*Editor.*]

"Few men have accomplished as much as Edgar Marburg. Through the sixteen years he acted as secretary-treasurer, much of the wonderful vigor and remarkable accomplishments shown by the American Society for Testing Materials has been due to his energy, vision and character. While his personal work on the technical committees of the society has been large and fruitful, by far his greatest contribution is the influence which he has exerted on the spirit and policy of the society and the relations which should control in the organization and its committees. Particularly has his insistence upon fairness and justice, his aversion to commercialism, and his conscientious guarding of the good name of the society had a marked effect on the organization itself and on the business world. It cannot be said too strongly that he has exercised a strong and far-reaching influence upon that part of engineering which deals with the materials of engineering and business relations connected with their manufacture and purchase.

"His distinguished service in this field should not be permitted to obscure his notable work in engineering education where most of his time and effort has been directed and where, although perhaps less well known to engineers generally, his accomplishments are of themselves worthy of the highest commendation."—*A. N. Talbot, president, American Society of Civil Engineers, past-president, A. S. T. M.*

"That the executive Committee (of 1902) chose wisely and well we all know. The happy selection made at that time has been a source of great satisfaction to those who made it. Much of our success has been due to Doctor Marburg's devoted interest in the society and its work, his untiring energy, his rugged honesty, his fair-mindedness, and his jealousy of its good name. Those of us who, by our good fortune as officers and members of the executive committee, have been closely associated with the Doctor are in a position to realize more fully than is possible for others how many rocks and shoals have been avoided by his keen foresight."—*A. A. Stevenson, past-president, A. S. T. M.*

"Professor Marburg was a close friend to me, and just now my dominant feeling is one of profound loss. His energy flowed in many channels—of teacher, author, researcher and organizer, in all of which his unusually critical sense of real values was evident. Several substantial researches on materials and structures were his personal work. He built up a testing laboratory of the first rank at the University of Pennsylvania, from which significant results have come and which has had that helpful contact with technology characteristic of a live laboratory. The higher standard which his influence imposed upon the work of testing materials is of chief note in an unusually productive life."—*W. K. Hatt, professor of civil engineering, Purdue University.*

"The selection of Marburg as secretary of the American Society for Testing Materials was one of those timely and judicious decisions which have great influence on the development of such an organization. It was apparent to those interested in developing the society that the secretary must have a good knowledge of engineering materials, be well acquainted with the leading men in the engineering field, have a good business training, and be widely known as entirely independent and fair-minded. The selection of Marburg was due to the recognition of his possession of all these qualifications. He was well known as one of the leading structural specialists among the younger engineers, he had a thorough business training with the Carnegie companies, in the course of which he acquired a wide circle of acquaintances, and his position as professor of civil engineering at the University of Pennsylvania was

a guaranty of his independence. When he was chosen, all knew that a good selection had been made, but only those who have seen the society grow from its first inception can fully realize that this development has been very largely due to the wisdom of those who turned its executive management over to Marburg and kept it in his hands ever afterward."—*John M. Goodell, former editor of Engineering Record.*

"Doctor Marburg's chief characteristics were his honesty and his concentration on the objects to be attained. He devoted a life of vigorous and strenuous effort to the American Society for Testing Materials, marked by the greatest and sincerest devotion to the objects of the organization. His work in the society was distinguished not only for his adherence to broad views of the results to be attained in the testing of materials, but also to his able handling of the details of the personal and diplomatic intercourse with the many and varied interests represented."—*Robert W. Lesley, past vice president, American Society for Testing Materials.*

American Concrete Institute Convention

(Concluded from page 49)

in strength and wear from 1 min. to 10 min. of mixing time that the increase was hardly enough to warrant its use economically. Thus there is an increase in strength of about 10% from a ¾-min. mix to a 1-min. mix and an additional increase of 10% for a 2-min. mix. The author therefore concludes that a full 60-sec. mix in the drum is all that should be required.

As to rate of revolution of the drum the studies show that there is a slightly rising curve of strength up to 18 r.p.m. after which the strength decreases so that 30 r.p.m. is about the same as 7 r.p.m. The 18 r.p.m. happened to be the speed recommended by the mixer manufacturer. Other tests showed that both strength and wear decrease with the wetness of the mix but that the relation between strength and wear does not continue uniform. However, curves have been prepared which relate wear, strength and water content, so that for a given condition any two can be predicated from the other one.

The paper contains many valuable diagrams and tables which will appear in the final "Proceedings" of the American Concrete Institute.

Effect of Age and Storage on Concrete Strength

Long-time tests on concrete were reported to both the joint session and to the American Concrete Institute. With few exceptions they show that concretes have little change in compressive strength after the first year or two when stored in air but in a moist medium the regular increase in strength will continue at least up to two and perhaps beyond five years. Prof. D. A. Abrams (Lewis Institute, Chicago) in an American Society for Testing Materials paper gave the results of a résumé of many long-time tests taken from available literature. These all showed a progressive increase in compressive strength up to one or in some cases two years with a slight falling off or continuance of strength beyond that period. When plotted to logarithmic curves, however, these data showed a characteristic straight line curve reducible to a formula with two constants dependent on material, manufacture and storage. The tests are all in compression and Professor Abrams said that the usual briquette tension test is of little value for long-time tests because the shape of the piece is such as to set up tearing stresses after the concrete has completely hardened.

In discussion, P. H. Bates (Bureau of Standards) said that selections of published tests could be made which would show a decrease in concrete strength at and after the five-year period.

Before the Concrete Institute H. F. Gonnerman reported tests made at the University of Illinois on compression cylinders over a period of five years in dry air and under moist conditions. His conclusions are as follows:

1. The strength of the concrete which was stored in contact with moisture increased rapidly up to an age of 1 year; the increase in strength at ages greater than 1 year, although considerable, took place at a much less rapid rate.
2. The air-stored concrete attained nearly its final strength at a comparatively early age and gained little strength with the lapse of time.
3. The concrete which had been stored in air for a considerable time increased in strength greatly after it had been stored in contact with moisture so that further hydration of the cement could take place; the strength of the specimens stored in damp sand 2 years and 8 months after they were 2 years and 4 months old was 1.46 times the strength of the specimens which remained stored in air for 5 years.
4. The strength of the concrete at an age of 7 days for both damp sand storage and air storage was about 70% of the strength at 28 days; at an age of 1 year the strength of the concrete stored in damp sand was about twice as strong as at 28 days and the air-stored concrete was only 10% stronger than at 28 days. At an age of 5 years the strength of the concrete stored in damp sand was about 2.5 times the strength at 28 days and the strength of the air-stored concrete about 1.3 times the strength at 28 days.
5. At ages of 3 and 5 years the strength of the concrete stored in damp sand was about 1.9 times the strength of the air-stored concrete.

New Abrasion Test for Road Materials

In testing stone, gravel and other aggregate for roads in the standard Deval rattler it has been found that a proportionate relation between soft and hard stone could not be determined because of the cushioning effect of the dust which forms in the rattler. Thus the ratio of a soft to medium stone which in the standard test is 1.95 became 2.41 when the dust was removed as fast as formed. To avoid this difficulty Prof. H. H. Scofield (Purdue University) his devised a Deval rattler which has $\frac{1}{16}$-in. openings between the staves to allow the dust to escape. Examples of some of the tests, given in the paper, show a greater range of results and consequent better differentiation of quality than in the regulation test. Professor Schofield presented his conclusions in a paper read before the American Society for Testing Materials convention this week.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trained Nurse and Field Hospital Reduce Labor Turnover

HURT men return to work sooner, damage suits are less frequent, serious results from minor wounds are decreased and the morale of workmen is raised, on a large Chicago building job, by a trained nurse and a 14 x 16-ft. field hospital.

About a thousand workmen are employed. The hospital is a room in the corner of a warehouse. It has two large windows; the walls and ceiling have been painted white and the windows fitted with plain wire muslin curtains. The floor is of hardwood, and can be always kept clean easily.

The furnishings of the room consist of one steel hospital cot; one operating table; two instrument stands (of enameled steel); one porcelain lavatory (hospital model); one hospital water receptacle; four glass jars (containers for sterilized bandages, absorbent cotton and swabs); one desk and desk chair, and two enameled chairs.

The accessories are two stretchers; one mattress and pillow; one wool blanket; six sheets and six pillow cases; two dozen hand towels; two simple forceps; one curved and one straight scissors, disinfectants, simple drugs, etc. The cost of the outfit was about $300. The wages of the nurse are about those of a skilled workman, say $30 a week.

In the operation of this hospital the nurse receives all cases from the job whether sickness or injury cases. She gives the aid which is necessary. If it is a surgical case, she superintends the preparing of the patient for the surgeon and the hospital. For minor cuts and bruises, she gives a dressing and either sends the patient back to work or to his home for a short period, as she deems best. These minor cases also report to her daily for attention and inspection, so that there is no chance for dishonest employees to take advantage of the employer.

The records show that from 45 to 100 cases of one kind or another are treated here daily. These include everything from a sliver in the hand to fractures of limbs, broken heads and surgical dressings. A complete set of records and reports of all cases and treatments are kept, and all fatal and accident liability reports which are required by the Government and the state are handled.

Low Benches Eliminate Stooping When Assembling Column Spirals

TWO low wooden horses set parallel and fastened together form a convenient bench for assembling column spirals, at the new quartermaster's depot under construction at Chicago. Altogether, 2856 spirals, for columns ranging from 48 in. to 36 in. in diameter, had to be assembled. As is customary, these spirals came

MEN WORK BETTER WITH LOW BENCHES

knocked down and flat, and each had to be "opened out" and have ten ¾-in. rods inserted and wired to the circumferential rods. By means of the bench the men could do their work without stooping, and their output was increased. Incidentally, the 408 columns of the building contained 5½ miles of reinforcing rods. The contractors are the E. W. Sproul Co., Chicago.

Latest Hog Island Pile Record Preceded by Consistent Work

WITHOUT special preparation and working part of the time in a thunderstorm that sent every other workman on Hog Island to cover, Edward Burwell and his colored crew of 11 men drove on June 12 220 piles, averaging 65 ft. long, in 9 hours and 5 minutes. The occurrence of the odd minutes did not result from a second thundershower. Burwell stopped because he had driven the last pile in shipway No. 46, which was also the last pile in the 10 ways of group No. 5, the section of the Hog Island plant being built by the Arthur McMullen Contracting Company.

The record believed to have been established was not, according to officials of the American International Shipbuilding Corporation, accomplished at a sacrifice of efficiency, but was the star performance of one among many gangs which have all shown extraordinary averages throughout the work. In support of this are cited the performances of William Gordon of the Hugh Nawn Contracting Co., 140 piles 60.6 ft. long in 9¼ hours on May 25; of Robert Sutton, who drove 165 piles 62 ft. long for the Raymond Concrete Pile Co. in the same time on May 10, and the recent work of a night crew of 24 men which cut off 327 piles with crosscut saws in 9 hours. Moreover, Burwell's crew averaged for six months from January to June nearly 43 piles a day, the average length of which was 58½ feet.

Burwell has been driving piles 15 years and estab-

COLORED CREW OF EDWARD BURWELL WHICH DROVE 220 PILES ON JUNE 12 AT HOG ISLAND

lished his record as a direct result of the rivalry which began with earlier claims for the honor. His equipment consisted of a Vulcan No. 1 hammer and a skidding-rolling machine, with a three-drum, 9 x 10 hoisting engine, both hoist and hammer being driven by compressed air. Average conditions prevailed. A good supply of piles was available, but no special preparation had been made for their piling or placing. From 7 a. m. until 12 m. 127 piles were driven. Thirty minutes were taken for lunch. At 2.30 p. m. 175 piles were in and the yard's standing record broken. During over an hour of this time Captain Burwell and his crew, stripped to the waist, worked through a drenching thunderstorm, as stated. At 4.35 p. m., with 220 piles driven, a total of 14,260 linear feet for 9 hours and 5 minutes, which is believed to be a world's record, Captain Burwell ordered the driving stopped for the excellent reason that the last pile had been driven.

Captain Burwell's log, for the day on which the record was made, reproduced herewith, presents some interesting details.

LOG OF RECORD DAY'S WORK.

7.00 A. M. — 8.00 A. M. .... 27 piles.
8.00 A. M. — 9.00 A. M. .... 23 piles.
(Delay 4½ minutes due to broken steam line; raining very hard from 8.15 a. m. to 10.00 a. m.)
9.00 A. M. — 10.00 A. M. .... 28 piles.
10.00 A. M. — 11.00 A. M. .... 22 piles.
(Delay 8 minutes due to pile fall breaking.)
11.00 A. M. — 12.00 A. M. .... 27 piles.
12.00 Noon — 12.30 P. M. .... lunch.
12.30 P. M. — 1.30 P. M. .... 25 piles.
(Heavy rain with electric showers from 1.25 p. m. to 2.50 p. m. 1.25 p. m. to 1.40 p. m. air pressure dropped considerably, which held up hammer.)
1.30 P. M. — 2.30 P. M. .... 23 piles.
2.30 P. M. — 3.30 P. M. .... 23 piles.
3.30 P. M. — 4.35 P. M. .... 22 piles.
9 hours and 5 minutes .... 220 piles.

Officials and inspectors of the American International Shipbuilding Corporation and of the Arthur McMullen Contracting Co. were interested spectators of this pile-driving feat and the figures and data have been carefully checked and recorded.

Lever and Street Car Pull Sheet Piles

IMPROVISED methods of pulling sheet piles were used at the Macomb St. bridge in Mt. Clemens, Mich. The circular cofferdam for the pivot pier had two rows of 9-in. T-girder rails. Those of the outer row were placed in radial position and alternated with heavy planks driven between the webs. Those of the inner row had their webs in a circumferential line, the heads and flanges being connected by lugs and clamps.

To pull the outer rails, a heavy timber was rigged as a lever, with its short end hooked to a hole in the rail web while four to six men on the long end kept the lever "teetering" until the pile came loose. At the same time a man with a sledge hammer struck the rail to help jar it free. When it was loosened, it was pulled out by means of a chain hoist hitched to the bridge.

For pulling the inner ring a work car of the electric interurban railway was used. A rope hitched to the car on the bridge was led through a snatchblock hooked to the handrail, then down through an open panel in the cement sidewalk to a snatchblock at the water's edge and then back to the cofferdam. This rope was attached to a ring fitted to a hole in the web of the rail. By moving the car forward the rail was pulled sideways and torn away from its next neighbor. When thus loosened it was pulled up by means of the chain hoist and lowered upon a raft. Men with rail tongs carried it on a working platform to the shore.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Testing Materials Convention Marked by Record Attendance and War Activities

Reports on Steel, Brass and Industrial Research Prominent—Late Sessions Shocked by Death of Secretary Marburg

War's impress gave unusually serious character to last week's annual convention of the American Society of Testing Materials at Atlantic City, and hurried its activities in spite of a long program. The total attendance exceeded even the high figure of 569 reached last year; nearly 580 men registered during the four days, June 25-28. Some of this large attendance may be chargeable to the fact that two other societies met in Atlantic City at the same time, the American Institute of Electrical Engineers and the American Concrete Institute. The latter joined with the Testing Materials Society in one session, when tests of concrete were discussed.

Word of the death of Prof. Edgar Marburg, secretary of the society since its foundation in 1902, reached the members while the evening session of Thursday, June 27, was in progress. It came as a profound shock, despite general knowledge of the fact that Prof. Marburg had been dangerously ill for some weeks. After Past President A. A. Stevenson had announced the news, a committee of three men long identified with the most important activities of the society was named to draft a memorial resolution. The text of this resolution is printed on page 59.

As in prior years, the society's deliberations were marked by active attention to the work in hand, but with the war spirit superadded to the technical purpose. Many members being engaged in war service, and much of the committee work having some contact with war conditions and requirements, the reports were disposed of in quick, matter-of-fact fashion, and the members concerned with a given subject left the convention soon after that subject was closed.

Chemical Limits For Steel Modified Temporarily

An important relaxation of the chemical limits in steel specifications was prominent among the war contacts of the meeting. The steel committee last January considered the newly-arisen difficulty of holding phosphorus and sulphur down to the limits fixed in the standard specifications, and discussed the advisability of raising the limits while conditions remain as they are. However, it recommended, instead of change in the standard specifications, that buyer and seller make the desired modifications by special contract, and that all parties be requested to keep full records of analyses and qualities of material, as data for future revision of the specifications. Subsequently it developed that this conclusion should be reconsidered. At the June meeting of the committee, therefore, the amending clause given below was voted upon and adopted; it received the sanction of the society at the annual meeting. It reads:

"In view of the abnormal difficulty in obtaining materials in time of war, the rejection limits for sulphur in all steels and for phosphorus in acid steels shall be raised 0.01% above the values given in the specifications. This shall be effective during the war and until otherwise ordered by the society."

This clause is to be printed under the title of each specification containing chemical requirements *except* those for boiler and firebox steel and those for boiler rivets. Further, as regards sulphur the note shall not apply to the specifications for carbon steel car and tender axles.

Symposium on Industrial Research

Industrial research, also a war subject because war experiences here and in England have centered attention on the subject, was made the theme for a special session. The importance of organized action in such research was emphasized strongly by prominent students of materials and testing. An abstract of two of these addresses appears on page 45 of this issue.

Munitions manufacture troubles in recent times brought the season-cracking of cold-worked brass again to the fore. Cracking of cartridge cases has caused some loss. The prior experiences with similar cracking of brass and bronze parts in the Catskill Aqueduct and in a Minneapolis filter led to study of causes and search for a cure at the Bureau of Standards and elsewhere, and these studies were further energized by the new troubles. Annealing as well as certain cold-distortion treatments have been found to be remedies.

Abstracts of several interesting discussions of the subject will be given in a later issue.

American Engineering Standards Committee

Progress made since the inception of the American Engineering Standards movement last summer led recently to the formulation of a final draft of a constitution for a standards body in which the principal technical societies

(Concluded on p. 58)

Many Ships to be Launched Today from Government Yards

American shipyards, operating under the United States Shipping Board and Emergency Fleet Corporation, will celebrate the July 4th holiday this year by launching 89 ships, having a total dead weight tonnage of 439,886, according to a statement issued by the Shipping Board. These launchings amount to about one-third more than the production of tonnage from American shipyards during the fiscal year 1915-1916 and exceed by 42,050 deadweight tons the launchings for the entire year of 1901, which was the record pre-war year in American shipbuilding.

The launchings set for today will exceed the amount of tonnage launched during the month of May by more than 95,000 dead-weight tons, according to present expectations. The 89 ships which are to be launched today include 37 steel vessels and 52 wooden ships of various designs. It is even expected that the number of 89 may be exceeded.

Thirty-Nine Killed in Collapse of Building at Sioux City

Thirty-nine lives were lost and $100,000 property damage was done when a four-story brick building collapsed in Sioux City, Iowa, at 1:30 p.m. June 29. The building was forty years old and a portion of it was undergoing remodeling. The first floor had been lowered about 10 in., but this work is reported to have been completed and the jacks removed.

The adjoining building was completely crushed by the falling walls, and fire broke out immediately, accompanied by several explosions. Reports vary as to whether the principal explosion occurred before or after the collapse, but the most reliable evidence is said to indicate that the explosion followed the failure of the building and that the walls appear to have crumbled at the base, causing the building to settle.

Engineers' Advisory Board to Help Employment Work

Fifteen engineers met June 28 in Chicago in conference with the heads of the new division of engineering, United States Employment Service, to define an engineer and an engineering draftsman, for classification purposes, also to discuss ways and means of getting a complete register of engineers. Several definitions were submitted, in each of which there seemed to be a common thread of service to humanity and an attempt to modernize Tredgold's defi-

nition. The outcome was instructions to a committee consisting of E. T. Perkins, Isham Randolph and Prof. C. F. Harding to edit a one-sentence definition embodying the following: An engineer is one who is qualified by education and experience to plan, design or direct engineering work with economic efficiency, and capable of organizing and directing men, to the end that the physical properties of nature may be adapted to the needs of mankind.

It was decided that a survey of the needs of industry for engineers and the members now employed be obtained through coöperation with the surveys undertaken by the War Industries Board. This will be tried out first in Zone No. 9, Illinois, Indiana and Iowa. Simultaneously with this work, registration lists obtained by engineering societies and universities are solicited and will give the division something on which to start. The necessity for the census data on supply and demand is pressing at this time, as rumors are rife to the effect that four positions are open to every engineer while men are unable to find places commensurate with their ability.

W. H. Finley, president of the Chicago and North Western Ry. Co., chairman of the conference, was authorized to appoint a permanent engineers' advisory board to consider means of handling classifications and furthering the registration.

Federal Control of Hudson River Bridge Permits Upheld

The Supreme Court of New York June 28 handed down a decision affirming the right of the New York Central R. R. Co. to build a Hudson River bridge at Castleton on the plans approved by the Secretary of War, regardless of the action of the New York legislature requiring the bridge to be built with a 1000 ft. span. The court declared that the primary Federal jurisdiction over navigable waterways cannot be interfered with by any state, and, the Federal authorities having established the restrictions which shall control any project, the state has no authority to impose any other restrictions.

Chief of Construction Division Becomes Major General

Richard C. Marshall, Jr., chief of the Construction Division, U. S. A., is included in the list of 43 major generals appointed June 28 by Presidential nomination. General Marshall has been connected with the construction work of the army ever since the beginning of the war, first as assistant to Brigadier General Littell, of the cantonment division of the Quartermaster Department, and later as head of the construction division when the cantonment division was changed to the latter some months ago. He is a Virginian, and entered the service from civil life. He is 39 years old.

Concrete Institute Meeting Emphasizes Ships Housing and Building

Lively Interest Displayed in Wartime Measures Though Average Attendance Was Decreased

With an attendance cut almost to half that of the past few years, the postponed annual meeting of the American Concrete Institute at Atlantic City, June 27-29, made up in interest what it lacked in attendance. Even with the comparatively small average attendance, the last session of the seven crowded a large assembly room in testimony to the great interest among engineers in the subject of concrete ships. The meeting had been postponed from its regular time of February because of the rail congestion at that time. It took place at the Hotel Traymore, at the same time as the meeting of the American Society for Testing Materials, with which a joint session devoted to concrete was held. At this session, alternate papers of the two societies were presented and though almost everybody in attendance belonged to both societies, the discussion seemed to take on unusual vigor, testifying to the wisdom of the joint session.

Committee work during the past year was almost at a standstill, owing to the wartime activities of the various committee members. Only two committees presented any changes in the standards of the institute. The Committee on Roads and Pavements made some minor changes in wording, which were adopted by the convention and sent to letter ballot. The committee on concrete sewers presented a revised report for adoption, but on account of many criticisms of details of the concrete provisions in the specifications the meeting voted to return the report to the committee for further revision. The reports of the other committees were entirely on progress.

Concrete Ship Interests Many

The session on concrete ships was made doubly interesting by a number of moving pictures, showing among other things the launching of the "Faith" in San Francisco, the famous upside-down launching of the little Norweigian boat and a number of the detailed operations in one of the United States Government concrete-ship yards. These latter were taken by the concrete ship department to be shown to the designers in the home office, so that they might be acquainted with the difficulties of field work, and were not intended for general display, but on account of the intimate detail they showed of the work were much appreciated by the audience.

The report of the committee on concrete barges and ships, which is a joint committee of the American Concrete Institute with the Portland Cement Association, was published in *Engineering News-Record* at the time it was presented to the latter association last fall. It is now somewhat out of date, so quick has been the development of the concrete-ship idea, but it is valuable as an indication of early investigations and for the design of the standard barge which it contains.

The main paper of the evening was entitled "Principles of Design of Concrete Ships," by R. J. Wig, chief engineer of the department of concrete ships, and S. C. Hollister, engineer of design. It is a remarkably good exposition of the elaborate details required for the design of ships and particularly of concrete ships, and it outlines the thorough study that the concrete ship department has made in the subject. This paper, which was read by Mr. Wig, took up a large part of the evening and was followed by the moving pictures referred to. It was preceded by a historical paper on concrete ships by J. E. Freeman of the Portland Cement Association, and was followed by a brief presentation of a paper by L. L. Livingston of the L. L. Brown Co., of New York, on concrete barges. This paper described in some detail the reinforced-concrete barge built by the company last year at Peekskill, N. Y., a deck barge intended originally to be placed with a cement gun, without the use of interior forms. This practice was carried out for the lower section, but was discarded for the upper work in favor of poured concrete.

Another paper by A. G. Monks, of the firm of Monks & Johnson, consulting engineers for the Liberty Shipbuilding Co., which holds a Government contract for concrete ships, described the Government yard at Wilmington, N. C. The paper was read only by title. Discussion on concrete ships was comparatively light, the audience very evidently being there in search of information and not to give it.

Concrete Housing Discussed

Another session was devoted entirely to the subject of concrete houses. This session was in charge of the committee on industrial concrete housing, of which Leslie H. Allen, of the Aberthaw Construction Co., Boston, is chairman, and consisted of the presentation of the report of the committee and of various papers by the different members of the committee, taking up the different ends of the housing problem.

A final paper by Lieut. K. H. Talbot on the "Method of Construction of Concrete Houses" gave full and valuable information on the different kinds of forms, methods of placing concrete

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Testing Materials Convention

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of the country shall coöperate. This draft was laid before the society through the executive committee, and was approved for submission to letter ballot of the entire membership on the question of the society's participation. Past President Stevenson represented the American Society for Testing Materials in the work of preparing the constitution.

Pipe threads were taken up by the society several years ago, and a committee was appointed to join with other societies in revising the existing thread standards. As this subject is out of the field of materials, question arose later whether it came within the proper scope of the society's work. The final conclusion was expressed in a report of the pipe-thread committee recommending that the subject be abandoned and left to the American Society of Mechanical Engineers, to whose field it belongs. This recommendation was approved by the meeting.

Specifications for Metals

Outside of the significant change in sulphur and phosphorus limits already mentioned, the steel committee, largest and most active of the society's committees, reported fully as much work as usual, in study and revision of standard specifications. With one exception, all recommendations concerned the revision of existing standards or the promotion of tentative specifications to the rank of standard, and the meeting gave its approval with virtually no discussion.

Urgent war conditions led to preparing the single new specification, for cast-steel anchor chain. A threatened shortage in wrought chain led to active study in several iron works of the possibilities of cast chain, and highly successful results were attained. The committee then made tests of the new material and drafted specifications to govern its acceptance, which were laid before the society's meeting and accepted as tentative.

Revisions of wrought-iron specifications were also approved by the meeting. The committee on cast iron recommended increasing the sulphur limit in light gray-iron castings from 0.08% to 0.10%; this was approved, and the committee's tentative soil-pipe specifications were approved as standards, subject to letter ballot.

In the field of non-ferrous metals also a remarkable amount of work was done. Regrading of railway bearing metals gave rise to some discussion. Eight tentative specifications were advanced to the grade of standard, subject to letter ballot. New tentative specifications were presented on cartridge brass and disks, naval brass rods, bronze bearing metals for turntables, and babbitt metals, and for methods of analyzing manganese bronze and gun metal.

Nothing new was reported in the fields of cement and reinforced concrete. The cement committee declared itself not yet ready to recommend further action on the tests for compressive strength of mortar which were accepted as tentative two years ago.

On building tile, the committee in charge reported progress, results of tile tests showing crushing strengths of 1000 to 5000 lb. per square inch, and stated that tests of tile walls are in progress.

The committee on refractory bricks reported further work on test methods for refractories.

Acrimonious discussion arose when the committee on clay and cement sewer pipe reported, recommending slight revisions in the present tentative specifications. E. Ashton and W. M. Kinney attacked the committee sharply for declining to eliminate the absorption limits of 5% for clay and 8% for cement tile. Recent tests in Philadelphia having indicated that these limits are probably too low, they demanded that the figures be stricken out. Mr. Ashton accused the committee of having reversed the general method of making specifications, and characterized its work as being contrary to the spirit of the society. Mr. Kinney intimated that the last meeting of the committee was "packed" by the clay men through their securing the proxies of two non-producer members, and also charged that in the makeup of the committee the clay interests with six members outweighed the cement interests with five—a charge admitted by the chairman, R. Hering. Endeavors to force the dispute back into the committee room failed. The controversy was based on the use of the society's tentative specifications as a standard by the city of Los Angeles. G. H. Tefft, representing the clay interests, C. L. Warwick and Cloyd M. Chapman also engaged in the discussion. In the vote the cement-tile representatives won the victory, the absorption figures being deleted from the specification.

Two new detail specifications for paint materials were presented by the committee on preservative coatings. Due to war activities of its members, this committee, usually very active, did only a moderate amount of work.

Highway Materials

Water-gas tar treatment of wooden paving blocks produced some discussion when the timber committee reported. In proposing tentative specifications for blocks, the committee omitted clauses for quality of water-gas tar oil, but placed them in an appendix "for information." Objection was raised in the meeting, and on vote these clauses were inserted as a footnote in the body of the specifications. Other highway matters were dealt with by the committee on road materials. Besides revision of several of its specifications this committee presented (as tentative) a new specification, for tests of apparent specific gravity of fine non-bituminous highway materials. It also recommended that six tentative specifications be advanced to the rank of standard, which course was approved by the meeting.

A distinct forward step was recorded by the committee on fireproofing, which during the year succeeded in bringing together all the interested technical societies in the joint preparation of a standard code for the conduct of fire tests and fire-stream tests. Under the new code, fire-protective materials are classified by their time of endurance in the fire test as one-hour protection, etc. War-service buildings of temporary character and of combustible construction, as storehouses (and even hospitals!) have made evident the importance of recognizing short-time protection, such as lath-and-plaster partitions. On this account 15-min. and 30-min. protection are recognized in the code. The meeting approved the code for letter ballot on its adoption as standard.

Reports of Technical Committees

Other technical committees reporting were those dealing with magnification scales for micrographs, textile materials, magnetic properties, lubricants, coke, waterproofing, insulating materials, shipping containers, rubber products, and methods of testing.

Papers covering a large range of subjects were read. The two topical discussions, already noted, included the following contributions: On industrial research, papers by Prof. H. M. Howe, John Johnston, A. D. Little, Charles L. Reese, Frank E. Gorrell, A. D. Flinn, and J. S. Unger; on season and corrosion cracking of brass, papers by Prof. William Campbell, W. H. Bassett, H. S. Rawdon, W. Reuben Webster, W. B. Price, P. D. Merica and R. W. Woodward. Other subjects represented include testing methods and appliances (4 papers), aircraft materials and tests of parts (2), steel (3), chemical analysis (1), concrete and stucco (5), tile, stone and the like (4), and lubricating oils (3 papers).

New Officers Elected

The society elected the following new officers: President, G. H. Clamer, of Philadelphia; Vice-President, George S. Webster, of Philadelphia; Members of Executive Committee, G. Aertsen and G. B. Heckel, of Philadelphia, G. K. Burgess, of Washington, and K. W. Zimmerschied, of Detroit.

By raising the membership dues two years ago the society reclaimed its finances very successfully. At the end of 1915 a deficit of $6400 was recorded; this has been converted into a surplus of nearly $12,000 (end of 1917). The membership increased in spite of the raising of the dues, however, and at the present time the total is 2261, including 224 junior members.

Improved administrative machinery is to be provided by the appointment of an assistant treasurer and an assistant secretary. An amendment to the by-laws creating these new offices was accepted and referred to letter ballot.

Memorial Resolutions on Death of Professor Edgar Marburg

Resolutions upon the death of its secretary, Prof. Edgar Marburg, were adopted by the American Society for Testing Materials at its first session after the news of Dr. Marburg's death was received. A committee of three past presidents of the society drafted the resolutions. Their text follows:

"The American Society for Testing Materials in annual meeting assembled learns with profound sorrow of the death of its esteemed secretary-treasurer, Edgar Marburg, on June 27, 1918.

"In this hour of bereavement the society desires to place on its records an acknowledgment of the great debt which it owes to Edgar Marburg. By zeal, industry, loyalty, insight and high ability exerted through sixteen years as secretary-treasurer of the society, by guiding its actions, energizing its activities and guarding its name, he has exercised a powerful influence on the character, standing and usefulness of the society and on the making of specifications and tests for the materials of engineering. He is honored and revered as a master and leader. The imprint of his work will long remain.

"The society extends to the family heartfelt sympathy for their great loss. May the knowledge that his fine character, strong manhood and great work in the field of engineering are appreciated by the membership of the American Society for Testing Materials become a part of their many treasured memories of his life and work."

Concrete Institute Convention

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and methods of finishing. The report of the committee is an abstract of the findings of the various representatives as given in their papers and outlines in brief fashion the present status of concrete house building, particularly for quantity production, such as is necessary in a housing development. The committee reported that work was hardly well under way, but expects in the coming year to gather some valuable data.

Tests of Buildings and Slabs

A third group of papers not delivered at the same session but of common interest were those on concrete tests. Most of these are abstracted elsewhere in this issue. Edward Smulski's tests on a spiral reinforced flat slab shows some very high values of resistance. In studying the tests consideration must be given to the fact that the load did not cover the entire test panel because of the necessity of leaving open a rather large space in order that the gage points on the big horizontal slab spirals could be reached. Uniform distribution of load was simulated by placing increased loadings around the edges of the openings.

Prof. W. K. Hatt read a paper containing an analysis of the general subject of moment coefficients for flat-slab design with special results on a large test panel built at Lafayette, Ind. He first analyzed a number of existing flat-slab and other tests in order to determine the relation between the total external moments in the steel stresses, finding that the percentage of load moment increases with the unit stresses in the steel but that it never reaches 100 per cent. in working conditions. These figures have considerable value in the study of flat-slab tests or in the preparation of a flat-slab theory. The figures given on his own test slabs are not complete but will be found in a later statement. They do indicate, however, certain load distributions of interest. Papers on fire-tested columns are abstracted elsewhere, as well as an elaborate paper by Prof. D. A. Abrams on the results of tests at the Structural Materials Laboratory, Chicago.

J. L. Pearson, of the United States Bureau of Standards, gave in some detail the present status of the well-known stucco tests being conducted by the United States Bureau of Standards.

Design Papers Less Numerous

Design papers were not so numerous. They included a very complete analysis of a reinforced-concrete chimney by J. C. Mingle, an analysis designed to permit anyone to carry through the design of the concrete chimney from the beginning to the end. A discussion of the stress in eccentrically loaded reinforced columns by L. J. Mensch, which was presented only by title, will appear in the Proceedings.

In construction work mention should be made of an analysis of the treatment of concrete surfaces by J. J. Earley, Washington, D. C. Mr. Earley has been working for some time over an ornamental concrete retaining wall at Meridian Hill Park in Washington. He has finally succeeded, by the use of exposed natural aggregate which is continuous through the wall and not merely the coating, in producing a uniform concrete texture of pleasing appearance.

Among important reports presented was that of the committee on the fire at Far Rockaway in a reinforced-concrete warehouse which seriously affected a great number of the concrete members about 18 months ago. The committee is of the opinion that while the gravel concrete may have spalled and cracked under the intense heat earlier than would concrete of some other aggregate, the heat was so intense and the steel so near the surface or in places exposed so that transmission through it would have caused expansion and cracking under any circumstances. The committee made a number of slab tests which will be reported later, showing that the repaired portions are stronger than the original structure. I. H. Woolson contended that the exposed steel would have little influence in transmitting heat to the reinforcement and that the damage was in fact due to the use of gravel concrete which expanded in the same manner as the columns tested by Mr. Hull and described in the convention.

Work of Three Committees

The committee on reinforced-concrete and building laws, which prepared the concrete specifications of last year that were ordered to be held over for a year, has had no opportunity to go very deeply into the matter this year, and recommended that the specifications hold over for another year. The committee states that it is studying the matter of shear in concrete and considers that there will be some wide revisions in the findings for next year. The report of the joint committee on fire tests of which I. H. Woolson is chairman, and on which the Concrete Institute had a member, was submitted to the institute for approval. On account of constitutional restrictions the specification, which had already been adopted by several of the other constituent societies, could not be adopted at this session, but it is to be printed in the "Proceedings" with an indication of the approval of the institute and is to be adopted as soon as possible. The committee on treatment of concrete surfaces presented the questionnaire which it had sent out to obtain information on stucco.

One session was devoted to the subject of roads, but with the exception of a paper on vertical change in the concrete pavement slab to subgrade movements, by J. W. Lowell, little of novelty was brought out.

Several papers on the details of certain concrete structures completed the program.

The institute is now in good financial state in spite of war conditions. It has issued all of its publications and will endeavor to get the new publications in the hands of its members at the earliest opportunity. Prof. W. K. Hatt, Purdue University, Lafayette, Ind., has been reëlected president for the ensuing year.

Robinson and Hallowell Retire from Stone & Webster

Dwight P. Robinson and John W. Hallowell have retired from the firm of Stone & Webster as of July 1, and the business will be continued by the remaining partners—Charles A. Stone, Edwin S. Webster, Russell Robb and Henry G. Bradlee. Dwight P. Robinson has been with Stone & Webster since 1893, from 1908 president of the Stone & Webster Engineering Corporation, and a member of the firm since 1912. John W. Hallowell has been with Stone & Webster since 1901 and a member of the firm since 1912. Since May, 1917, he has been in Washington with Mr. Hoover as a member of the United States food administration and expects to continue in that work for the duration of the war.

Engineering Educators Discuss Student Shortage

How to meet the increasing demands for engineers to carry on the war and industry now and to provide for the reconstruction period was the subject of much of the discussion at the convention of the Society for the Promotion of Engineering Education, held June 26-29 at Evanston, Ill. Prof. C. R. Mann, who outlined the forthcoming report of the Joint Committee on Engineering Education and also the latest decisions of the Government with refence to students' training camps, was the center of debate nearly the whole of one day. During the evening session engineers of the Western Society of Engineers and sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers added their views, a joint meeting being held for the purpose of getting the opinions of the practicing engineer.

W. L. Abbott, chief engineer of the Commonwealth Edison Co., Chicago, detailed the methods by which the public service companies recruited engineers. Formerly a young graduate was put to work at $2 per day with the gang. At the end of the year the man might still stick, but not from any effort on the part of the company. His trustworthiness and eagerness to take responsibility were about the only things that would bring him to the attention of the employer. That day passed some years ago, as the recruits failed to materialize. This reluctance on the part of men to seek work was progressive from East to West, and finally the Central Station Institute was founded, in which 30 to 50 were trained each year. A charge of $400 a year was made and the men were paid $40 per month for the part time spent in the different departments. In four years 85 were graduated, one-half of whom stayed with the company until the war began, when 80% left, practically terminating the experiment.

Now the scheme is to give the men a large part of the preliminary work in five vacation periods while at school; only one-half day a week is given to classroom study. The pay is $60 to $90 per month. As before, the men are shifted often from one department to another. This is a serious drawback, because department heads are not enthusiastic about training "greenhorns" charged up to them only to have the new man transferred when he is ready to do productive work.

In his presidential address, on "Essentials in Engineering Education," (read by John F. Hayford) Milo S. Ketchum pointed out that the most critical problem in engineering education today is to obtain a sufficient number of competent teachers. No greater task can be undertaken by the society, in his opinion, than to improve the conditions and increase the emoluments of engineering teachers so that the engineering students may all have instruction under men of thorough training in theory and practice who can comply with the specifications for a good engineer. The address bristled with humanistic statements such as the following: "A man with a disagreeable disposition ordinarily has no opportunity to use his technical ability except in a very inferior position. One of the most important advantages gained from technical education is contact with other men and an appreciation of the value of human engineering. Of all the materials with which an engineer has to deal there is no material so difficult to handle and control as human material."

Detroit Adopts New Charter

Detroit adopted a new charter on June 25 by a vote of 32,690 to 4587. In place of 42 councilmen elected by wards there will be 9 elected at large. Other details were given in *Engineering News-Record* of May 30, p. 1047.

Real Estate Men Discuss City Planning

City planning received considerable discussion at the recent St. Louis convention of the National Real Estate Association, at which some 135 cities were represented. J. C. Nichols, Kansas City, urged that houses for war workers should be located to conform with a sensible city plan and to fit into a zoning system.

PERSONAL NOTES

JOHN M. GOODELL, who has been assisting the personnel division of the United States Shipping Board for the past six months, has been appointed consulting engineer of the office of Public Roads and Rural Engineering and will represent the office on the United States Highway Council. Mr. Goodell was formerly editor of *Engineering Record*. For some months at the beginning of the war he assisted in the organization of the work of the Committee on Public Information.

FREDERIC A. DELANO has tendered his resignation as a member of the Federal Reserve Board to accept a commission in the Corps of Engineers, United States Army, to engage in railroad construction and management in France. It is understood that Mr. Delano has been offered a commission of high rank in connection with military railroad supervision in France. Before his appointment to the Federal Reserve Board in 1914 he was president and receiver of the Wabash R.R. from 1905 until 1913, when he became president of the Chicago, Indianapolis and Louisville Ry. Previously he had twenty years' experience in railroad work in the service of the Burlington.

WILLIAM A. MCGONAGLE, president of the Duluth, Missabe & Northern Ry., has been appointed Federal general manager, with headquarters at Duluth, Minn. Previous to 1902, when he became assistant to the president of the Duluth-Missabe road, Mr. McGonagle was assistant chief engineer of the Duluth & Iron Range Railroad.

JAMES P. MURRAY, for the past five years engineer in the State Reclamation Department of Texas, has been commissioned as captain in the Engineer Reserve Corps.

A. T. HARDIN, vice-president of the New York Central R.R. Co., has been appointed assistant Federal regional director, Eastern territory, with headquarters at New York City. After his graduation from the University of South Carolina in 1894 with the degree of civil engineer, Mr. Hardin entered the maintenance of way department of the Southern Ry., and later entered the engineering department of the New York Central & Hudson River R.R., becoming engineer maintenance of way in 1903.

C. E. TILTON has been appointed city engineer of Phillipsburg, N. J.

W. C. KEGLER, engineer maintenance of way, Cleveland-Indianapolis division of the Big Four Ry., has been appointed district engineer in charge of construction with headquarters at Galion, Ohio.

W. A. BALDWIN, general superintendent of the Erie Lines West and previously division engineer, has been appointed transportation assistant to the Federal manager and will have authority over such transportation matters as were in charge of the general manager under private control.

V. R. PARKHURST is in charge of drainage work at Camp Funston, Kansas. Mr. Parkhurst was formerly consulting engineer for the Shawnee County Drainage Board, Topeka, Kan.

R. J. MIDDLETON, valuation engineer of the Chicago, Milwaukee & St. Paul Ry., who has been appointed assistant chief engineer of the Chicago, Milwaukee & Puget Sound Ry. with headquarters at Seattle, as mentioned in *Engineering News-Record* of last week, was graduated from the civil engineering department, University of Arkansas, in 1903. Mr. Middleton entered the engineering department of the Chicago, Milwaukee & St. Paul as a draftsman in the bridge and building department in 1906, and in a short time was promoted to assistant engineer, afterwards being assigned in that capacity to duty on the Evanston track elevation at Evanston, Ill. In 1913 he became engineer of track elevation with headquarters at Chicago, and in 1915 was promoted to valuation engineer.

HERMAN F. SCHOLTZ, assistant chief engineer of the Newport Hydro-Carbon Co., the Newport Chemical Works, Inc., at Carrollville, Wis.,

has been commissioned as captain in the Engineer Officers' Reserve Corps.

W. J. HARAHAN, president of the Seaboard Air Line Ry., has been appointed Federal manager, with headquarters at Norfolk, Va. From 1886 to 1895 Mr. Harahan was in the engineering and maintenance departments of the Louisville & Nashville R.R., the Chesapeake & Ohio Ry., and the Baltimore & Ohio Southwestern R.R. In 1901 he was chief engineer of the Illinois Central Railroad.

PAUL O. KINGENSMITH, formerly bridge engineer for the State Highway Commission of Indiana, which was recently dissolved by the State Supreme Court, has become research engineer for the Indiana Public Service Commission.

H. A. CASSILL has been appointed engineer maintenance of way, Pere Marquette R.R., and will have jurisdiction as assistant in track maintenance and construction with offices at Detroit.

H. L. INGERSOLL, assistant to the president, New York Central R.R., has been appointed mechanical assistant to the Eastern regional director with headquarters in New York City.

MILO C. TAYLOR, of Folsom & Taylor, consulting engineers, Bloomington, Ill., and formerly city engineer of El Paso, Ill., has left his private practice to enter the service of the United States Shipping Board, Emergency Fleet Corporation, with headquarters at Philadelphia. He is engaged in highway improvements, sanitary, water supply and sewage work in connection with industrial housing development

L. J. PUTNAM, who has been appointed chief engineer of the Chicago & North Western Ry., as mentioned in *Engineering News-Record* of last week, was born in Iowa in 1878 and was educated at Cornell College, Iowa. He entered the service of the Chicago & North Western Ry. in 1899, after a short period with the Illinois Central R.R. Starting as instrumentman, he was successively assistant engineer, acting division engineer, resident engineer and division engineer. His promotion to division engineer was in April, 1912, and in May, 1913, he became principal assistant engineer.

F. C. HUFFMAN, resident engineer, Chicago & North Western Ry., who was promoted to principal assistant engineer, succeeding L. J. Putnam, promoted to chief engineer, as mentioned in *Engineering News-Record* of last week, p. 1250, was graduated from Purdue University in 1905 and entered the service of the Pennsylvania R.R. in the engineering department. The following year he was employed by the Chicago & North Western as instrumentman and later was appointed assistant engineer on construction. In 1908 he became assistant state engineer of North Dakota, but returned to the service of the North Western as locating engineer in the following year, after which he became resident engineer of construction with headquarters at Chicago, having charge of grade reduction of the Southern Illinois division and the construction of the grain elevators at Milwaukee, South Chicago and Council Bluffs.

A. PEARSON HOOVER of the firm of Goodrich, Hoover & Bennett, consulting engineers, New York City, has been commissioned as major in the quartermaster corps, National Army, and assigned to duty in the construction division. As mentioned in *Engineering News-Record* of June 20, p. 1204, John W. F. Bennett of the same firm has also been commissioned as major in the construction division.

W. A. MURRAY, division engineer, Pennsylvania division, New York Central R.R., has been transferred to the Mohawk division. G. N. Edmonson, division engineer, Rochester division, succeeds Mr. Murray. J. W. Stevens, supervisor of track at Clearfield, Penn., becomes acting division engineer, Rochester division, succeeding Mr. Edmonson.

OBITUARY

LIEUT. ARCHIBALD ROBERTSON of the British Royal Engineers and formerly a civil engineer of Seattle, has been killed in action in France. Lieutenant Robertson left Seattle a few weeks after the outbreak of the war and enlisted as a private in a Canadian regiment. Later he was transferred to the Royal Engineers and won his commission through bravery in action in the first battle of Ypres. He was wounded in this action but returned to active service after a period of several months in a base hospital.

DR. JAMES DOUGLAS, former president and lately chairman of the board of directors of Phelps, Dodge & Co., copper mine operators and owners, died June 25 at his home in Spuyten Duyvil, New York City. Doctor Douglas, who was noted as a philanthropist as well as a mining engineer, had taken great interest in the activities of engineering societies, and in November, 1916, presented to the United Engineering Society $100,000, the income from which is to be used in the development and extension of the library. Doctor Douglas, who stood in the front rank of mining engineers, had been engaged in a constantly active career for more than forty years, principally in the mining and production of copper, although he also won acknowledgment of his ability as a railroad executive in the management of the El Paso & Southwestern R.R. He was 80 years old and was born in Quebec, Canada, and was graduated from Queen's College, Kingston, in 1858 and later from Edinburgh University, Scotland. For several years after graduation he served as professor of chemistry in Morrin College, Quebec. During that period, with the assistance of the late Dr. T. Sterry Hunt, he made a special study of metallurgical treatment of copper ores. These experiments led to the discovery of the Hunt-Douglas process, an important development in the modern methods in the metallurgy of copper.

Doctor Douglas came to the United States in 1875, at the age of 38, to take charge of the copper works at Phoenixville, Penn. About 36 years ago he became identified with copper industries in the Southwest and northern Mexico. He soon formed the nucleus of the great copper mining enterprises which, under his management, have taken place in the first rank of American industry. As president of Phelps, Dodge & Co., Doctor Douglas directed the management of the Copper Queen Consolidated Mining Co., the Montezuma Copper Co., the Detroit Copper Mining Co., the Burro Mountain Copper Co. and the Stag Canon Fuel Co. In 1887 he was made president of the Arizona & Northeastern R.R., and from July, 1901, was president of the El Paso & Southwestern R.R., which took over the Arizona & Southeastern and other lines in Arizona and which, in 1905, absorbed the El Paso & Northeastern. He was also president of the Nacozari Railroad.

He was a member and twice president of the American Institute of Mining Engineers. He was also the author of several books, among which are "Canadian Independence," "Imperial Federation and Annexation" and "Untechnical Addresses on Technical Subjects," and contributed extensively to the technical press.

LESLIE ABRAM WATERBURY, head of the department of civil and architectural engineering, University of Arizona, died June 15 at Nitro, W. Va., where he was engaged in the construction of the explosives plant there. Mr. Waterbury was graduated from the University of Illinois in civil engineering in 1902 with the degree of B. S., and since that time has taken three other degrees from the university. On June 12 last he received the professional degree in architectural engineering. In September, 1902, he became instructor in mathematics and civil engineering at Michigan Agricultural College, and in 1903, after brief employment with the Scherzer Rolling Lift Bridge Co. became instructor in civil engineering at the University of Illinois. Later he entered private practice and in 1917 became professor of civil engineering at the University of Arizona at Tucson. Professor Waterbury was born in Polo, Ill., in 1880.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

America First in World's Export Trade

Lead To Be Maintained After the War by Largest Merchant Marine and Will Stabilize Industry

Practically one-half of the world's export trade, amounting to \$8,000,000,000, was supplied by the United States in 1917. In 1913 Great Britain stood first, Germany a close second and the United States third. Now it stands in the first place with a manufactured export trade figuring at more than \$4,000,000,000; Great Britain second with more than \$2,000,000,000, which, owing to the higher prices due to the war, actually represents less goods shipped than in the 1913 record. America's lead in trade will probably be increased as the shipbuilding program proceeds. The 88,000 tons of shipping delivered in January was increased 300% by May, and Edward N. Hurley, chairman of the Shipping Board, reports that the production by the end of the year will be 500,000 tons per month. This will make a total for the year of 3,500,000, in addition to the ships already in commission. By the end of next year there will be 9,000,000 more and by 1920 a total of 25,000,000 tons will be in commission. Since it takes about 2.5 tons of shipping for each United States soldier at the front it will require 12,500,000 tons to support an army of 5,000,000.

The Webb-Pomerene bill permits combinations for foreign trade to meet the competition of the great commercial trusts of the European countries. Such trusts are still being formed in Germany in spite of the war. One of the most recent is a "Corporation for Domestic and Foreign Commerce," a combination of bankers, steamship companies, coal, metal, manufacturing, shipping and planters' interests, for the building and operation of railways, electric plants, factories, mines, irrigation, ore and oil fields and plantations.

England has made a study of the maintenance of essential industries, recovery of trade, new markets, development of native resources and prevention of their falling into foreign control, and France has sent out delegations from her industries. One is now visiting Australia to encourage trade between the two countries.

In order to bring all these facts before the manufacturing public, associations are holding meetings in various parts of the country. They assert that the great stabilizer for the industries after the war will be a large foreign trade carried in our own merchant marine. At a recent meeting of the National Conference of State Manufacturing Associations at Albany, N. Y., Representative N. J. Gould pointed out the English and German plans for post-war commerce, and offered a resolution to authorize the appointment of a representative of that body to confer with the various national commercial and manufacturing associations for the purpose of uniting and coöperating with one another and with the Federal Government.

Although the close combination for foreign trade authorized by the Webb-Pomerene foreign trade act would be illegal in domestic trade, the law was framed to permit such combinations for foreign trade under the control of the Federal Trade Commission. It is required that registry of names, places of business or office, list of officers, direc-

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Eighty-Acre Munition Plant to be Erected in Chicago

A munition plant covering 80 acres is to be built in Chicago, for the Symington Co. by the Thompson-Starrett Co. The main building will be U-shaped, of mill construction and will be 2400 ft. long containing a machine shop 1240 ft. x 250 ft. It will also contain a shell shop 1200 ft. x 300 ft., the daily capacity of which will be 10,000 three-inch shells. The plant will be completed in November.

Building Trades Will Organize at Atlantic City Meeting

The building trades will meet at Atlantic City, July 15-16, at the call of President Harry A. Wheeler of the Chamber of Commerce of the United States, to form a War Service Committee.

The sessions will be opened by a speech by President Wheeler. The business of the meeting will be to "coördinate assistance to the Government during the war" and to "reëstablish and maintain the general prosperity of the industry." If the organization of a permanent War Service Committee is postponed, an immediate and temporary committee will be appointed. Each organization is urged to send several representatives and to name a prominent business man as a delegate to serve on such a temporary committee.

After the organization is perfected a War Service Committee which, it is said, will speak for the entire industry will be formed. Those intending to participate may make arrangements with Allen Walker, Chamber of Commerce of the United States, Woolworth Building, New York City.

New Aid to Employers in United States Employment Service

Maximum assistance to employers is the object of the establishment of an inquiry office by the United States Employment Service. The office will give full information regarding the procuring of help, from common laborers to men of highest technical attainments. Records of labor surplus and shortage, laws and court decisions affecting labor, naturalization and immigration are kept. Activities of industrial plants to reduce labor turnover as well as statistics on wage scales and cost of living are other lines of information obtainable from the office.

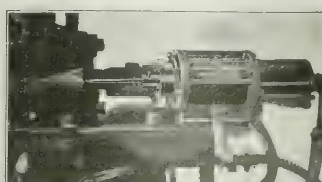
The address is Inquiry Office, United States Employment Service, Department of Labor, Washington.

Bridge and Structural Output Two-Thirds Contracted For

Further evidence of the demand on the steel production of the country is seen in the records of the Bridge Builders' and Structural Society, showing that during the month of May, 60% of the entire capacity of the bridge and structural shops of the country was contracted for. In August, 1917, the steel industries made an estimate of 4,000,000 tons as the requirement of the United States Government for the current year.

Compact Steel Drill Puncher

The puncher shown in the accompanying illustration is a compact pneumatic device designed to open a hole in the end of a piece of drill steel while being worked into a bit, collar or lug. The punch is held in a tappet chuck with a hammer set in an air-feed cylinder which permits the punch to be



DEVICE FOR PUNCHING DRILL STEEL

simultaneously hammered and fed forward into the steel when opening a water hole. The action of the hammer and air-feed cylinder are controlled by a single handle, and the whole device may be mounted separately or adapted to other sharpeners. It is made by the Denver Rock Drill Manufacturing Co., Denver, Colorado.

More Lumber Included in Export Conservation List

In a notice sent out by the War Trade Board dated June 28, the following lumber and manufactured wood items are added to the export conservation list of May, 1917: Round, sawed, sided or square logs; manufactured lumber in all dimensions, and sizes for commercial users, including walnut, mahogany or birch wood cut for parquet flooring or wood suitable for gun stocks, airplane propeller blades and other war uses; partly manufactured articles of an unfinished shape that are to be completed into finished articles at the point of destination.

The falling off in lumber production to the extent of 10 per cent less than that in 1916 is reported by the forest service, United States Department of Agriculture.

This is attributed principally to decreased private building operations, scarcity of labor, transportation difficulties, curtailment in the wood-using industries and general dislocation of the industry.

Royalties on Railroad Specialty Patents to Be Allowed

Royalties usually allowed to patentees of railroad and other manufacturing specialties will, in the future, be allowed by the railroad administration, according to information recently received.

Recent proposals by the railroad administration, that royalty rights on material used in Government orders for cars and locomotives should be relinquished, brought forth protest from many sections. The manufacturers informed the administration that in their opinion such action would kill the initiative in which inventions arise.

Allied Publicity Bureau Completes Tour of Manufactories

A tour of inspection of the plants of the manufacturers represented in the conference with the Allied Publicity Bureau of Cleveland followed the conference in Chicago, June 17. The tour ended in Cleveland June 28.

The plants visited were the Western Wheeled Scraper and the Barber Greene Co. at Aurora, Ill.; the Clyde Iron Works and the Carbic Manufacturing Co. at Duluth, Minn.; the Parsons Co. at Newton, Iowa; the C. H. and E. Manufacturing Co., Inc.; the Milwaukee Concrete Mixer Co. and the Sterling Wheelbarrow Co. at Milwaukee, Wis.; the Marsh-Capron Mfg. Co. and the Austin Mfg. Co. at Chicago, Ill.; the Cleveland Welding Co., the Lakewood Engineering Co. and the Hydraulic Pressed Steel Co. at Cleveland, Ohio.

At each of the plants an informal meeting was held for discussion of sales and advertising problems.

D. H. Nichols, managing director of the Allied Publicity Bureau, conceived and carried out the idea of the trip.

Advanced Railroad Rates Will Probably Have Slight Effect on Material Prices

Iron Ore, Steel, Cement and Lumber Receive Consideration—Volume of Normal and War Building Work Compared

The effect of the new railroad rates on prices has occupied most attention during the past month, and, as expected, has caused an upward movement, though slight. The effect on cement, for instance, will be 8c. per barrel. Assuming 1½ bbl. per cubic yard of concrete, it will make an advance of but 12c. per yard. If the gravel and sand are hauled by rail, add about 60c. per yard, making 72c. per yard total. The advance in steel for reinforcing would amount to hardly more than 1c. per cubic yard of concrete, so that the whole effect is negligible.

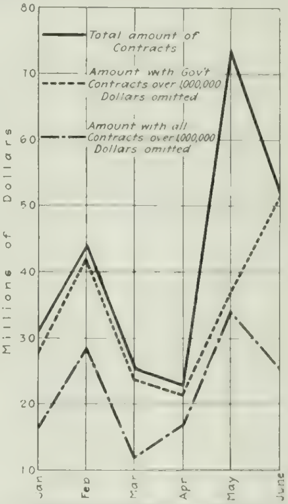
Cement and steel have been subjects of recent conferences at Washington, cement being continued on the priority list until Aug. 1. The uncertainty of the fuel situation prevented extending the period beyond that time.

An agreement of an advance of 45c. over the present price of $5.05 per gross ton f.o.b. lower lake ports for iron ore was also reached at Washington. The price of steel will be the same until Sept. 30.

The copper interests have been anxious for a revision of the 23½c. per pound, but so far no action has been taken.

The lumber interests of the Northwest report that although the rates will increase the cost slightly it will not affect their market, as the differential will be the same. Douglas fir in Chicago will advance from $16.50 per thousand to $18 per thousand and Southern pine from $7.95 to $9.45 per thousand. Heavy buying by retail dealers in anticipation of the rise in freight rates has occurred, causing a rise in prices and great depletion of stocks at the mills. Still higher lumber prices have been prevented by the price fixing committee taking them under advisement. This is probably the beginning of the fixing of all the building material prices.

Compiling certain amounts of contracts for buildings that have been let since the beginning of the year and plotting them by months, as in the accompanying diagrams, shows a peak in May. The solid line gives the total figures, but assuming that those contracts of $1,000,000 and over are unusual, and deducting them from the totals, the bottom line results. This shows the operations among the average con-



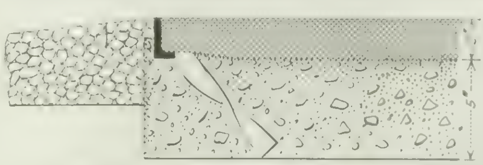
VOLUME OF NORMAL AND WAR BUILDING WORK

tracts and it is noted that from March to April there was a falling off of the totals but an advance in the amount of average contracts. Otherwise, the bottom line fluctuates about the same as the total line. The intermediate line represents the difference between the total and Government contracts alone that have been $1,000,000 and over.

Highway Paving Guard Formed by Anchored Steel Angle

To supply a rigid guard to secure the edges of paving against movement or disintegration from traffic on bituminous, brick or block roadways that are not constructed in connection with sidewalks, the device shown in the accompanying cut has been used.

Other methods employed have been to pave up to loose stone shoulders or to extend the concrete base on the edges up to the surface level of the pavement, forming a small concrete edging. The paving guard illustrated is a special steel angle having a continuous bearing on the base, being securely anchored at intervals into the edge of the base. It is manufactured by the International Steel Tie Co., Cleveland.



ANCHORED STEEL ANGLE FORMS PAVING GUARD

America Leads in Export Trade

(Concluded from page 62)

tors and stockholders, with copies of articles of incorporation or agreement be made and information regarding organization, conduct of business, etc., must be furnished whenever the commission may require.

The industries that unite will form a central export company to handle foreign selling and its problems, and will have a competent managing force, offices and equipment. It will act as a clearing house for shipping, financial, credit and other matters, gather all information obtainable from the United States and foreign departments of commerce.

Must Study Conditions

At the present time the United States is the only country in position to supply many articles needed by foreign countries, and that we shall reap the advantage of this temporary condition only from the attention given this trade and upon the establishment of a feeling of good will on the part of our foreign customers, was pointed out by Consul T. C. Davis of Grenoble, France. He added that, if the customers' necessities are properly handled at the present time, there is certain to be increased business. He stated further that American exporters must not be indifferent to the buyer's methods of doing business, and should quote prices in money, weights and measures with which he is familiar. Germany would have been absolutely supreme in South American markets in less than 20 years and the reason lies in the fact that the Germans adapted their merchandise to the wishes of the purchaser, facilitated the purchaser's credit and gave longer time in their drafts, quoted prices and quantities in terms of the country in which they dealt, and used the metric system, all of which the South American appreciated.

Although such action is comparatively recent, the financial interests of this country are providing American banking facilities throughout the world, especially in South America. The first branch bank was established in Buenos Aires, Argentina, about five years ago. Now one bank has twelve branches in eastern and western South America, and another corporation, representing a number of the largest banks in the greater cities of the United States, is opening banks in competition with the first.

Foreign markets are opening. A recent commerce report says that an American trench-digging machine has been shipped to Scotland for trial. European markets for brick-making machines, also given in recent commerce reports, include Denmark, Netherlands, Spain, Switzerland and Greece, and a demand for American lumber has arisen in China, due to a shortage of the Japanese supply on account of existing difficulties and the high prices of Japanese labor.

The Italian lumber demand has been mentioned in a previous issue, and F. T. F. Dumont, American consul at Florence, suggests that American manufacturers begin to exhibit wood samples in Italy, submitting several qualities of each variety, with prices. The great requirement is to have samples of American woods in Italy now, so that dealers may see just what the United States can furnish in the way of cheap lumber. And in this connection it is noted that the Italian Government is already studying the proposition of organizing an international sample fair.

Pointing out the paramount financial economic and constructive problems that will arise after the war, and having in mind these factors of trade possibilities, Arthur Reynolds, vice-president of the Continental and Commercial Bank of Chicago, in addressing members of the Bankers' Club said, "After ships are no longer needed to carry soldiers, munitions and food to our allies and our army in France, what are we going to do with the ships we are building? We shall lose a golden opportunity if we sit supinely by and do nothing while other countries make plans for world commerce."

Lime Association Officers Elected at Annual Meeting

The Lime Association, a body recently organized at Cleveland, Ohio, to coördinate the activities now carried on by the Hydrated Lime Bureau, the Agricultural Lime Bureau, the Lime Service Bureau, and similar bodies, has elected W. E. Carson, of the Riverton Lime Co., as president, C. W. S. Cobb, of the Glencoe Lime Co., as treasurer, and a board of directors composed of 14 members. The secretary-manager is to be appointed by the board of directors in the near future.

The meeting was adjourned from Cleveland to Washington for the purpose of holding a conference with the War Industries Board.

A war service committee was organized, with headquarters at Washington, to work with the board.

It is stated by the association that this organization is in no sense a combination of manufacturers, its purpose being similar in nature to that of the Portland Cement Assn., Yellow Pine Assn., Metal Lathe Assn., and many other similar associations.

The various activities carried on by the organizing companies or bureaus will be placed under the direct management of the general association, and are to become departments such as construction, agricultural, product standardization and uniform cost accounting, to meet the desires of the Government and bring about the general betterment of the industry.

Business Notes

James T. Lind, of Detroit, Mich., has been appointed Director of the Bureau of Gas Plants in the fuel administration. Mr. Lind is considered an authority upon subjects relative to the gas industry, and will have supervision of the regulation of the artificial gas industry, in so far as it affects the consumption of fuel.

C. C. Hanch, formerly treasurer and a director of the Studebaker Corporation, has been appointed chief of the automotive products section of the War Industries Board, to succeed H. L. Horning, resigned.

Max Thelen, of San Francisco, has been appointed by Secretary Baker to be supervisor of war contracts under Quartermaster General Goethals. Mr. Thelen is to be in the office of Brig. Gen. Hugh S. Johnson, and will have complete control of contracts, acting in coöperation with Assistant Secretary of War Stettinius.

Trade Publications

Concrete mixers and contractors' machinery are the subjects of a new 60-page catalog of the Waterloo Cement Machinery Corporation, Waterloo, Iowa. Mixers and hoists occupy 42 pages, the remainder dealing with machinery for general contracting work.

"Wheeler-Balcke Cooling Towers" is the name of Bulletin 109-B, just published by the Wheeler Condenser & Engineering Co., Carteret, N. J.

"Sullivan Rotators" type "DP-33"; "DR-33" and The Sullivan "DR-6," mounted water hammer drills, are the subjects of Bulletins 70-F and 70-H issued by the Sullivan Machinery Company, Chicago, March and April, 1918, respectively. They give complete descriptions and illustrations of the mining machinery noted.

"Tarvia-KP" is the title of a vest pocket reference booklet issued by the Barrett Co. showing each step in cold patching a road with that material.

The Ingersoll-Rand Co., 11 Broadway, New York City, recently issued Form 4039, an eight-page bulletin on the Leyner shank and bit punch for punching out holes in bits and shanks of hollow drill steel; and Form 901, a four-page bulletin showing the line of "Little David" pneumatic tools. Tables of sizes and capacities are given.

Engineering News-Record

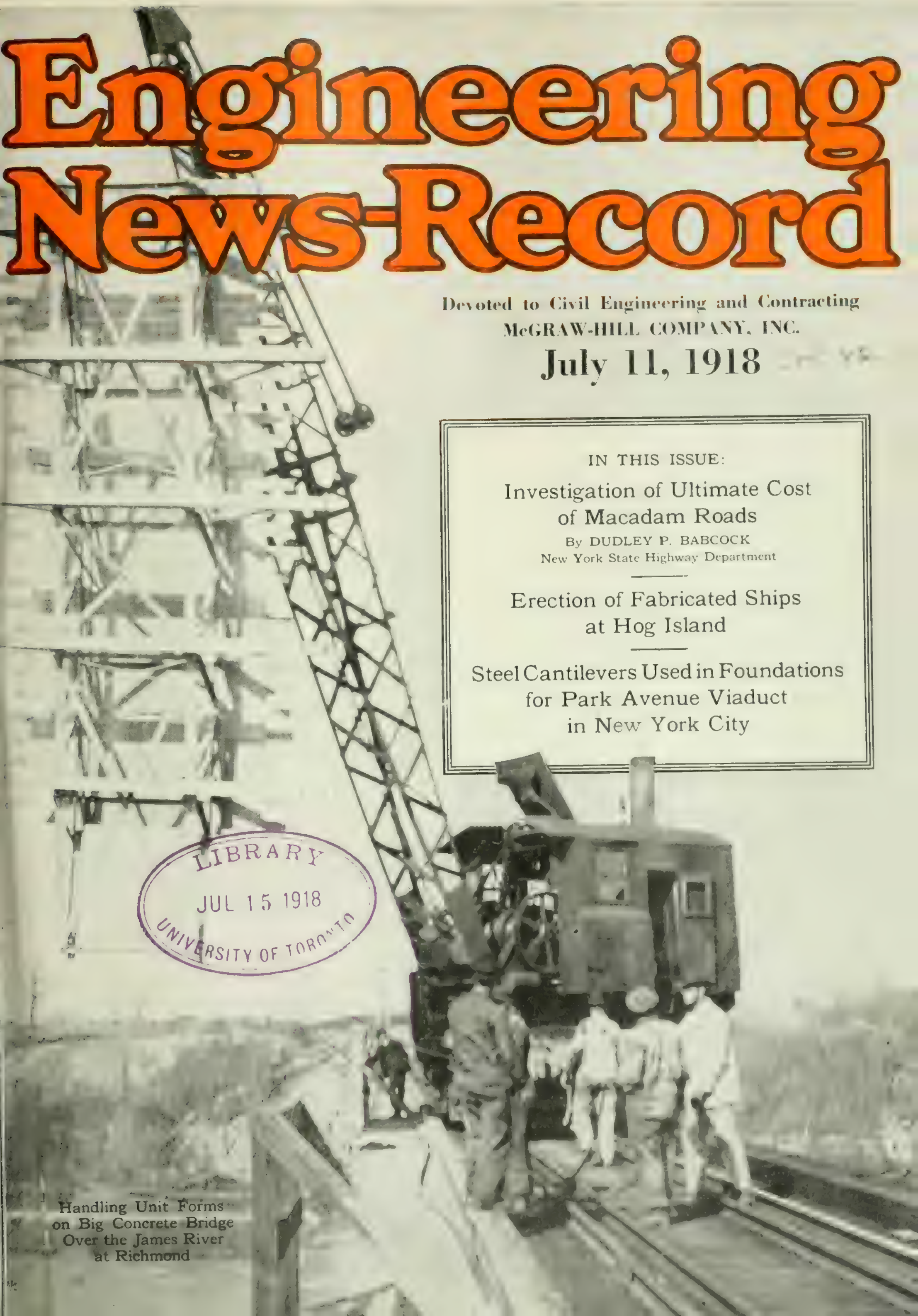
Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
July 11, 1918

IN THIS ISSUE:

Investigation of Ultimate Cost of Macadam Roads
By DUDLEY P. BABCOCK
New York State Highway Department

Erection of Fabricated Ships at Hog Island

Steel Cantilevers Used in Foundations for Park Avenue Viaduct in New York City



Handling Unit Forms on Big Concrete Bridge Over the James River at Richmond


Kreolite LUG WOOD Blocks
"The Paving that's Saving"
Why Nashville adopted them—
NASHVILLE had previously laid some plain rectangular creosoted blocks, but after extended investigation, the City Engineer decided that LUG BLOCKS gave a much better foothold for horses—horse and mule traffic is still used on an extensive scale in Nashville, and there are many steep grades. Furthermore, it was also found that the LUGS eliminated bulging and retard "bleeding"—so Nashville, like many another, came to Kreolite Lug Wood Blocks for paving. Write for full data.
"The Lug Makes a Good Block Better"
50% of orders received in 1917 were repeat orders.
THE JENNISON-WRIGHT CO., 2479 Broadway, Toledo, Ohio
BRANCH OFFICES: New York, Philadelphia, Cleveland, Cincinnati, Chicago, St. Louis, Toronto

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc. — James H. McGraw, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, JULY 11, 1918 — Number 2

Zone Postage Not to Affect Subscription Price

NEW rates of postage on magazines which went into effect July 1 will cause material increases, especially at distances of more than 300 miles, in the cost of supplying *Engineering News-Record* to its subscribers. The obvious action for the publishers to take is to raise subscription rates in distant zones to cover the added postage. For the present, however, it has been decided not to increase the subscription price, trusting Congress will restore the flat-rate system in the interest of national unity. Zone rates on magazines, which obtained in this country before the Civil War, were abolished in 1863. It is to be hoped that the publishers will not find it necessary to increase the cost of the paper to its readers.

Movies May Help Designing Engineers

SOME years ago several educators independently of one another suggested the use of the moving picture as an adjunct to student instruction. The possibility of presenting in the classroom the orderly sequence of certain operations was obviously superior to any other method of visual impression. If the method has been used with any great success, little notice has been taken of it; but a recent use of the moving picture in a similar field is proving quite successful. The concrete ship department of the Emergency Fleet Corporation has had a number of moving pictures taken of various yard operations in some of its remote plants where concrete ships are under way. These pictures are reproduced regularly for the benefit of the designing force in the home office in Philadelphia, with the idea of impressing on that force the many construction details which otherwise they would have to imagine and also of pointing out particular difficulties met with in the field with which the designer not only should be conversant, but to meet which he should change his future design. In these days of large central offices and outlying construction work, the idea may prove valuable to other concerns.

Pavement Cost Data Is Often Misleading

DIFFICULTIES involved in determining the cost of pavements in relation to the tonnage carried are shown in an article in this issue by C. D. Babcock. Present information is hard to analyze and results which are seemingly contrary to reason are often reached. This is evident when Mr. Babcock is forced to conclude "that the traffic tonnage has relatively small influence on the ultimate cost of waterbound macadams." Such a finding is apt to be misleading unless the quality of traffic and the peculiar characteristics of the pavement are carefully considered. Waterbound macadam is designed to carry light, slow-moving traffic, such as horse-drawn vehicles; and for this service it is excellently fitted. Its inherent defect is its well known susceptibility to destruction by high-speed motor traffic. One pneumatic-tired automobile, weighing only a ton, will do more damage to the average waterbound surface than loads of four times that amount, traveling at low speeds. We might expect on highways where a large percentage of the traffic is light and travels at high speed, that the effect of its weight would be relatively small when compared with this and other destructive agencies. If the data were such that it might be readily separated into tonnage classes, the heavier classes would probably show a different result. As Mr. Babcock says, the conclusions reached cannot be considered as holding for other roads under widely varying conditions. The fact stated so often in these columns, that intensive study of paving problems is desirable, is emphasized anew by Mr. Babcock's article.

Imhoff Tank Shutdown at Baltimore Explained

RUMORS and questionings about the shutting down of the Imhoff sewage tanks at Baltimore, the largest installation of the kind in America, have been numerous for some time past. The truth of the matter, with corrections of some misleading statements, as given on p. 84 by Mr. Pitts, until recently engineer in charge of the installation, will doubtless be welcomed by a host of sanitary engineers. Although some of the happenings at Baltimore are local in their bearing the general conclusions as to Imhoff tank design reached by Mr. Pitts deserve careful attention.

Mitchel, a Pattern for Municipal Administrators

THE nation suffered a serious loss in the death last week of John Purroy Mitchel, major in the aviation service, late mayor of New York. He was of the type of young men who, standing on a platform of efficiency and honesty, are ready to do battle against entrenched political organizations. The nation had not felt his hand directly as a public official, but surely the example he gave of good civic government in New York must have been an inspiration to communities and the young men in political life throughout the land. To-day, in the hour of his death, all parties in New York, all the newspapers, attest that his administration was one of the best the city has ever known. And yet he

was young when he came to the mayorality of the country's largest city. Only 35 then, he won the respect and support of the solid elements of the community. Schooled by eight years of service in responsible positions in municipal government, he entered the mayor's office with an intimate knowledge of city administration. He gathered about him men who were not only experts in the duties assigned but effective administrators also. He inspired them with his views as to the service which a city should render its people. Above all he was not afraid to fight when the cause was good. This fighting spirit he carried to the army, choosing a service where he could get into action with the least delay. Had he lived, the nation would surely have come to know him as New York did. Engineers have a special reason for honoring him, for he believed in them and in their methods, and never failed of an opportunity to show his approval of their work. He was the type of official that we shall have more of in the future, when municipal administration shall have been raised to the dignity of a profession, when experts rather than political machines will direct civic activities.

The Railroad Valuations Again

WHAT about the railroad valuations? This question was asked by *Engineering News-Record* a short time ago, and valuation engineers were urged to give the public the benefit of their expert opinions. For reasons best known to themselves they have not expressed themselves to this journal in large numbers, but the responses of a few agree closely and point to rational conclusions.

The valuation work should not be dropped, despite the defects in the Valuation Act, the certain degree of wastage of effort in the present method of doing the work, the unsatisfactoriness from the companies' viewpoint of the tentative valuations thus far reported. Some think the work should be suspended during the period of the war, but a more general belief seems to be that where the inventory of a road has proceeded very far it should not be suspended even temporarily.

More than one valuation engineer thinks the work from the start could have been done more efficiently in some different manner—probably with the railroads themselves making their own valuations, and the Government merely checking them. The coöperative system has been developed to quite a high degree in some sections, however, and there is probably ample warrant for the opinion that an attempt to change the system now would result in chaos.

This journal's conclusion is that with all its faults the valuation is a good thing. Most of the valuation men appear to think the data they are getting are well worth the cost of compilation. The companies have assembled information about their property that they never had before, information useful for many purposes other than valuation. And with the whole future of the railroads uncertain it is highly important that the Government and the companies put themselves in a position to be able if the occasion demands to say what the railroad properties are worth. The valuations will at least help materially in that.

City and State Programs for the Coming Reconstruction Period

MUNICIPAL war programs were advocated by this journal in its issue of Jan. 3. The plea was that every city should consider each proposed expenditure and improvement project in the light of war conditions and thus insure, on the one hand, the execution of all really necessary work and, on the other, the postponement of such expenditures as are unnecessary. A three to five-year war program for each city was suggested, so that if happily the war were soon over the inevitable reconstruction period would find the city with a plan. Although but few comprehensive war programs have been adopted the municipal surveys published in *Engineering News-Record*, July 4, p. 33, show that the subject has received consideration and that action has been taken along some of the lines detailed in the editorial. Far more should be done, and that at once, or our cities will not be able—or will be less able—to meet the vast and complex problems that will follow the war.

Recently a number of commendable proposals for municipal reconstruction have been made. Thus, at the meeting of the American City Planning Institute at St. Louis, in May, a resolution was passed urging "the governing bodies of the various States and the Mayors of the various cities" to undertake the planning of public works with a view to meeting post-war industrial conditions. Subsequently, the National Municipal League authorized the appointment of a committee to study reconstruction problems and suggest lines of action to the executive committee of the League. Now comes the Chicago *Tribune* with a printed suggestion for immediate, concrete action. It urges that the city council at once provide a commission of reconstruction. In other words, it applies locally what this journal and the two associations mentioned have advocated for the cities of the nation.

It would be the duty of Chicago's reconstruction commission to consider now the works that should be undertaken when peace comes, to prepare plans for these projects, secure their approval, and, in general, dispose now of all the preliminaries, so as to be ready to make the dirt fly promptly but according to a well-defined program. As the *Tribune* well says, addressing the people of Chicago: "Let us not drift and then in the eleventh hour hastily improvise measures to meet conditions we should have foreseen. Our main business is to win the war. But we can do that and prepare for peace, too."

The State of Illinois, incidentally, is already showing intelligence in planning such as the *Tribune* suggests for Chicago and the two associations had in mind for the country at large. A bond issue campaign, to secure popular approval for a $60,000,000 road program, is now in hand. The proposal will be voted on in November, *but the money is not to be expended until after the war.*

Toledo, as the municipal survey from that city on p. 37 shows, has a reconstruction program well started. It is maturing plans for public works which would provide employment for its quota of returned soldiers.

Other states and cities might well take pattern from Illinois, heed the words of the Chicago paper, and follow the examples set by Toledo and other cities already hard at work on reconstruction programs.

Speedy Disintegration Not to Be Feared in Concrete Ships

TWO weeks ago there appeared in newspapers throughout the country a news note from Atlantic City stating that Rudolph J. Wig, chief engineer of the Concrete Ship Department of the Emergency Fleet Corporation, speaking before the American Concrete Institute, said: "The Government concrete ships are expected to disintegrate. All we are counting upon now is that they will last at least one and probably three years." Coming from one in authority in the Governmental agency that has let $40,000,000 worth of contracts for such ships, this naturally caused some consternation. If the life of a concrete ship is so definitely limited, the large concrete ship program would be most closely scrutinized and the value of such ships after the war is nothing. Much good thought and effort among engineers would be going to waste.

Fortunately, the note and its alarming prediction are subject to doubt. Members of the staff of this journal were in attendance at all the meetings at Atlantic City two weeks ago and no such remark as the one attributed to Mr. Wig was heard from anyone on the floor of the conventions. Furthermore, Mr. Wig expressly denies having made any such assertion. His prepared paper, a portion of which appears in this issue of *Engineering News-Record,* contains no such radical statement. On the contrary, there appear the sentences: "We do not anticipate any trouble from chemical disintegration except as the hull may be seriously abraded. We estimate the life of a concrete ship without any special protection at several years, and known methods which can now be applied should extend the life several years longer. We believe adequate protection will be developed to insure reasonably permanent life to the concrete ship."

The life of a concrete ship depends, more than on any other thing, on something about which we have little knowledge; that is, the ability of the hull to withstand the rack and the wrench of the sea, the terrific strains and twists imposed on a rigid structure under reversal of stresses and suddenly applied loads. Computations of great elaboration based on the best naval architectural knowledge of the day have been made to take care of just these conditions of stress. Scientific foresight has done its best, but so far our sole practical information on the subject is the behavior of the "Faith" on its exceptionally rough voyage up the Pacific about six weeks ago. Minor defects, due to obviously weak design, appeared, but structurally it survived this most severe test and as a ship it received the commendation of the Lloyds agent who was aboard.

Possibly one of the new concrete ships will break its back in its first storm. Steel ships have been known to do so. Possibly, but hardly probably, it may make its first port with so many and serious cracks as to incapacitate it for future service. But these things will not mean a life of one to three years; it will be a question of days or weeks. Assuming the ability of the ship to stand up under such conditions, the good concrete we now know how to make should guarantee a ship's life of indefinite length. Early disintegration, the mortal disease of the Atlantic City dispatch, need not be considered.

Sea water has had a deteriorating effect on certain concretes in the past, but, properly made and protected, no such trouble is to be anticipated in ship concrete. Such concrete must be made dense to attain the necessary high strength. It is not subject to abrasions which will expose the steel or the possibly vulnerable subsurface concrete, except in above-water parts which are readily inspected and repaired, and it will be protected by a surface paint. Furthermore, there will be some sort of anti-corrosion coating on the steel. In the light of our present knowledge, these precautions assure its immunity from saline attack, always provided that the concrete is a first-class product.

Concrete ocean-going ships are radically new, and all new things in engineering must ultimately stand or fall on their behavior in service. So far as theory goes, it can now be definitely stated that the concrete ship can be designed more accurately than has been the custom with the steel ship. As for practice, in one case at least a concrete ship has been built that can withstand the battering of high seas. While one would be rash indeed to insist on the impossibility of its failure, no one can restrict its possible life to a short and definite term of years, and certainly no one can predict its failure from disintegration within a period of economic use.

Unfairness Promoted By Too Many Laws

THOUGH jurisprudence postulates that ignorance of the law is inexcusable, the lay mind finds itself bewildered while trying to thread the maze of legal verbiage of most laws in an attempt to understand their meaning. This bewilderment is increased when it is found that there are two or three different laws in force at the same time all of which aim at governing the same condition. A striking example of this state of affairs is described on page 95. Mr. Robbins explains, briefly, the provisions of three different laws which were framed for the purpose of relieving conditions due to the war, as they affect the performance of public contracts in New York State.

The laws are drawn from different viewpoints, and their administration is left to the discretion of the various department heads. Thus one department can give a certain degree of relief to one contractor, while another can give greater relief to another for the same class of work; all depending upon which law he elects to utilize. It further appears that the state courts have ruled that departments are within their rights in using the laws giving lesser relief.

To say the least, this appears to be unjust discrimination. Present conditions in contracting are unprecedented, and with contracts let before the war, could not be foreseen. To force contractors to complete work at pre-war prices, places the party of the first part in the position of "getting something for nothing." No just person desires this, and no official can in justice require it. Public officials should use every lawful means to enable contractors to complete public work, but at the same time, all of the contractors should be treated alike, regardless of which department supervises their work.

Foundations, Forms and Concrete Distribution Mark Bridge Construction

Cofferdam Leakage Presents Problems in James River Concrete Arch Bridge—Combination Unit Wood and Steel Forms and Steel Arch Centers Used Many Times—Concrete Distributed by Two Types of Car

BY EDWARD W. STEARNS
Resident Engineer, James River Belt Line Bridge, Richmond, Va.

CONSTRUCTION of the new James River Belt Line Railway reinforced-concrete arch bridge at Richmond, Va., now fast approaching completion, required unusual precautions to keep tight the shallow cofferdams in the swift current over a boulder bottom, and involved repeated use of special wood and steel forms and arch centers and the distribution of concrete in special cars running on an old steel bridge adjoining.

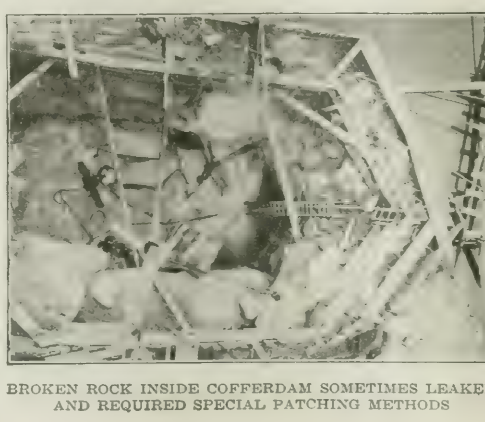
The bridge was described in *Engineering News-Record* of July 12, 1917, p. 73. It is being built jointly by the Richmond, Fredericksburg & Potomac R.R. and the Atlantic Coast Line R.R. where the belt line connecting the two roads crosses the James River about four miles west of Richmond. It replaces on the same grade an immediately adjoining old steel bridge. The new bridge is of reinforced concrete throughout, 2278 ft. long and 32½ ft. wide. In addition to semi-circular 60-ft. arches at the abutments, the main spans consist of twelve 116-ft. and three 122-ft. double-rib, open spandrel, five centered arches with 58-ft. rise, 10 spandrel posts rising from each arch to the under side of the 15-in. deck slab. Upon the slab there will be 2 ft. of fill and 18 in. of ballast. Every third pier is an abutment pier 20 ft. thick, the intermediate piers being only 14 ft. thick. It is estimated that the finished structure will contain 20,000 cu.yd. of 1 : 2½ : 5 concrete in the foundations, piers and the umbrella extensions from the piers to the arches; 21,400 cu.yd. of 1 : 2 : 4 concrete in the arch ribs, spandrel slab, etc., and 1,500,000 lb. of steel rods.

FRAME FOR HALF COFFERDAM WAS SLUNG INTO PLACE FROM ADJOINING BRIDGE

All foundations bear upon granite, which so evidently lies just below the water that it was not considered necessary to make test borings. The river bed is so completely covered with large boulders that at low stages one can almost cross on top of them to an island in the center. At this island, however, an old loose rock and timber dam crosses the river in a diagonal direction, so that the water level in the north half of the river is about 6 ft. higher than in the south half. Partly on account of the very swift current, both above and below the dam, and also on account of the presence of so many boulders, a great deal of care had to be exercised in the construction of the cofferdams.

These are all of double walled timber-frame construction, with 8 x 8-in. timber wales, 2-in. sheathing, and a 6-ft. clay puddle between the walls. No serious trouble was encountered with them until the foundations for Piers 6, 7 and 8 were reached. Here the water was about 8 ft. deep, and, on account of the bottom being overlaid with boulders and gravel, it was impossible to drive the sheathing sufficiently to seal the bottom of the puddle. Here the sheathing was adzed off to a feather edge and driven until it took more or less the contour of the boulders. Burlap bags, partly filled with clay, were then carefully placed around the bottom of the inside row of sheathing, and rammed into all the crevices with 2 x 4-in. timbers; at the rods through the puddle these bags were filled one on top of another until they came up to the bottom rod, and to prevent scouring through the puddle along the rods all of them were wrapped either with a small piece of burlap or a wisp of hay. The puddle was then placed in layers about 1 ft. thick, and each layer was allowed to settle before the next one was placed.

With the cofferdams built in this manner, very few leaks developed, but, when they did start, a very quick and effective way of stopping them was found to be to drive a good-sized hole in the puddle above the leak and ram in quantities of excelsior. This swelled very quickly



BROKEN ROCK INSIDE COFFERDAM SOMETIMES LEAKED AND REQUIRED SPECIAL PATCHING METHODS

as soon as it reached the water and at the same time acted as a filter. It usually stopped the leak permanently. In none of the foundations was more water met than could easily be taken care of with a 3-in. Pulsometer pump, although there was always kept on hand on the cofferdam, ready for emergencies, a 4-in. Pulsometer, a 3-in. gasoline-driven centrifugal, and a 6-in. steam-driven centrifugal pump. These were used chiefly to unwater the excavation quickly, when starting work in the morning

CONCRETE WAS DUMPED INTO SPECIAL CAR ON OLD BRIDGE LEADING TO CHUTE TO NEW WORK

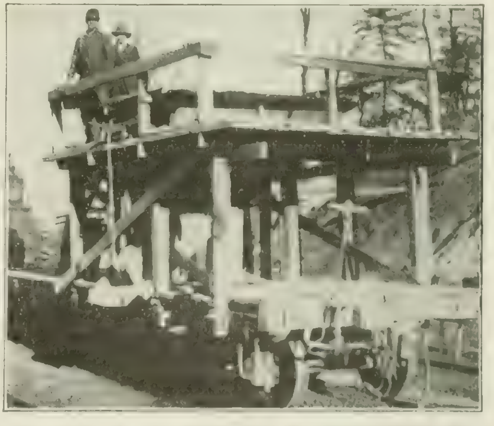
Concrete is mixed at two plants, alike in general details, one at each end of the bridge, and is distributed to near-by forms by chutes and to distant sections in distributing cars running on the adjoining railway bridge.

The south plant, situated at grade at the south end of the bridge, contains the usual mixer, sand and gravel storage, and other miscellaneous buildings. The sand and gravel, which is furnished by the railroads from their gravel pits, is run up in ballast cars on a timber trestle about 12 ft. high, where, by dropping the bottoms of the cars, it runs out within easy reach of each boom of a guy derrick, carrying a 1-yd. clamshell bucket. Under this derrick, there is an area of about 8500 sq.ft., divided into three approximately equal spaces, one for the 2½-in. gravel, one for the 1-in. gravel, and the third for the sand. As fast as the cars are dumped, the derrick moves the material back from the trestle into large piles, so that it is possible to have on hand at one time sufficient aggregate for more than 1000 cu.yd. of concrete. When concreting is being done, this same derrick handles all the aggregate to the mixer, which is directly opposite the piles of material and just on the other side of the trestle.

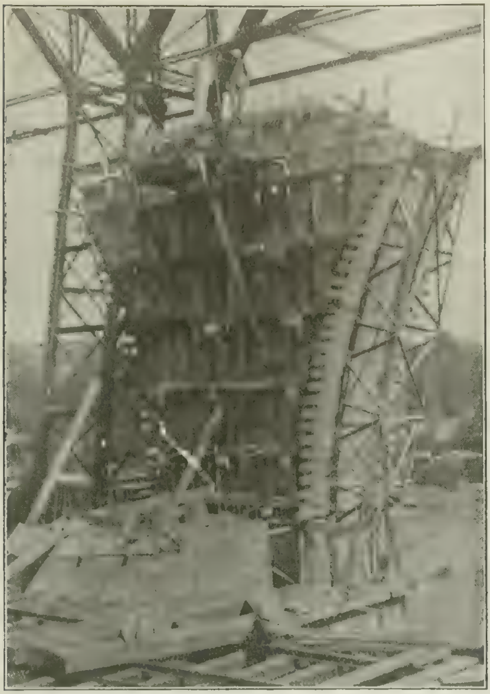
As soon as the work at the south end of the bridge had progressed sufficiently, and when the cut and grading at the north end had been finished to allow it, a similar plant of the same capacity as that at the south end, except for storage, was placed at the north end of the bridge. This plant does not have the tower and chuting system, since in order to get it to a point where there is sufficient storage room it was necessary to place it about 200 ft. from the end of the bridge. This plant was built because when the concrete has to be poured anywhere in the north half of the bridge, or north of some point where it is necessary to be carrying on some other work from the old bridge, it can be mixed and handled from here without interfering with the other work going on the old bridge. At the same time the length of the haul is materially reduced.

Aside from a local chuting system, which was used only so far as the two 60-ft. spans and the abutment pier at the south end of the bridge, there are two distinct methods of handling the concrete to the forms. Directly in front of the mixer is a 125-ft. timber tower carrying a 1-yd. bucket. The same engine which pulls the cement from the cement storage houses to the charging floor above the mixer pulls the concrete to the top of the tower, where chutes distribute it to the forms. About 30 ft. above the bottom of the tower is another hopper, from which the concrete is chuted into distributing cars, which run out over the old bridge and discharge the concrete wherever it is required.

One of the distributing cars is an ordinary timber underframe flat car upon which has been built a timber, steel-lined hopper large enough to carry three batches of concrete, the discharging gate from the hopper being placed just above the level of the car floor. It is hauled by a light broad-gage engine of the type which was originally used on the elevated railroads in New York City, a type which is peculiarly adapted to this sort of service because of its ability to accelerate quickly, attain a comparatively high speed, and stop quickly at the end of the haul. Out on the old bridge, wherever concrete is to be placed, is set another 2-yd. hopper at such a height that the concrete can be discharged into it directly from the distributing car, and from this hopper chutes are easily run down to the forms, by hanging them from the old bridge. The method is as follows:



LOW DISTRIBUTING CAR BROUGHT CONCRETE TO LOW-LEVEL WORK



PIER UMBRELLAS USED STEEL FORMS IN CURVES WITH WOOD LAGGING AND WOOD FORMS ON SIDES

While the distributing car is making its round trip out to the hopper on the side of the bridge, one batch of concrete is mixed, dumped into the bucket and hauled up to the top of the hopper on the side of the tower, and another batch is introduced into the mixer. By the time the car has returned to the mixer, and the first batch has been emptied into it, the second batch is sufficiently mixed, so that it is necessary only to lower the bucket, dump the mixer and raise the concrete about 30 ft. to give the car its second batch. By a stop watch, it is found to take about 40 sec. at the mixer, 30 sec. at the hopper on the bridge, and from a minute to a minute and a half for travel, depending on how far out on the bridge the car has to run. In other words, the mixer can mix as fast as the car can haul the concrete. In nine hours as many as 260 batches of concrete have been handled in this fashion, the greatest delays being caused by clearing trains.

The above order is followed where the haul is comparatively short. For the longer hauls, where the time consumed in traveling is necessarily longer, a gate is provided in the hopper on the side of the tower; this can be operated from the ground and permits of holding a batch of concrete in the hopper, one in the bucket in the tower, and a third in the mixer itself; so that the distributing car hauls three batches instead of two. Before the plant at the north end was put in operation, it was necessary to haul the concrete for the foundation of the north abutment and for Pier 2 the full length of the bridge. This was done three batches to a trip, and it was found that just as good time could be made in this way in spite of the length of the haul. As many as 33 batches an hour have been handled in this way, but this rate cannot be maintained throughout a full day, on account of such delays as are occasioned by the necessity for clearing trains.

The above method is suitable for that concrete which comes below a point at least 16 ft. below the top of the bridge. As the grades of the old and new bridges are the same, a special distributing car was built to take care of the concrete in the tops of the spandrel walls, the slab and the copings.

On a short flat car, similar to the one in the other distributing car, is built a wooden tower of 6 x 8-in. posts, braced with 2 x 10-in. planks, and fastened to the bed of the car by bolts passing through the sills of both the tower and the car. The tower is 5 ft. 9 in. wide, 10 ft. long, and rises $12\frac{1}{2}$ ft. above the car floor, with a 3-yd. steel hopper so mounted on its top that the center of gravity of the hopper is approximately over the center of the track. In order to bring the center of gravity down as near the rails as possible, a bin which can hold 10 yd. of gravel, is suspended between the car sills and the rails, and reduces the danger from overturning.

At the center of the tower, and on the edge of the car nearest to the work, is mounted a 14-ft. boom, made up of two parallel 3 x 8-in. timbers, set 18 in. apart. This boom is pivoted at the bottom to allow its being swung either away from, or alongside the car, but is fixed at one vertical angle, by two $\frac{3}{4}$-in. steel rods at the top. Inside of this boom is a steel chute, 20 ft. long, pivoted under the hopper at one end, and with the other end hung from the boom by block and steel falls, so that it can be raised and lowered to any desired position by a hand windlass, attached to the lower end of the boom. The operator stands on a platform around the hopper to regulate the flow of the concrete.

The operation of this car is essentially the same as that of the lower car except that, instead of dumping

HIGH CAR WAS USED TO CARRY CONCRETE FOR UPPER PARTS OF BRIDGE

the concrete into the hoppers on the side of the bridge, the boom swings the end of the chute out over the forms and the concrete is poured directly from the car into the forms. While traveling, the boom and chute are swung alongside the car. The operation of this car is necessarily rather slow, but in view of the fact that all the time necessary to place hoppers and chutes is done away with, the actual time consumed in filling the forms is no greater than with the other method.

For forms for the sides of the piers, the Blaw collapsible steel forms have been provided, but wood forms are used in the ends. Inasmuch as the side forms are identical for the nine 14-ft. piers, and the four 20-ft. piers, it was decided to build the timber forms for the ends heavy and exceptionally strong, so that the same forms could be used throughout the entire bridge. The forms for the downstream end are made in two sections, and those for the upstream end in four. The sheathing is 1¾-in. dressed lumber, and the studs 6 x 8-in., all thoroughly spiked and braced. The forms are rigidly held in place with ¾-in. rods, incased in tin speaking tubes, and the wales are bolted to the steel forms, so that they may be moved with them to save handling. Instead of having the end forms braced together with rods, the wales are built with truss rods, and span the full width of the piers. Because of the size of the cross-section of the piers, it is impossible to pour them fast enough to get a sufficient head of soft concrete to cause these wales to bow. By so building these pier forms in units, it is possible to remove them in so few pieces, with only four men and a locomotive crane, that they can be taken off from one pier, and set up on the next, braced ready for concrete in four days. The 14-ft. piers can be poured in a little more than two days, and the 20-ft. piers in three days.

The forms for the so-called umbrellas, that is, the transition section between the pier and the arch, are also built partly of steel furnished by the Blaw Co., and partly of unit timber construction. The arch ribs being only 10 ft. wide, the curve of the intrados is taken care of by steel trusses, set 6 ft. c. to c., with the top chord bent to the proper radius. These trusses rest on timbers bolted to the pier proper about 5 ft. below the springing line. To these trusses are bolted 3 x 6-in. spiking strips to which the 4 x 6-in. lagging is spiked. To the bottom chord of these trusses are bolted permanently 4 x 8-in. wales, 18 ft. long, the ends of which are braced to the trusses with diagonal struts. Through the ends of these wales ¾-in. rods are passed to prevent the forms from spreading, and, being entirely outside of the concrete, they are removed without any difficulty when the forms are moved.

The curve of the intrados of the 122-ft. arches at the umbrellas is only slightly different from that of the 116-ft. arches, for which the forms were built. In order to accommodate the same forms to the 122-ft. arches, the ordinates between the two curves superimposed were computed every 4 ft., and blocks of these thicknesses were bolted between the trusses and the spiking strips. After the spiking strips had been placed around these blocks to make a smooth curve, additional blocks were placed between them, supporting the nailing strip every 2 ft., and preventing it from springing in under the pressure of the wet concrete.

UMBRELLA FORM WAS SLUNG FROM ADJOINING BRIDGE

As there is an abutment pier every third pier, the centering for the main arches is provided for by two complete sets of three ribs each of Blaw three-hinged steel arches, each rib being composed of two trusses, spaced 6 ft. c. to c., on which are bolted 3 x 10-in. spiking strips to which is spiked the 4 x 6-in. dressed lagging. These centers rest on steel brackets, carried in pockets let into the concrete of the umbrellas, about 4 ft. above the springing line. Across these brackets, and also under the shoes of the trusses, are oak timbers, 12 x 12 in. x 14 ft. long, separated by 8 in. of oak wedges. In the one case the timber is bolted to the bracket and in the other to the seats of the trusses, and, finally, to prevent overturning, they are bolted together. As a further precaution against overturning, the trusses are guyed to the umbrella and additional guys are run from the center hinge to the ends of the timbers bolted to the shoes of the trusses, these latter to prevent any tendency toward buckling of the centers.

The same steel centers are used for the 122-ft. arches and the 116-ft. arches by spreading them out at the bottom, and, at the same time, lowering them bodily 15 in., this being necessary to make them clear the outside point of the umbrellas. This naturally lowers the crown, but this condition was easily overcome by computing the ordinates between the top of the steel centers and the intrados of the arch, and building a false center above the steel center.

The steel centers, delivered at the site in sections, were assembled, riveted and braced complete in halves at a point within access of the locomotive crane, which

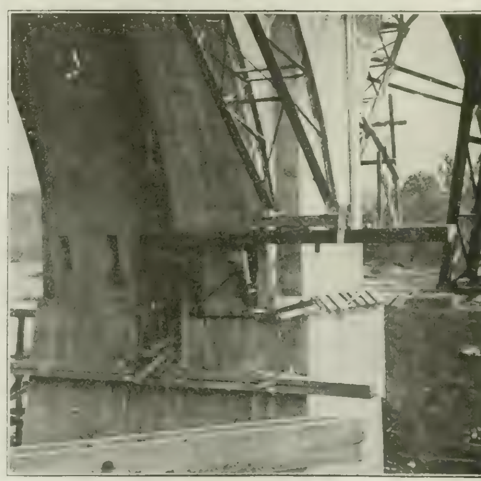
SIDE FORMS FOR ARCH RIBS WERE MADE ON GROUND AND LIFTED INTO PLACE

was used to set them. The timbers which are bolted to the brackets on the sides of the piers were extended under the old bridge, the outside end being supported by a steel cable from the top of the old bridge. Near the center of the span, and cantilevered out from the old bridge, are two beams of two 8 x 16-in. timbers each, carrying on their ends chain falls of sufficient capacity to carry half the weight of the center. The centers were lowered in two lifts to rollers on the bottom timber, the upper end being hung in the chain falls, after which the center hinge was connected by slacking the chain falls. They were then rolled over into their first position, the rollers removed, and the bottoms wedged up to the proper position, after which the spiking strips and lagging were placed. The process of removing them is merely the reverse of setting.

Side forms for the arch ribs are made on the ground and lifted into place. The ordinates between the extrados and the intrados were computed for every foot of the arch, and these curves were laid out on a rigid platform. Timbers, 2 x 6 in., were then bent around them and clamped to place, and a third 2 x 6-in. timber was laid straight between them. The 1¾-in. dressed lagging was spiked to them in this position in such a way that, when in place on the centers, it would stand vertically. In the case of the forms near the haunch, where the lagging was necessarily long, two and even three 2 x 6-in. timbers were used between the intrados and the extrados. These forms were then rigidly braced and were built in such lengths that all except those forms for the last section of the arch ribs next to the umbrellas could be used for both the 122-ft. and 116-ft. arches. The braces are set radially with the intrados, and are held in place at the bottom by a plank securely bolted to the lagging at frequent intervals, and at the top by rods passing entirely above the back forms of the arch. On account of the length of the braces at the haunches, it was necessary to run extra rods through the ribs, to keep the braces from distorting. The back forms are built in sections sufficiently long to reach from one spandrel to the next, so that they may be removed intact and used on all the arches. These forms can be built on the ground before being set much more cheaply than in place, and they are easily set or removed. There is a comparatively small waste of lumber, and there is great economy in using the forms over and over.

In pouring the arch ribs, a haunch section on all three arches is placed first; this is followed by, first, the sections immediately above the umbrellas and below the first spandrels; second, the intermediate sections between sections 1 and 2. Finally, the crown sections on all three arches are poured at once, transferring thrust to the piers uniformly.

When the concrete had set sufficiently for the arches to carry their own weight, the centers were struck, lowered bodily on rollers, and rolled laterally to their position under the upstream rib. It was originally planned to roll the centers from this position out to cars running on a temporary trestle just above the cutwaters of the piers and to roll them on these cars intact to the next set of arches. At no small expense, and with no little difficulty on account of the character of the river bed, about 600 ft. of such a trestle was built, and was used for the traveling derrick car in setting umbrella forms, etc. When the ice came down the river in January, this trestle was entirely destroyed, except that part on which the derrick car stood, next to the Southern R.R. track. It was, therefore, decided not to rebuild it, but instead to follow the reverse process of erecting the forms and to put the derrick car up on the old bridge where it could be used to much better advantage than in the river. It is now being used there,



EXTENDING TIMBERS CARRIED BASE OF STEEL-ARCH CENTERS FROM UNDER CONCRETE ARCH

together with an Industrial Works locomotive crane for handling chutes, forms, loose lumber and the like.

All the designs, plans and specifications for the bridge were prepared by J. E. Greiner & Co., consulting engineers, Baltimore, and the construction is under their supervision. The contractors are W. W. Boxley & Co., of Roanoke, Va.

Sees Serious Business Problems Ahead After War

Industry Must Be Put on International Basis and Huge Merchant Fleet Used, W. S. Kies Tells Publishers and Manufacturers

IT IS presumptuous for anyone to attempt to forecast the future, and it is, of course, unsatisfactory to speculate upon the effect of the war, and upon after-the-war developments, upon business, said W. S. Kies, vice-president of the American International Corporation, in the course of an address before the after-the-war-prepardness meeting of publishers and manufacturers held June 17 in Chicago. Business men, however, he continued, must of necessity look ahead, because it is impossible to run any business without planning for future growth and development. Business wants to be optimistic, and desires to proceed on the theory of continued growth and expansion. This is natural, but at a time like the present is dangerous, for there are many new factors which must enter into calculations for the future, and no far-reaching business plans are safe without taking them into consideration and discounting their possible effects.

The present and the future of American business is now in the hands of the administration at Washington. This is an established fact which, however, is not a proper subject for criticism, because this nation cannot be organized for war except through centralization of power and authority. The vitally important questions are—to what extent will these powers be exercised after the war; what will be the effect upon business organizations of the broad exercise of these powers during the war; and what new conditions created by their exercise will business have to meet in the future?

Results of War Price Fixing

Price fixing to-day is a war measure. It is an artificial interference with the economic laws of supply and demand. Its tendency, however, is to restrict production rather than increase it. Production in wartime is the all-important consideration, and is always stimulated by the possibility of profits. Excessive profits can always be taken care of by taxation. If, however, price fixing is successful in keeping down prices of necessities, and, at the same time, results in maintaining supplies sufficient for the nation's requirements, then we may well anticipate powerful support for a continuance of the practice after the war, even though the abnormal and artificial conditions which made for its success as a war measure shall no longer exist. Interference with fundamental economic laws always has in it the possibility of disaster. The laws of competition in the long run must determine prices, but the possibility of price fixing after the war, due to popular demand, is a factor with which business must reckon.

Profits to-day are limited as a result of price fixing and through excess profits taxes. When there is an overwhelming demand and the supply is inadequate, both price fixing and limitation of profits may be justified, on the theory that the hazard of finding markets for products and the business risk, due to possibility of over-production, is removed. In such a condition competition is no longer possible, and the producer has a monopoly with the power to make his own prices.

But after the war, when the problem of finding markets capable of absorbing our surplus production in this country will become serious, then price fixing and the limitation of profits will destroy business initiative and make commercial growth and expansion impossible. It is a plain fact, which the people and the politicians of this country must recognize, that the incentive to all business, the thing which makes possible the growth and expansion of a country, is the possibility of profits, and that any legislation which tends to restrict the earning possibilities and the reasonable profits of business is fatal not only to business itself, but to the continued development and the prosperity of the country.

May Have to Continue Control

To what extent, after the war, will the Government continue to restrict our exports and imports? To-day nothing can be imported into or exported from the country without a license. This power is exercised in the interest of economizing shipping space, of checking the production of non-essentials, and of restricting the consumption of non-essentials imported from other countries. When the war is ended tonnage will be plentiful and there will be no need for restricting the production or consumption of so-called luxuries, which, as a nation becomes more cultured and civilized, contribute largely to the pleasure and convenience of life. But a world condition may arise which will compel our Government still to continue a large measure of control over the foreign commerce of the country. The belligerent nations of Europe will need raw materials. They will need steel, machinery and other supplies for rehabilitation purposes. Their gold supply has been depleted and their credit exhausted. So huge are expenses and so large the accumulation of national debts that Europe may be forced to adopt bimetallism, if not obliged to go on a paper basis altogether. The purchasing power of the belligerents will necessarily be restricted, and we may reasonably look forward to not only a limitation of imports on the part of the European belligerents, but the purchase of necessities by the Government itself or through strong central organizations under Government patronage.

England, for example, might purchase its cotton through a Government agency, or through an organization of cotton manufacturers. France might purchase needed steel and machinery for rehabilitation purposes through a central agency. If such a development should take place, then, to protect our cotton growers and our manufacturers it might be necessary for our own Government to continue some form of governmental control over our exports and imports. Such a possible restricting of the free movement of our foreign commerce is a factor which will affect future business, because of the increasing importance of our foreign trade and the growing necessity of foreign markets to absorb our surplus production.

This country is to-day building ships at a rate which, if continued, will give us the largest merchant marine in

the world. In 1914 we built but 7.1% of the ships constructed in the world during that year. In 1918 it is estimated that we shall build in this country 48% of the world's tonnage, and in 1919 59% of the ships to be built in that year.

No matter how the war ends, at its close we shall be the second, if not the first, ship-owing nation in the world. Will we again permit our merchant marine to dwindle to insignificant proportions as we did once before in our history after the war of 1812?

Without Markets No Prosperity

The prosperity of every part of the country is closely dependent upon the prosperity of every other part, and the central West should be as vitally interested as the Eastern seaboard in the development of the means of carrying our foreign commerce. We manufacture and raise more than we can consume in normal times, and unless we can find and develop markets for our surplus products the country as a whole cannot be prosperous. In the upbuilding of this foreign commerce an efficiently operated merchant marine is a necessity.

Just before the war we placed upon our statute books a Seamen's Act which made it impossible for American ships, privately operated, to compete with the ships of other nations. For years our mercantile marine had been declining, and the Seamen's Act was the last blow.

A careful analysis of figures of cost of operation proves that before the war it was impossible to operate ships in competition with other nations which were not hampered by restrictive navigation laws. Even before the Seamen's Act was passed this differential in operating costs was sufficient to stop the increase of our marine. When the war opened there were under the American flag a mere handful of ships. The necessities of war demanded ocean transportation, and to meet the situation billions of dollars were placed at the disposal of the Shipping Board for the purpose of constructing and operating ships. The lack of tonnage, the tremendous demand, and high freight rates make it possible to operate now without consideration of operating costs. After the war this will be different. That the great merchant navy we are now acquiring will be operated goes without saying, but it is for the American people to decide the serious question of policy as to whether it shall be operated under private management, and have the benefit of private initiative, or whether it shall be operated by the Government.

If it is to be operated privately, restrictive legislation must be supplanted by constructive measures in aid of its maintenance. To compete with the rest of the world in ship operation, the conditions under which we operate must be equalized. If it costs more to build and operate ships in this country, and we expect to maintain our marine, then the difference in cost must be made up in some way. If the Government operates, this difference will be met by drafts upon the public treasury, as in the case of the Post Office. But do the people of the United States desire Governmental operation of our merchant marine? Are they sufficiently confident that such management will prove efficient and economical?

At the moment Government management may be successful, because in wartimes political favoritism is admittedly unpatriotic, and the great danger of politics and the building of a political machine through Government operation is less threatening. The best brains and highest managerial skill are at the command of the Government. Men to whom private corporations would readily pay thousands of dollars for the use of their ability are to-day in the service of the Government without compensation, actuated by patriotism and a desire to serve in this crisis. When the war is ended the Government can no longer retain these men, and without them successful operation is impossible.

The future of our merchant marine is in the hands of the people; the policy to be adopted after the war is of serious consequence to this nation and should receive the careful, thoughtful consideration of every citizen.

The railroads of the United States were taken over by the Government, as a war measure, last December. It was rightly assumed that the wartime needs of the country in transportation could only be taken care of by the proper coördination of all the railroad lines of the country and their operation as one unified system, but the railroads were so shackled by state and national restrictions that this coördination under private management—however desirable—seemed impossible of achievement.

If unified operation results in economies, improvement in service along some lines and a profit to the Government, then immediately a strong campaign will be inaugurated to have the Government permanently retain control of the railroads, and the result of this campaign will be a factor of great importance in the future business development of the country. When the world crisis has passed the patriotic incentive will no longer exist. The best men in the railroad world will seek employment elsewhere because of restricted opportunities in the Government service. It is inevitable that the railroad labor unions will obtain larger and larger control of the railroads of the country, and that politics will dictate the appointment of high officials, the rate of wages, and the policy of extensions and service in different communities. The vast political machine which could be built up out of the railroad employees of the country, reinforced by the sailors of our merchant navy if this too were Governmentally operated, would be in complete control of the country.

What of Demobilization?

When the war is won, what of the problem of demobilization of our armies and of the reorganization of industry for the purpose of again taking up the pursuits of peace? Let me point out a few of the serious questions that will arise. The millions of men who have been fighting our battles will of right be entitled to their old places in commerce and industry. Will the women workers, who have tasted the fruits of economic independence and have earned large wages, willingly give up their places?

The workers of this country are now receiving wages unheard of before in history. When the men released from war come into the labor market and the law of supply and demand begins to operate, will wages be reduced to a lower level in an orderly manner or shall we enter upon a period of labor troubles with attendant strikes and riots?

Our soldiers have been fighting the battles of democ-

racy. The world is imbued with this idea, and the ideals of democracy, as put forth not only in Russia but in conservative England, contemplate the control of industry by labor. The movement in labor circles looking toward industrial democracy is deserving of most careful and sympathetic study by all employers, for it expresses a fundamental and powerful instinct of human nature which must be reckoned with. There is no getting away from the fact that we must face an adjustment between capital and labor after the war, and that, unless this situation is handled with the utmost intelligence and wisdom on the part of both the leaders of capital and labor, serious consequences will result.

If it be possible to turn the forces of production from war materials into peace-time production, and to find markets for all that we can produce, so as to keep our industrial machine going at top speed, then the problem will be less aggravated. But here again we must clearly face certain facts. The productive capacity of the country has increased during the last three and a half years. Large additions to our great industrial plants have been built. The output of this increased capacity must be sold in order to keep these plants going.

Little Opportunity in Europe

After the war the purchasing power of Europe will be decreased. The belligerent nations have piled up huge debts. England's debt has increased from $3,458,000,000 to $27,636,000,000; France from $6,598,000,000 to $22,227,000,000; Italy from $2,792,000,000 to $6,676,000,000, and Germany from $1,165,000,000 to $25,408,000,000. The gold resources of Europe have been depleted. With national debts reaching staggering totals there will be difficulty in finding funds or arranging credits to pay for imports. In fact, the problem of the European belligerents will be to build up depleted gold reserves and shattered credits, and this can only be done by restricting the consumption of imported articles and by stimulating exports. Except, then, for raw materials absolutely needed to feed her industries, and machinery and construction materials needed for rehabilitation, European markets will offer little opportunity. The surplus products of this country must, therefore, find their markets in neutral countries that have not been impoverished by war. But in these neutral markets we shall meet a keener competition than before the war because of Europe's necessity of rebuilding its financial strength through favorable export balances.

Of course Europe's problem of demobilization will be even more exaggerated than ours, because of the more perfect organizations for war purposes, but Europe, particularly England and France, have learned lessons in industry as a result of the war which will make their competition in neutral markets more keen. The United States and Germany, before the war, were the exponents of mass production. We know that England and France have shown marvelous development along these lines during the war, and it is safe to assume that after the war the same methods which have so wonderfully increased the munitions production of England and France will be used in the production of articles for international commerce, and by these methods they will be produced at a cost as low or lower than we can produce them here.

Competition in the world's markets is mainly on the basis of price. If the quality is practically the same the cheaper article will dominate a market. The cost of an article in commerce is mainly made up of the cost of capital, the cost of raw material, and the cost of labor. Improved scientific processes, skillful direction and intelligent labor may tend to decrease the cost, but the cost of labor is so large a part in the cost of most articles that, if it is out of line with labor in a competing country, the product suffers in competition in foreign markets. It seems inevitable, therefore, that if industry is to be kept prosperous in this country our foreign commerce must be maintained, and to do this production must be continued on a basis that will enable us to compete. This may of necessity mean lower wages as a last resort, but every other effort to bring down the cost of production should first be made. Labor must be taught that its interests lie in intelligently aiding in increasing the results of its labor, which would help to bring down unit costs. Labor, on the other hand, has the right to demand the most skillful and intelligent management. Organization of our industries along the lines of cutting down useless expenses, eliminating wasteful competition and combining for the purpose of the purchase of raw materials, the marketing of goods, and the extension of credits will put our industries in a stronger position to compete against the world.

Foreign business after the war, in spite of the many difficulties, holds promise of large volume. The neutral countries of the world have been shut off from their European sources of supply, and the shelves are empty. Needed improvements and developments, both public and private, have been postponed until after the war. Many of the neutral countries prospered as we did and are in a position to buy for cash or on short credits when shipments are possible. On the other hand, the undeveloped countries of the world have been obliged, for lack of capital, to pause in their development.

We Must Extend Credit

Europe must have credits for raw materials, and for the machinery and construction materials needed for rehabilitation. This means that we must develop in this country a market for foreign securities. We are much better equipped to extend credit and to take advantage of foreign business possibilities than we were before the war. The wealth of our country has increased, and we have sources of credit information which did not previously exist. Branches of our national banks have been established throughout the world.

Our banking system, under the Federal Reserve Act, is elastic, and furnishes the machinery for enabling this country to take its part in world finance. The Federal Reserve Act permitted national banks to accept bills of exchange drawn against merchandise, first in foreign trade, and latterly extended to domestic trade. This gives us the opportunity of developing a great, broad money market in this country, built around the handling of acceptances, which are the most liquid and most desirable of the forms of commercial paper.

One other favorable factor which we must not overlook, and which gives cause for confidence in the future in spite of the many serious problems to be faced, is

the great addition to the sum of knowledge of world business which we have obtained, and the shaking off of our provincialism in the development of a broader international viewpoint. We know more about the peoples of the world, their characteristics and their national ideals than we did before the war. We have sensed our international obligations and have developed a feeling of world citizenship. Our country stands before the world as an unselfish exponent of the highest ideals of democracy, and as an example of national sacrifice to our sense of right and duty to the world. The magnificent work of our Red Cross has created respect for our ability to do things, and has inspired a feeling of gratitude and affection for the American people. In the years to come prejudices which affected our business relations in other countries will be removed, and it is safe to say that our relations, both commercial and public, with the nations of the world will be on a much more friendly basis of understanding in the future than in the past.

Proposed Constitution for Standards Committee

Would Have Government Departments Participate in Work of Setting Up Engineering Standards—Report Submitted

SECTIONAL committees are to develop and recommend standards to be passed upon by the main American Engineering Standards Committee, which is to meet four times a year and to be composed of representatives of the four national engineering societies, the American Society for Testing Materials, and three Government departments, according to the provisions of the constitution submitted by a committee appointed to take up the question on behalf of the societies mentioned. This committee reported to the American Society for Testing Materials at the recent Atlantic City annual meeting, reported on p. 56 of this journal last week. The salient provisions of the proposed constitution follow:

The object of this committee is to unify and simplify the methods of arriving at engineering standards.

The Main Committee shall be composed of three representatives each from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, and three each from the Department of Commerce, the War Department, and the Navy Department.

The Main Committee shall elect annually a chairman and vice-chairman from its own membership. The Main Committee shall elect from its own members an executive committee consisting of one representative of each society and Government department.

The executive committee shall engage a secretary, who shall not be a member of the committee. The Main Committee shall hold at least four regular meetings each year on dates to be specified by the committee. The chief duties of the Main Committee shall be to receive and pass upon recommendations for standards approved by sectional committees; to formulate rules under which the sectional committees shall be constituted and organized and to maintain a central office in the Engineering Societies Building in New York with a paid full-time secretary, which office shall also serve as a bureau of information.

Any proposed standard submitted to, and approved by, the Main Committee shall be known either as a "recommended practice" or as a "tentative standard," and when, in the opinion of this committee, after approval by the sponsor society or societies, it has proved its suitability, it shall be known as an "American standard." The approval as "recommended practice" or as "tentative standards" of any standard submitted to the main committee shall require the affirmative vote of three-fourths of the committee; the advance of status to "American standard" shall require an affirmative vote of 90 per cent of the Main Committee. Such votes shall be by letter ballot. A "recommended practice" or "tentative standard" may be revised at intervals of not less than one year, by the same procedure as that required for its original approval. A period of not less than one year shall intervene between the last revision and the admission to "American standard." An "American standard" may be revised at intervals of not less than three years by the same procedure as required for its original approval.

Any society coöperating in the preparation of standards shall notify the Main Committee of the names and affiliations of the members of, and the field covered by, any existing or proposed committee dealing with a standard of any kind. It shall also send to the Main Committee not less than 20 copies of each standard which it has in force. Any proposal for the development or adoption of a particular standard or group of standards shall be referred to the Main Committee, which shall request one or more of the societies coöperating to organize a sectional committee to carry on the work. The society or societies so designated shall be sponsor (or joint sponsor) for the work in hand, and the final recommendations of the sectional committee shall be made to the sponsor, who shall submit these recommendations to the Main Committee. The Main Committee shall not approve these recommendations without the previous approval of the sponsor.

Sectional committees dealing with standards of a commercial character (specifications, shop practices, etc.) shall be made up of representatives of producers, consumers and general interests (engineers), no one of these interests to form a majority.

Sectional committees dealing with standards of a scientific or noncommercial character shall consist of persons specially qualified, without regard to their affiliations.

"Recommended practices," "tentative standards" and "American standards" approved by the Main Committee may be printed in the publications of any coöperating society under the appropriate title and over the statement "Approved by the American Engineering Standards Committee." They shall not be released prior to such publication, whereupon right to publish may be granted to any other publisher.

Hog Island's Ship-Erection Equipment: Four Hundred Tower Derricks for Fifty Ways

With Larger Program Than Other Yards, and Building Ships of Two Sizes, American International Provided Ample Equipment—Trucking Road in Addition to Track at Each Way

SHIPBUILDING at the great Hog Island yard is carried on with quite different erection equipment from that of the other agency yards. It is steel-erection equipment, however, and not shipbuilding equipment, and in this respect most of the yards at which Emergency Fleet Corporation work is being done embody the same idea. That established shipyard precedents were not followed is most noteworthy in the case of Hog Island, for the American International Shipbuilding Corporation is affiliated with one of the largest of the older shipyards—that of the New York Shipbuilding Corporation at Camden, opposite Philadelphia. Overhead traveling cranes have given very satisfactory service at Camden, but in spite of this Hog Island adopted derricks. Derricks could be obtained quickly and in large numbers, while cranes of other types would have had to be built as special orders, requiring a long delivery time.

Fixed towers carrying stiffleg derricks, set between the shipways, were chosen as the erection tools (Fig. 4), just as at the Newark Bay shipyard of the Submarine Boat Corporation. In all other points, however, the two yards differ widely in their erection equipment. Thus, the Newark Bay yard, as was described in *Engineering News-Record* of June 6, 1918, p. 1073, has its shipways grouped in pairs, hull material is stored at the head of the ways, and erection is handled by derricks on towers between the pairs which hoist from a railway track in the middle of the pair. Further, the derricks being set on the middle line of the towers, one at each end, the arrangement is strictly symmetrical. In all these points the larger yard is different. At Hog Island, structural hull material is stored in a single central storage yard of highly systematized arrangement, and other material is stored in storehouses, located on the main roads of the plant. The supply to the shipways is over a railway track along one side of each way and a plank road (for trucking) along the other side. The road, a feature peculiar to Hog Island, makes the layout unsymmetrical. The keel blocks are placed 1 ft. off the center line of the way, to give extra clearance at the railway track, not required at the road on the other side. The derrick towers are placed astride of the road, and thus are nearer one than the other of the two adjoining ships; to make up for this the derricks are set unsymmetrically on the towers. The section, Fig. 1, shows the points mentioned. Further information is given by the plan, Fig. 2, which explains the arrangement of the ways with respect to each other and to the supply tracks and derrick towers. A detail characteristic is the use of wooden derricks at Hog Island, as the view, Fig. 7, exhibits, as against steel derricks at most of the other large yards.

But the most prominent feature of Hog Island's erection equipment is the great number of derricks provided. There are in all 400 tower derricks for the 50 shipways, or eight booms per ship over the ways, besides a derrick on the ground near the head of each way. This represents a considerable safety margin over the max-

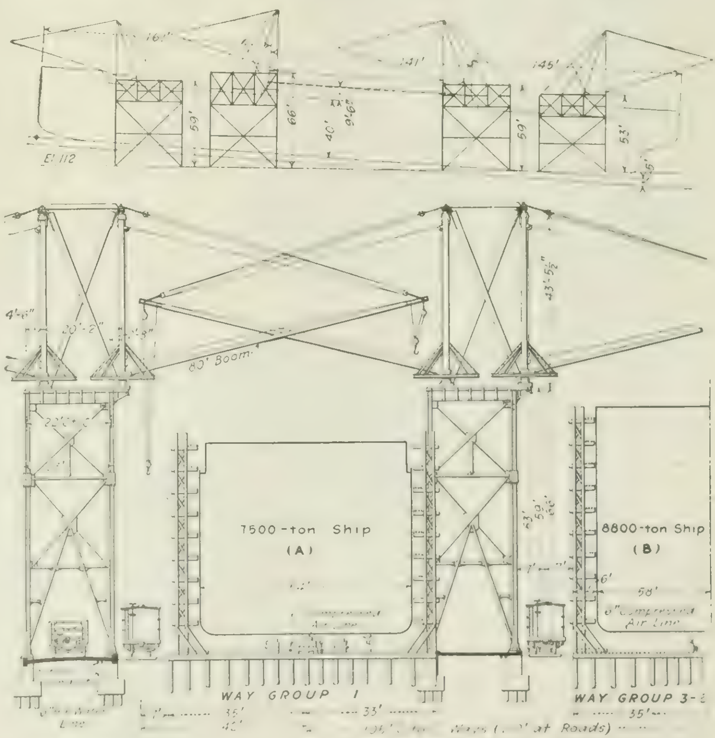


FIG. 1. RELATION OF SHIPWAYS, ERECTION DERRICKS, TRACKS AND ROADWAYS

Road and track in lane between ships, ship off center of ways, derricks not symmetrical placed on towers; scaffolding on shipway platform. Two types of way, built for "A" and "B" ships, are shown side by side, but occur only in separate groups of ten. The ways for "B" ships are longer and have closer pile spacing. "A" ships may be built on either type of way

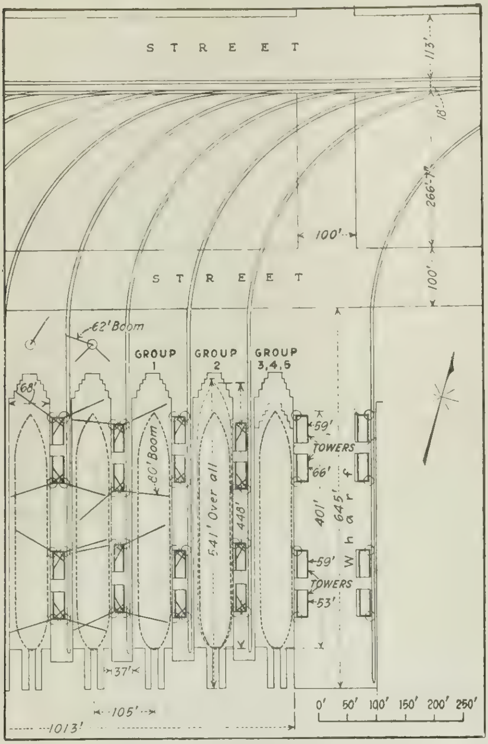


FIG. 2. EIGHT DERRICKS IN EACH LANE BETWEEN SHIPS

imum estimated service requirements, as well as a hope that at some stages of the twenty-three month contract period—during which 180 ships must be built, with total dead-weight carrying capacity 1,441,000 tons—unexpectedly high speed of erection could be obtained if a surplus of hoisting equipment were provided.

Hog Island is the largest of the agency shipyards, having nearly twice as many ways (50) as the Submarine yard at Newark Bay (28). This in itself gave the American International Shipbuilding Corporation a different problem with respect to the shipbuilding tools. The adopted machines are the simplest, most easily replaceable hoisting devices in the country—five-ton wooden derricks, framed on the ground with standard derrick fittings.

For its enormous shipbuilding program, the yard draws its supply of fabricated ship parts from more than fifty different structural steel shops, scattered from Virginia to Nebraska and Minnesota. The ample provision of erection derricks—other yards have only two hooks per ship, against eight here—and the resulting ability to concentrate excess hoisting capacity on any one part of a ship, are likely to prove valuable features if at any time the inflow of material from the fabricating shops should become irregular beyond the equalizing capacity of the storage yard.

A graphical showing of the flexibility of derrick service which features the Hog Island layout is given by the plan sketch, Fig. 3. This shows the several derrick circles and their overlap in various degree. No part of the ship is served by less than two hooks, while parts of the area are served by three and four. Interruptions of service may be considered wholly eliminated, with this arrangement. A slight limitation on flexibility lies in the fact that in some few positions the two derricks on one tower cannot handle their rated loads simultaneously.

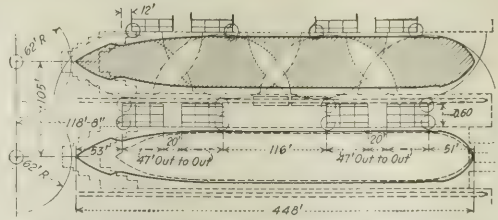


FIG. 3. TWO TO FOUR HOOKS AVAILABLE AT EVERY POINT OF SHIP BEING BUILT

Hatched areas are covered by two hooks. The white segments are covered partly by three and partly by four hooks.

That the selection of the machinery was governed more by availability than by any other consideration has already been mentioned. Before derricks were chosen consideration was given to cableways—one cableway longitudinally over each ship—because of their simplicity, their success in Pacific Coast shipyards, and their use in a few prominent cases elsewhere. These grounds were not believed to be adequate, however, in relation

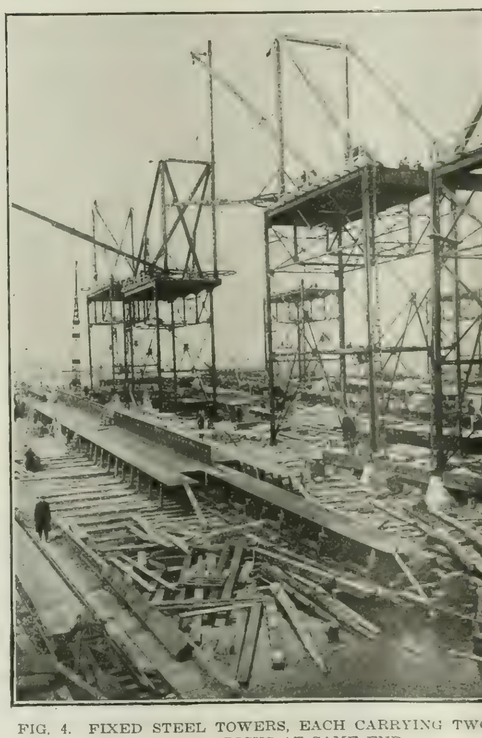


FIG. 4. FIXED STEEL TOWERS, EACH CARRYING TWO WOODEN DERRICKS AT SAME END

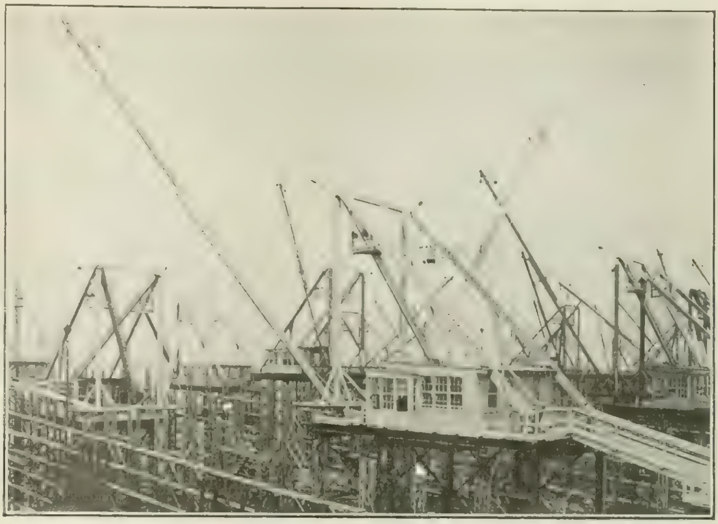


FIG. 5. EACH STEEL TOWER CARRIES AT ONE END TWO WOODEN DERRICKS WITH UNUSUAL STIFFLEG ARRANGEMENT

to the high-speed erection contemplated. Detail study indicated that the use of cableways would involve considerable loss of space and that the operating characteristics did not give promise of being best suited to the service. Cableways were therefore rejected. Once derricks were decided upon, the selection of capacity had to take account of possible assembly of ship sections on the ground (at the head of the ways) before they were placed in the ship. The parts as received from the shops are below two tons in weight. Bulkheads might be assembled in horizontal position, to advantage, but as they weigh up to 30 tons some limit had to be set to this procedure in advance. Small derricks were believed to give such a gain in operating speed that it was finally concluded to disregard bulkhead assembly and limit the capacity to five tons.

Data concerning the dimensions and locations of the towers and the relation of their height to the ship's height will be found in the sectional diagram Fig. 1. The towers range from 53 to 59 ft. high, the lowest being at the outshore end, while the highest is alongside the bridge. The design in all respects is for the larger of the two types of ship which the American International Shipbuilding Corporation has on order for the Government (dead-weight tonnage 8800, length over all 450 ft.) The dimensions of the two were given in *Engineering News-Record* of July 4, p. 6.

Various interesting features of the derricks and towers are brought out by the drawing, Fig. 5. With both derricks at one end of the tower the bull wheels are too close together to admit bracing in the plane of the two masts, and in consequence diagonal stifflegs were necessary. As the two stifflegs have to pass each other, they are set at different angles; the deck plan of the derrick tower shows this most clearly. Steel brackets forming part of the tower construction engage pins in the lower ends of the stifflegs, taking the uplift when the load is far out and also holding the derricks in position on the platform.

The towers have rigid bracing throughout. The end planes have A-frame portals, which give the necessary traffic clearance over the trucking road. The side bracing contains trusses to support the load of the deck.

The derricks were among the very first items of equipment ordered by the corporation. At the time, the controlling view was that all the plant construction should be of most temporary character—to do the required work at lowest first cost. Accordingly the towers as well as the derricks were to be built of timber. Difficulties in developing satisfactory tower framing with timber were soon encountered, however, and the design was worked out in steel. Timber derricks were retained, and the result is the present combination of wood and steel. Alternating-current motors operate the hoisting engines. They are induction motors with resistance control through slip rings. The yard transformer station receives current by high-voltage transmission from Philadelphia, and steps it down to 440

FIG. 6. SCAFFOLDING AND DERRICKS ARE FITTED WITH PROJECTOR LAMPS FOR NIGHT WORK AT HOG ISLAND SHIPYARD

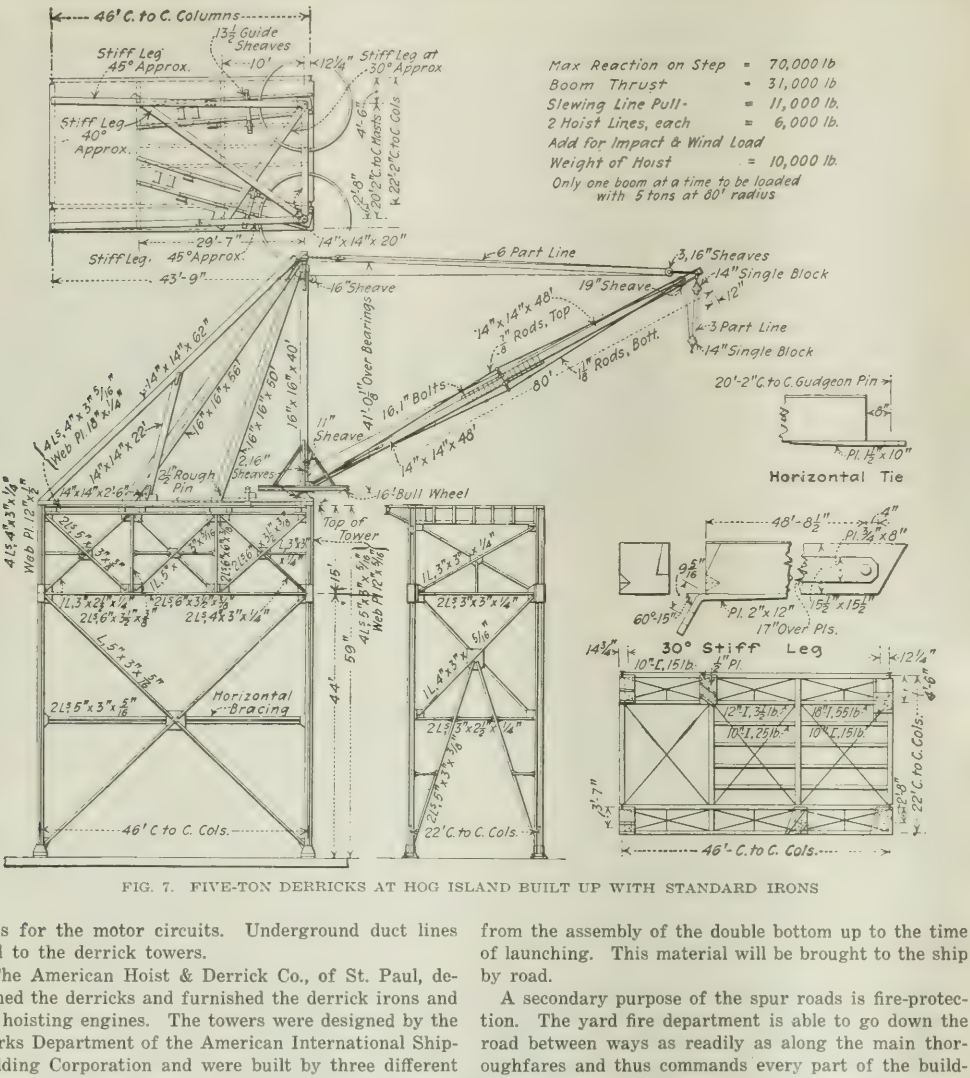


FIG. 7. FIVE-TON DERRICKS AT HOG ISLAND BUILT UP WITH STANDARD IRONS

volts for the motor circuits. Underground duct lines lead to the derrick towers.

The American Hoist & Derrick Co., of St. Paul, designed the derricks and furnished the derrick irons and the hoisting engines. The towers were designed by the Works Department of the American International Shipbuilding Corporation and were built by three different concerns, John Eichleay Co., Blaw-Knox Co., and American Bridge Co., all of Pittsburgh. The towers were erected and the derricks were framed by the shipyard forces.

The provision of trucking roads in the lanes between shipways is an extension of the close-mesh road system of the yard to the ways (note the approach road in Fig. 6). All hull material reaches Hog Island by rail, and the intention is to schedule its fabrication in such order that it can go direct to the ways when received. If it must go to the general storage yard, it is later again loaded on cars and sent to the ways; there are no vehicle roads in the storage yard. A great deal of ship equipment material, however, comes to the shipways from storehouses; this includes piping, joinery and a multitude of other items, required at all stages from the assembly of the double bottom up to the time of launching. This material will be brought to the ship by road.

A secondary purpose of the spur roads is fire-protection. The yard fire department is able to go down the road between ways as readily as along the main thoroughfares and thus commands every part of the building-berth area. All roads in the Hog Island shipyard are built with plank surfacing.

The organization of the American International Shipbuilding Corporation is headed by Frederick Holbrook, president. George J. Baldwin is chairman of the board. Peter O. Knight, H. D. H. Connick, A. R. Patterson, F. W. Wood, H. L. Rogers and G. O. Muhlfeld are vice presidents.

Concrete Freight Cars May Be Coming

The use of concrete as a substitute for steel in car construction is one of the latest methods suggested to offset the scarcity of steel. A 40-ft. reinforced-concrete gondola car of 50 tons capacity is being built to the designs of J. B. Strauss, Chicago, and will be submitted to loading and service tests.

Arched Steel Cantilevers Used in Park Avenue Viaduct

Crossing Over Forty-Second Street, New York, Creates New Thoroughfare to North—Spans Arched for Beauty—Design Eliminates Thrust

By Harry W. Levy
Assistant Engineer in Charge of Designing, Bureau of Highways, New York City

FIG. 1. VIADUCT AT GRAND CENTRAL TERMINAL WILL CARRY NORTH-SOUTH TRAFFIC OF PARK AVENUE OVER FORTY-SECOND STREET TO ELEVATED ROADWAY AROUND TERMINAL BUILDING

STREET traffic north and south at the Grand Central Terminal in New York City is seriously hampered by the narrow streets, street-car concentration, traffic congestion and the detour around the station building. An important improvement will be effected by a new viaduct, now under construction, carrying Park Ave. across 42nd St. over grade, and leading to an elevated roadway which, passing around the west side of the station building, connects by way of 45th St. with the northward prolongation of Park Ave. In designing this structure, conditions led to the unusual expedient of using steel cantilever girders shaped to appear as arches. Æsthetic considerations called for arches, but as the site is over a network of rapid-transit subway structures it was not practicable to provide abutments for true arches. The arched cantilever construction offered a convenient solution.

In the Borough of Manhattan the heaviest traffic is carried by the north and south thoroughfares, which are few in number, being spaced about 800 ft. apart. Some

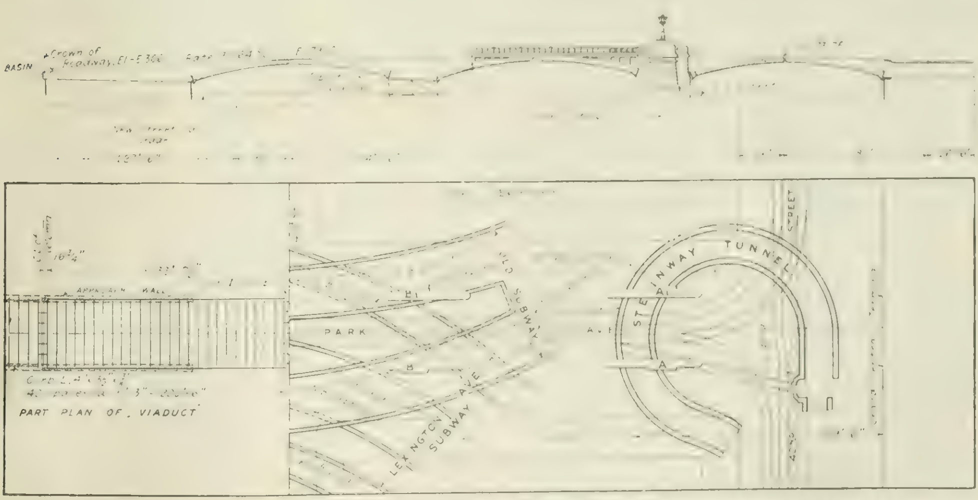


FIG. 2. VIADUCT SUPPORT OVER COMPLEX NETWORK OF RAPID-TRANSIT SUBWAYS WHERE NEW LEXINGTON AVENUE LINE CONNECTS WITH FOURTH AVENUE LINE

of them, like Park Ave., are not continuous, and steps are being taken to relieve this situation by connecting the parts now obstructed. The most important advance in this respect will be made by the completion of the Park Ave. viaduct.

Park Ave., or Fourth Ave., is now interrupted from 42nd to 45th St. by the Grand Central Terminal building. Vehicles must take a roundabout route through 42nd St. and Vanderbilt Ave. When the Grand Central Terminal was designed, in 1911, provision was made for the railroad company to continue Park Ave. southward from 50th St. to 45th St. by way of a steel viaduct over the railroad tracks, and construct an elevated roadway around the western side of the Terminal building to 42nd St. The city agreed that it would build a viaduct south of 42nd St., connecting the elevated roadway with Park Ave. at 40th Street.

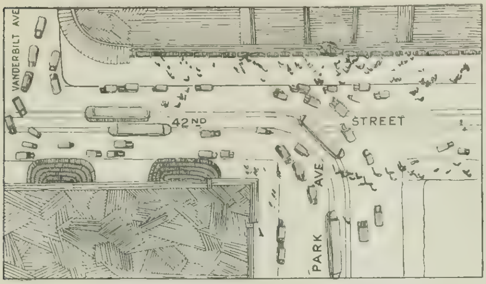


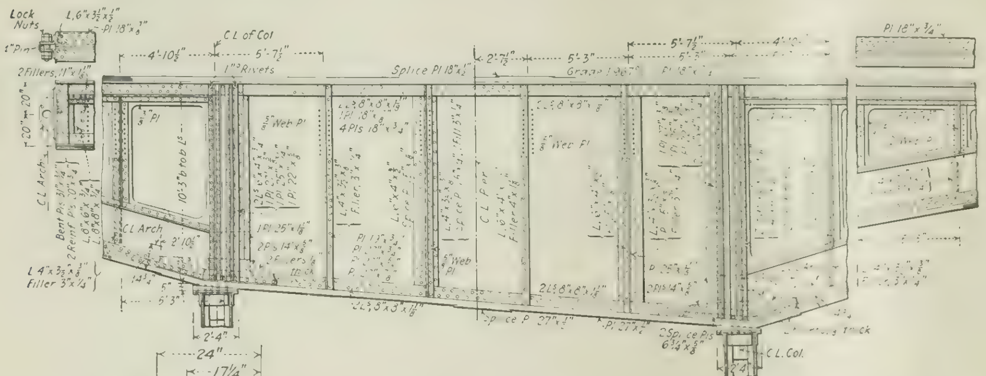
FIG. 3. TRAFFIC CONCENTRATION WHICH VIADUCT WILL RELIEVE—SKETCHED FROM AERIAL PHOTOGRAPH

The railroad work was completed some time ago, but the building of the viaduct by the city was delayed, owing to the construction of the new Lexington Ave. subway directly beneath the proposed footings of the viaduct. The subway is now nearing completing. The contract for the viaduct has been awarded and work has been begun; if there is no unexpected trouble in obtaining deliveries of steel, it will be completed early in 1919.

The structure is directly over the present street railway tracks, which here are in the open-cut approach of the street-railway tunnel extending from 34th to 40th St. They are at present several feet below the street grade, but are being raised in connection with the construction of the viaduct to meet the roadway grade of Park Ave. between 41st and 42nd Sts. This will open 41st St. to crosstown traffic.

Because of its location, the new structure was subject to rather high æsthetic requirements. It was designed to harmonize architecturally with the Grand Central Terminal. The graceful lines of the viaduct, its paneled steel arches and its ornamental lamp standards and railings give it a monumental character.

From 40th to 41st St. there will be an approach carried by closed granite-faced walls. Three arch-shaped spans extending north from 41st St. will connect it with the elevated roadway at the front of the Terminal building. These spans, while in appearance steel rib arches, are heavy steel cantilever girders resting on pairs of columns in the approach walls and piers. The granite piers are ornamental only, the entire load from the viaduct being carried by the steel columns.



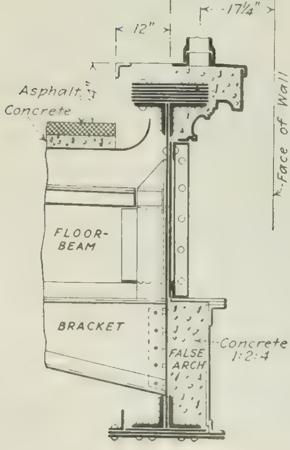


FIG. 4. FRAMEWORK OF "ARCHES" CONSISTS OF STEEL CANTILEVER GIRDERS CARRIED ON COLUMNS IN PIERS—PANELING OF GIRDERS SURMOUNTS FACING RIB

The girders will be built up to appear as steel box paneling resting on a long steel arch chord member abutting against the granite piers and approach walls. Above the steel paneling an ornamental iron fascia supports a decorative railing. The cross-section in Fig. 4 shows the facing-rib construction used to emphasize the arch appearance, and also shows the coping fascia.

The viaduct is designed for a distributed live load of 100 lb. per square foot., in addition to a concentrated live load of 30 tons on a wheel spacing 8 x 12 ft. It will be used solely for vehicular traffic. The roadway will be wide enough to accommodate four lines of vehicles.

The idea of designing the steel spans as cantilever beams, but yet making them appear as arches, grew out of the physical conditions of the site. A true arch design would have required space for its abutments, in the street and in the Grand Central Terminal building, that could not be spared, and would have involved practically impossible foundation conditions. The girders forming the northerly half of the north span will be supported on columns located at the northerly building line of 42nd St., extending back over these columns to frame into the existing steelwork in the Terminal building. The other girders will be supported individually on two steel columns at the piers or in the approach walls, which will incase both the columns and that part of the girder between them. The girders over the piers are the largest and heaviest, being 136 ft. long by about 12 ft. deep at the supports, and weighing 73 tons each. All of the girders will be fabricated and shipped as units, and erected without field splicing. The meeting ends at the crown of each "arch" will be joined by a horizontal pin through slotted holes allowing a maximum expansion of two inches.

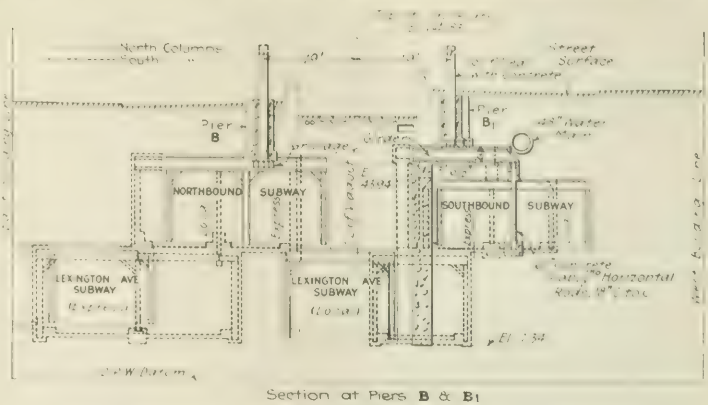


FIG. ELABORATE FOUNDATIONS OF VIADUCT MADE NECESSARY BY NUMEROUS SUBSURFACE DIFFICULTIES

The floorbeams are to be of plate-girder sections; the upper side of the web is cut parallel with the crown of the finished roadway. An 8½-in. reinforced-concrete floor slab continuous over the tops of the floorbeams will be covered with four-ply waterproof fabric which will be protected by a 3-in. layer of concrete. On top of this a 3-in. asphalt pavement is to be laid.

The exposed portions of all floorbeams, brackets and inside of the main girders will be covered with 1½ in. of 1:3 cement mortar placed by the cement gun on 2-in. mesh of 12-gage wire, securely fastened to all steel members.

Most difficult foundation conditions confronted the designers. Park Ave. is honeycombed with subway and tunnel structures at the site, as can be seen in the plan, Fig 2. The column footings had to be supported on them or carried around them.

The two southerly pairs of columns will rest on two sets of double girders which span the old or Fourth Ave. subway. The other columns will generally be supported by girders resting on columns located between the subway tracks and on piers built up outside of the subway walls or the columns will rest directly on the subway roof itself. The maximum reaction (400 tons) occurs at the base of the columns in Pier A, which will be placed on high concrete pedestals founded on rock. The columns on the north building line of 42nd St. extend through five finished floors of the Grand Central Terminal building and rest on grillage beams 60 ft. below street level.

Construction work is to be carried on in a manner that will cause the least interference with street traffic. The existence of gas mains, sewers and a 48-in. water main in the western roadway, makes it necessary at one pier to excavate the eastern roadway and carry a drift beneath these structures to the subway roof, so that grillage girders can be placed in position. In addition, a depressed bay will be constructed in the subway roof to accommodate the girders. By setting the girders so as to clear the subway, all danger is avoided of transmitting to the latter any load from the viaduct. The other foundation piers and girders will be placed in the ordinary manner through an open cut.

To avoid side pressure on the subway walls, all adjacent concrete piers will be carried down to the elevation of the wall footing. Protection of the columns between the subway tracks against damage in possible derailment of subway cars is provided by concrete walls extending several bents on either side of the columns.

The completed structure will require 1200 tons of steel, 2000 cu.yd. of concrete and 14,000 cu.ft. of granite; about 2000 cu.yd of excavation will be necessary. The contract form required itemized bids but there is a provision for doing extra work which could not be itemized, on a cost-plus-percentage basis. The Terry & Tench Co. bid of $517,000 was the lowest of six.

The original design of the viaduct was made by Olaf Hoff, consulting engineer, and Warren & Wetmore, architects. Modification of this design was suggested by Eugene W. Stern, chief engineer of highways. As Mr. Stern is absent on military duty the supervision of construction will fall upon Clifford M. Pinckney, acting chief engineer.

Well Condemnation Decreases With Depth

Condemnation of well waters as the result of inspections and analyses by the Illinois State Water Survey for the nine-year period from 1907 to 1916 shows that as the depth of the wells increases the percentage condemned as unsafe decreases. During the period named 11,281 wells were examined and of these 5091, or 45%, were condemned. For wells less than 25 ft. deep the percentage of condemnation was 74; 25 to 50 ft., 63; 50 to 100 ft., 36; more than 100 ft. deep, 14. Of wells with unknown depths the percentage of condemnation was 44, the total number of wells being 636.

The Truth About Imhoff Sewage Tanks at Baltimore

Correction of Misleading Statements—Foaming Difficulties Outlined—Insufficient Sludge Capacity—Cause of Disuse

BY THOMAS D. PITTS
Lately Engineer in Charge of Sewers, Baltimore

REPORTS have been circulated that "the Baltimore Imhoff tanks are in bad repute * * * that the operation of the tanks became unsatisfactory, sludge foamed over the top, and the condition seemed to be beyond remedy to the extent that the tanks were taken out of service and the further construction of units of this type is not contemplated." This report is just near enough to the truth to be misleading, and therefore it seems worth while to give the facts.

Before construction was started on the Baltimore sewerage system, in 1906, the consulting engineers, Messrs. Stearns, Gray and Hering, outlined for the disposal plant a plan which contemplated the use of septic tanks, sprinkling filters and final settling basins before the effluent was discharged into Back River, an arm of Chesapeake Bay. This outline plan was followed very closely in the contract plans, prepared by the disposal division, Ezra B. Whitman, division engineer, under Calvin W. Hendrick, chief engineer, with the exception that for the primary treatment plain settling tanks are used instead of septic tanks, arrangements being made to draw the sludge off for digestion in separate tanks. Later, it was decided to interpose revolving screens, covered with wire cloth having 26 meshes to the inch, between the settling tanks and the filters, to reduce the trouble from clogging of the sprinkler nozzles by the fine material carried over in the effluent.

TWENTY-EIGHT IMHOFF TANKS CONTRACTED FOR

In 1914 the Sewerage Commission contracted for the construction of 28 Imhoff tanks, anticipating that the flow of sewage would shortly be too great for the settling tanks already installed, and desiring, further, to give the Imhoff tanks a thorough test. These tanks were described and illustrated in both *Engineering News* and *Engineering Record* at the time. They are circular in form, with conical sludge chambers, and are designed for radial, downward and outward flow from a central, circular distributing channel, the effluent being drawn off through V-notch weirs at the circumference. These tanks were designed in accordance with Dr. Imhoff's latest ideas and the plans were submitted to him for approval before the contract was let. Each tank was expected to pass 500,000 gal. of sewage per day, representing about 4000 population, and the volume of the sludge chamber in each tank is 3650 cubic feet.

The tanks were put in service late in 1915 and they were very slow in ripening, no digested sludge being found in them until well into the summer of 1916. During the ripening period the tanks were operated at a very low rate, but as soon as they showed signs of proper bacterial action the rate was increased, and we began to have trouble almost at once with foaming at the gas vents and excessive scum formation. There were times with all the tanks when nothing but liquid was discharged from the sludge pipes, all of the solid matter having risen to the top. We tried various expedients without success, such as breaking up the scum with a hose stream, skimming it off, sinking it, etc., but found the only thing to do was to put the tank out of service for periods varying from a few days to two or three weeks, and then start it again very slowly.

After trying various rates of operation we found that we had little trouble as long as we did not try to pass more than 250,000 gal. per day through a tank, and for nearly two years they were operated at that rate. At the end of that time they were put out of service because the volume of flow was too low to be handled by one of the settling tanks and the Imhoffs, and at the same time not large enough for the running of two settling tanks and the Imhoffs with satisfactory results, especially in the matter of odors. Another reason for discontinuing the use of the Imhoffs was that there was so much loss of head through them that the water level in the channel leading to the screens had to be carried a foot lower than would otherwise have been necessary, seriously reducing the available area of the screens.

TO CHANGE IMHOFF TANKS AND BUILD NO MORE

We are now planning to change the Imhoff tanks from outward and downward flow to outward, horizontal flow, and to raise the inlet and outlet weirs so that a higher water level will be carried on the screens; and shall put them in service again as soon as the flow increases beyond the capacity of two settling tanks. We do not, however, expect to be able to operate them at a higher rate than 250,000 gal. per day each, as Hammond's experiments in Brooklyn show clearly that, for American conditions, our sludge room is not large enough for a larger population than is represented by that amount of sewage. Our observations indicate, further, that our gas vents are not large enough to take care of the gas generated when the rate of flow is greater than that figure.

It is not likely that we will build any more Imhoff tanks at our Back River plant, because we find the cost, both for construction and operation, to be higher per million gallons than for the settling tanks with separate sludge digestion tanks which were built in the first place. Future tanks will probably be plain settling tanks similar to those we now have, but narrower and deeper, with pyramidal hopper bottoms and with sludge tanks set enough lower to allow the sludge to be run out of the settling tanks by hydraulic pressure, as in the case of digested sludge from the Imhoff tanks. We anticipate that tanks of this design can be operated at about half the cost per million gallons that is shown for the Imhoff by our experience.

I do not believe that the Imhoff tank will prove satisfactory for any plant which has to handle quantities of sewage approximating ours, especially where it is stale, as at Back River, but it may be both satisfactory and economical for smaller plants with fresher sewage, if ample sludge room is provided. I should prefer a longitudinal-flow design in any event, and our experience is that the horizontal flow is less likely to lead to excessive sludge formation than the downward flow used in our tanks. One tank arranged for horizontal flow has given us little or no trouble.

How the War Has Increased the Corps of Engineers

Officers and Men Before War Were Twenty-Five Hundred—Two Hundred Thousand Now—More Than Half in France

WHEN the United States declared war on Germany, Apr. 6, 1917, the corps of engineers of the United States Army consisted of 256 officers and three battalions of engineer troops aggregating 2100 enlisted men. There were also 112 civil employees in the Engineer Bureau. These figures do not include any of the civil employees of the Enginer Department at large engaged on river and harbor and other public works, but do include the officers of the Corps of Engineers detailed to such work. At the present time there are approximately 7800 engineer officers on active duty, of whom about 400 are officers of the Corps of Engineers of the regular Army. The balance are officers of the Engineer Reserve Corps; Engineers, National Army; Engineers, National Guard; and Railway Transportation Corps.

There are at present in various stages of organization some 284 regiments, separate battalions or smaller independent units including the following special services:

Divisional Engineer Regiments.
Mounted Engineer Battalions.
Divisional Engineer Trains.
Forestry Regiments.
Standard-Gage Railway Construction Regiments.
Standard-Gage Railway Operating Regiments.
Standard-Gage Railway Operating Battalions.
Standard-Gage Railway Shop Regiments.
Standard-Gage Railway Maintenance of Way Battalions.
Standard-Gage Railway Maintenance Equipment Battalions.
Standard-Gage Railway Transportation Battalions.
Standard-Gage Railway Trades and Storekeepers Battalions.
Camouflage Service.
Railway Transportation Corps.
Light Railway Construction Regiment.
Light Railway Operating and Shop Regiment.
Highway Regiment.
Supply and Shop Regiment.
General Construction Regiments.
Water Supply Regiment.
Mining Regiment.
Quarry Regiment.
Surveying and Printing Service.
Gas and Flame Regiment.
Electrical and Mechanical Regiment.
Crane Operating Companies, Port Terminal Service.
Auxiliary Forestry Battalions.
Service Battalions.
Motor Transportation Companies.
Pontoon Trains.
Army Pontoon Park.
Engineer Depot Detachments.
Engineer Training Regiments.
Corps Engineer Regiments.
Replacement for Engineer Units.
Inland Waterway Companies.
Military Mapping Service, and Gas Training Service.

The total authorized enlisted strength of the above organizations is 231,000. The actual enlisted strength of all engineer troops is now 200,000, of which some 110,000 were in France the middle of June. In addition there are approximately 315 civil employees in the Engineer Bureau.

Porto Rico Army Camp Designed for Tropical Conditions

Ideal Site Near San Juan in Hills by Ocean—Designs Made More Airy—Sanitary Details Raise Standard in Island Territory

ALTHOUGH the huge army camps which engineers and contractors put up so rapidly last summer have been described over and over until every one must recognize their general appearance and know the details of their design, the cantonment being erected in subtropical surroundings in Porto Rico has developed decided revisions in the types of buildings used. The climate made easy the selection of a site much more inviting than was possible for the camps in the states. In consequence, there is building near San Juan a cantonment familiar in its general appearance, but at the same time of a type indigenous to the country. For engineers who have had or will have experience in the tropics it is worthy of note that the high grade of conditions sur-

LOCAL WORKMEN ERECT WITH SPEED AND EFFICIENCY THE WOODEN BARRACKS FOR CANTONMENT

TYPICAL BARRACKS HAVE NO GLASS WINDOWS BUT LOUVER SHUTTERS AND OPENING UNDER EAVES

rounding the laborers building the camp has had a stimulating effect on the morale of the natives and has markedly increased the productivity of the workmen.

The site for Camp Las Casas covers several hundred acres about five miles southeast of San Juan. It borders on one of the best suburban residential sections and is reached by the Carretera, one of the famous military roads built by the Spaniards. It is on a high, sandy ridge rising from 50 to 100 ft. above sea level and jutting out along a lake of considerable size directly connected by a waterway to the city of San Juan and only a short distance from the ocean. The soil is sandy, and almost the entire tract is covered with beautiful cocoanut palms, mangoes and other tropical trees, most of which have been saved, thus adding materially to the appearance of the camp.

The standard building plans of the other cantonments were adopted by the Government, with modifications required by the climate. No glass, for instance, is used on the island, so in this camp louvered shutters cover the windows, all openings being protected by screens against flies and mosquitoes. The eaves of all buildings are board, and the walls are left entirely open for a space of a foot or more under the projecting roofs, to permit the greatest circulation of air inside the barracks. The temperature in Porto Rico in winter averages 73° and in summer 79°, so that a practically open building can be used.

Special effort was made to maintain the highest grade of sanitary services in the camp. A complete sewer system was installed and an abundant supply of pure water arranged for. It is stated that the high standards kept have had a favorable reaction in the adjoining community. The officer in charge found upon his arrival that the sanitary conditions of the city of San Juan were not as good as they might be. Whether it was due to politics, lack of money, or other influences, the fact remains that sewerage facilities, proper plumbing, lavatories and cesspools were in many places lacking. Realizing that the health of the soldiers in the camp would depend very largely on the sanitary conditions of the city, this officer started a campaign which resulted in arousing not only the officials but the population at large to an effort to improve sanitary conditions. At this time they have planned an incinerator for the destruction of garbage, new sewers, cesspools and public

THE UNITED STATES ARMY BUILDS A CANTONMENT AT SAN JUAN IN PORTO RICO ON THE SHORES OF A LAKE AND ALONGSIDE THE OCEAN

STREETS AND ROADS OF CANTONMENT NEAR SAN JUAN, PORTO RICO, LAID OUT THROUGH TROPICAL FOREST WHICH WILL BE PRESERVED

latrines, all of which when completed will do much to make the city more sanitary and safe. The elimination of flies, too, has been taken up by the local authorities and, following the advice of the army engineers, a campaign is now on to destroy these pests.

Labor conditions have greatly improved since work started. The engineers, together with the labor superintendents, were all Americans, many of whom had been employed in similar work during the past summer in the States, but the other labor was secured locally. The Porto Rican peon laborer at first was unsatisfactory. Generally he was lazy, inefficient and dull when he first came to work, but it has been proved on this job, that a large part of these defects are caused by lack of nourishment. The Porto Rican workman is very ignorant on the question of food, and subsists largely on bananas, beans and coffee. His food is cooked with a great deal of grease, eaten in unsanitary conditions and irregularly. On the camp work a mess was established and these workmen received three good meals a day. Reports came in at once that their efficiency had increased at least 50%. When properly fed and managed by skilled workmen, these laborers were found most satisfactory and carried on the work expeditiously and well. There is no doubt, too, that the native workmen will act as missionaries to carry back to their homes the gospel of cleanliness and the effectiveness of well prepared food they learned in camp. There was a little delay in starting due to the holding up of materials which came from the States, but this was overcome by local purchases.

The construction of Camp Las Casas is directly in charge of Major Ernest B. Steward, Corps of Engineers, N. A., with Capt. G. A. Watkins, N. A., as assistant constructing quartermaster, and Charles B. Burdick, of Alvord & Burdick, Chicago, as supervising engineer. The contractor is the Purdy & Henderson Co. of New York City, with N. A. Richards, vice president and general manager, in charge. Camp Las Casas was so nearly completed by June 1 that the 6000 men called then could be accommodated. It is now practically completed.

Ultimate Costs of Bituminous and Water-Bound Macadams Nearly Equal in New York

Highway Department Investigation Indicates Total Tonnage Affects Cost But Slightly—Equation Derived for the Relation of Ultimate Cost to Traffic Tonnage

BY DUDLEY P. BABCOCK
Assistant Engineer, New York State Highway Department

WATER-BOUND and bituminous macadam pavements were found to be almost equal in ultimate cost, in recent investigations of these types made by the New York State Highway Department. The results were interesting and quite unexpected, not only in that there was so small a difference between the two types, but also because it appeared that traffic tonnage has a very small effect upon the ultimate cost. Some interesting data in regard to the average daily traffic on the highways of the state were also collected.

The advent of motor vehicles and the consequent introduction of various new types of pavements have raised the question of the ultimate cost of highways, and this has become a vital and complex issue throughout the entire country. The term "ultimate cost" not only comprehends the first expenditure, but also covers the outlay for maintenance, repairs, and resurfacing. In other words, it is everything that its name implies from an economic point of view. More specifically, throughout the study of New York state highways, which has been made under the direction of the State Highway Commissioner, the ultimate cost has been considered the amount of money spent by the people of the state per year, in order to build, repair, resurface, and at periods of time far apart reconstruct each square yard of pavement. In view of the limitations put upon it, this study does not attempt to go beyond the pavement. Notwithstanding this fact, figures illustrating the cost of excavation, subdrainage, culverts and the like would be distinctly pertinent to the discussion.

It seemed practicable to include in the study only the shorter lived types of pavement, as water-bound and bituminous macadams, as the more permanent types, as brick and concrete, are of such recent development compared with their probable length of life that even tentative conclusions are hardly warranted. However, in the case of macadam types, many of the roads analyzed were old enough to form a basis for such conclusions. To aid in the more complete estimate of the cost of these roads, extensive statistics had been collected and were available for comparative study.

Treating, first, the ultimate cost, it may be resolved into the following factors:

(1) First cost per square yard; (2) length of time before this expenditure will have to be repeated; (3) interest on bonds; (4) cost of maintenance and repair per year; (5) cost of resurfacing, which is somewhat less than the first cost, inasmuch as resurfacing does not generally include the replacing of the bottom course; (6) the time interval between the resurfacings.

Factors 1, 3, 4, and 5 are easily obtainable from the records kept by the department. The number of years over which the expenditure for construction and the periodical expenditures for resurfacing may be considered to extend are more difficult of deduction. It will be assumed that the life of the pavement extends from the date of construction to the time when it will have to be entirely rebuilt at an expense approximating the original cost. Thus, if the original cost of construction is assumed to be 70c. per square yard, and the depreciation, notwithstanding ordinary maintenance and repair, is assumed to be 2c. per square yard per year, the term of the bonds would then be $70 \div 2 = 35$ years. The classification in one item of the resurfacing and the

TABLE SHOWING RESULTS OF INVESTIGATION OF ROADS UNDER CLASSES I AND II, INCLUDING ULTIMATE COSTS AND THEIR DISTRIBUTION

Type	Class	No. of Roads Studied	Mileage	Time Limits of Original Construction (Inclusive) From	To	Average Period, Years	Average Ultimate Cost per Sq.Yd. per Yr. Cents	Distribution: Average Depreciation per Sq.Yd. per Yr. Amt. Cents	% of Total	Average Maintenance and Resurfacing per Sq.Yd. per Yr. Amt. Cents	% of Total	Average Net Interest on Investment per Sq.Yd. per Yr. Amt. Cents	% of Total
Waterbound macadam	1st	79	300	1902	1912	6 3	11 4	2 0	17 0	7 88	69 0	1 55	14.0
Waterbound macadam	2nd	108	410	1902	1910	7 6	13.7	5 5	40 0	6 7	49 0	1 5	11 0
Bituminous macadam	1st	11	44	1909	1910	4 74	12 2	2 0	16 4	8 49	69 7	1 69	13.9
Bituminous macadam	2nd	67	257	1909	1910	6 3	14 0	7 57	54.2	4 48	32.1	1 91	13 7
Waterbound macadam resurfaced with bituminous	2nd	21	68	Built 1902 1907	Resurfaced 1909 1910	12.7	13 5	2 6	19 3	9 6	71.1	1 3	9 6

ordinary maintenance and repair obviates the necessity for distinguishing between the two.

Two methods of arriving at the ultimate cost suggested themselves, and the department grouped the roads studied in two classes. The assumptions determining the classification have in each case their peculiar disadvantages, but it was felt that a fairly equitable value would be obtained if the two methods were used independently and the results averaged.

In the first class were grouped those roads which had just been resurfaced, or which because of thorough maintenance and repair were considered "just as good as new"; with the exception of a small charge for depreciation. In the second class, those roads were grouped which had been built five years or more. They were selected irrespective of the condition of the road at the end of the period.

Determining Ultimate Cost

Taking up the first class, the ultimate cost was deemed to be made up of (1) An arbitrary depreciation charge, which was placed at 2c. per square yard per year; (2) maintenance and resurfacing per square yard per year; which item included the summation of all maintenance, repairs and resurfacing, divided by the number of years since the original construction; and (3) interest on the first cost per square yard at 2% per year, which is approximately the net interest per square yard per year at 4% on the investment. It is made up of the annual interest at 4% on the cost per square yard, minus the average interest per square yard per year at 4% on the invested sinking fund. Considering a road with a 35-year life, this last item would be the interest per square yard on the sinking fund in the 17½ years. While 2% of the first cost per square yard does not give exactly the net interest per square yard per year, as figured by compound interest, still it is close enough for the purpose of this study.

This may be shown analytically as follows; let $c =$ the original cost of the pavement per square yard; $d =$ the depreciation per square yard per year; c/d, the life of pavement $= L$; $c/2$ the total amount of money per square yard deposited in the sinking fund by the $L/2$ year. Interest rate $= 4\%$; then net interest $= 0.04c. -0.04\ C/2 = 0.04c - 0.02c. = 0.02c.$

A concrete example may help the reader to follow the method of analysis used with the first class. Assume that a road has just entered its eighth year, and that the original cost of the paving was 70c. per square yard; that every year 2c. per square yard has been expended for patrol, oiling, repairs, etc.; and that at the end of every seventh year it must be completely resurfaced at a cost of 42c. per square yard. Assume, further, that at the end of 35 years not only the top course but the bottom course also must be entirely renewed at the original cost. The road, having just been resurfaced, would then appear to be "just as good as new," and would be in the first class, but as a matter of fact there would be a small depreciation charge due to the fact that the resurfacing did not include the renewal of the bottom course. The ultimate cost per square yard per year would then be as follows:

	Per Square Yard Per Year
Depreciation 70c 35	\$0 02
Maintenance	02
Resurfacing 42c./7	06
Maintenance and resurfacing	08
Net interest chargeable, 2% of \$0.70	014
Ultimate cost	\$0 114

Next, considering the second class, the depreciation was assumed to be one-half of the first cost divided by the number of years covered. This was done because some of the roads included were as good as new, others were half depreciated, and still others were in almost a worthless condition; thus, the average road might be considered one-half depreciated. Therefore, the ultimate cost of the pavement would be the sum of this depreciation per square yard per year; the maintenance and resurfacing per square yard per year; and the interest on the first cost per square yard at 2%. The last two items were figured the same as for the first class.

Results of the Investigation

The results of the investigation, under the two classifications, of 286 macadam roads, of both the water-bound and bituminous types, are shown above in tabulated form. In the first class, 79 water-bound and 11 bituminous roads, with an aggregate mileage of 300 and 44 respectively, were studied. Under the second class, 108 water-bound and 67 bituminous roads were studied, their respective mileages being 410 and 257. Twenty-one water-bound macadam roads which had been resurfaced with bituminous coverings were studied under the assumptions for the second class, although these were not exactly applicable. The table shows the data mentioned above, the years between which the roads studied were built, the average period studied, and the average ultimate cost per square yard per year. The distribution of the average ultimate cost among the separate items and their percentage of the total are also tabulated.

It seems probable that the figure derived from the first class, for the ultimate cost of water-bound macadams, is under rather than over the correct value. This is due to the assumption that the top course at the end of the specified time was as good as new. This, in many cases, was probably not strictly true. On the

other hand, the figure derived from the second class is more likely to be high than low. The assumption made for the latter was that the original cost of construction was half used up at the end of the specified period. It is probable that the bottom course, especially in the newer roads, was about as good as new, and that in the case of the older roads it was not more than half used up. If, then, these two classes give, respectively, results that are too low and too high, the true ultimate cost of water-bound macadams lies somewhere between 11.4c. and 13.7c.—say, 12½c. per square yard per year. The same method of analysis applied to the bituminous macadams gives an average ultimate cost of 13.1c. per square yard per year.

Practically all the bituminous roads constructed between 1909 and 1910 were included. The first year in which the state actively constructed bituminous macadam was in 1909, and no roads built after 1910 were taken. It was thought that subsequent construction had not been in place long enough to determine the charge for maintenance and repair. As explained under water-bound macadam, the first class included only roads which had just been resurfaced. Only 11 roads could be found which were constructed of bituminous macadam prior to 1911, and which had been resurfaced with the same material prior to 1917.

When it is remembered that the traffic on the water-bound macadams was probably considerably less than on the bituminous pavements, the ultimate cost of the latter compares very favorably with that of the former. While the first cost of the bituminous macadams was higher than that of the water-bound macadams, this was apparently offset by a relatively lower maintenance charge. The small variation in the ultimate cost between the two classes studied is remarkable, if we consider the widely different assumptions that were made. Each class was figured completely before being compared with the other.

The relation between traffic tonnage and ultimate cost was next investigated by comparing the results, as obtained by the study outlined above, with the traffic censuses of various roads which were taken by the department in the year 1914. The number of roads considered in the 1909 census was too small to use in any analysis

TABLE SHOWING AVERAGE NUMBER OF VEHICLES, THEIR DISTRIBUTION, PERCENTAGE OF TOTAL, AND PER CENT CHANGE IN PERIOD

Year	No. of Roads Averaged	Average No. Vehicles per Day of 12 Hours	Horse Drawn		Autos and Motorcycles		Motor Trucks	
			No.	%	No.	%	No.	%
1914	510	352	168	48	172	49	12	3
1916	797	433	103	24	309	71	21	5
% Change in 2 yrs.		23	39		80		75	

* Note. The average length of roads may be taken at 3.77 miles.

TABLE SHOWING AVERAGE NUMBER OF TONS CARRIED IN TWELVE-HOUR DAY, THEIR DISTRIBUTION, PERCENTAGES OF TOTAL AND PER CENT CHANGE IN PERIOD

Year	No. of Roads Averaged*	Average Tonnage 12-Hr. Day†	Horse Drawn		Autos and Motorcycles		Motor Trucks	
			Tons	%	Tons	%	Tons	%
1914	902	630	184	29	375	60	71	11
1916	797	853	111	13	609	71	133	16
% Change in 2 yrs...	...	+35	—40		+62		+87	

* Note. The average length of roads may be taken at 3.77 miles.
† Based on assumption of following weight: Motorcycle = 0.2 tons; automobiles = 2.1 tons; motor trucks = 6.2 tons.

covering the whole state. The statistics taken in 1914 and 1916 were fairly complete, and summaries of the results in number of vehicles, their tonnages, distribution, percentage of the total, and total increases and decreases are shown in the tables printed herewith.

The 1914 tonnage per 12-hour day, reduced to the equivalent for a 16-ft. width of road, was plotted horizontally on a chart, and the ultimate cost per square

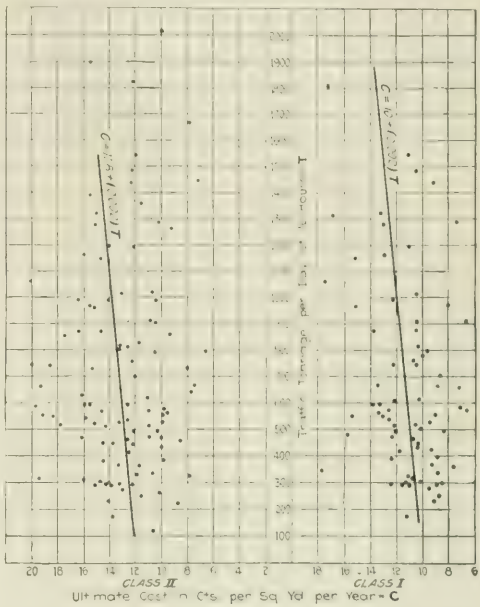


CHART SHOWS RELATION BETWEEN ULTIMATE COST OF MACADAM ROADS AND TONNAGE

yard per year was plotted vertically. For example, if the traffic census shows the tonnage on a 12-ft. road to be 1200 tons per day, the equivalent tonnage adjusted for a 16-ft. highway would be 1600 tons. Only the water-bound macadam roads were used in this part of the investigation, and the ultimate costs and tonnages of each were plotted.

The straight line which most nearly approximated the points, and which is shown on the illustration, was obtained by plotting the figures from the 79 roads included in the first class. It was found to have the equation $C = 10 + 0.002\ t$, where c equals the ultimate cost in cents per square yard per year, and t equals the traffic tonnage per day of 12 hours. The 108 roads included in the second class were plotted, and the equation resulting was $c = 11.8 + 0.002\ t$. Taking a rough average of these equations we have $c = 11 + 0.002\ t$, which, it is fair to assume, is the equation expressing the relation between traffic tonnage and ultimate cost.

The large number of roads used in obtaining this equation seems to warrant the tentative conclusion that the traffic tonnage has relatively small influence on the ultimate cost of water-bound macadams. The maintenance and repair necessitated by traffic tonnage seem

to be hardly more than 15% of the total cost of maintenance and repair.

The elements of uncertainty entering into these studies may be summarized as follows: All maintenance and repair were estimated to apply to pavement. As a matter of fact a small percentage was used to clean ditches, repair culverts, etc. The traffic statistics were obtained by patrolmen, and their accuracy is doubtful. The effect of traffic on the deterioration of the pavements is probably slightly larger than the equations would indicate. This is due to the fact that the roads of heavy traffic were in most cases more easily accessible, being nearer centers of population and railroad centers, and were therefore cheaper to build and maintain. The assumption of 2c. as the deterioration rate used for the first class was purely arbitrary; however, it represents only about 16 per cent. of the total, and this compared very well with results obtained for the second class. The traffic tonnage was used for the year 1914, and was a very rough measure of the relative traffic for the entire period.

Furthermore, it may be noted that the road construction of New York State has been variable in quality, and that roads built during some periods would probably make a better showing than those built in other periods. Therefore, the figures developed are, in a considerable measure, relative, and cannot be used blindly in comparison with other work elsewhere which has been done in different circumstances and under local conditions.

In conclusion, the writer desires to state that while the above analysis is far from giving an accurate solution of the ultimate cost of highways, it is (as far as he is aware) one of the first attempts of its kind.

Reports Show Results of Motor Parcel Post Service

Gross Earnings of $40,000 Per Year Per Route Indicated—Hope to Expend $200,000,000 Of Earnings to Build Roads—Aids War by Saving Transportation

GROSS earnings of $304,436 per year, or approximately $40,000 per year for each of the eight routes operating during the period between Dec. 1, 1917, and May 31, 1918, were indicated by tabulations and reports submitted to the Committee on Post Offices and Post Roads of the House of Representatives at its meeting held June 21. James I. Blakslee, fourth assistant postmaster general, submitted the information and told the committee that the motor trucks operating over the eight routes have traversed 201,811 miles of highway at an average cost of $0.1442 per mile.

The evidence was presented in support of a joint resolution in Congress permitting the Post Office Department to expend 50% of the gross earnings of the motor parcel post business in the building of post roads throughout the United States. It was estimated that such a system of roads would cost in the neighborhood of $200,000,000. It was asserted that the establishment of the motor parcels post would help to relieve the transportation difficulties of the country, and that such a system of roads, bringing the motor express directly to the door of the farmer, would greatly increase production by allowing him to work during the time which he would otherwise have to use in going to market. Thus, this service would help greatly in winning the war, it was asserted. A map showing the proposed system of roads east of the Mississippi River was also submitted, and, together with the tables mentioned above, is shown in the drawing. An abstract of the report submitted by Mr. Blakslee and a discussion of the tables follows.

The Post Office Department has long considered establishing this form of parcel post service, and believes the transportation conditions due to the present war have greatly emphasized its desirability. It was felt that any relief of the present congestion of rail facilities would have a direct bearing upon the winning of the war, and greater attention has been given to the problem recently. Experimentation has shown the many advantages to the mail service of direct connection by motor truck between the various post offices. The great convenience of transporting mail matter directly from the door of the producer to the door of the consumer is also evident, and the consequent saving of man power, which is so precious at this time, would, it is believed, amply justify the necessary expenditure.

The success and the efficiency of operation of the motor parcels post was deemed to rest upon three conditions. The first of these is the interest and coöperation of the patrons, and this could not be obtained until they were first shown the value of the service. The second depends upon economical operation of motor vehicles in reference to first cost, maintenance and capacity for delivering goods with profit to the operator. Third is proper highways over which to operate. To arouse interest and also to obtain information in regard to proper methods of motor truck operation, the Post Office Department decided to establish several routes over good roads, in various parts of the country. Wherever this service has been established, it has been well received, and the interest and coöperation of the public seem assured. The successful operation of the

TABLE SHOWS THE OPERATING COSTS AND EARNINGS OF THE UNITED STATES

Route No.	From—	To—	*Gasoline Gallons	*Gasoline Cost	*Grease and Oil Cost	*Tires and Tubes	*Repairs Labor	*Repairs Material	*Accessories	*Garage	*Salaries of Carriers	†Supervision P. O.	†Supervision Dept.
10738	Philadelphia	Atlantic City	2,888	$686 84	$51 44	$400 28	$335.60	$43.55	$16 40	$145.72	$942 03	$222 00	$165 72
13283	Baltimore	Solomons	2,866	697.97	92 83	373.77	132.31	42 04	25 78	141 74	1,068 82	88 31	425 31
13293	Washington...	Leonardtown..	3,814	874 94	163 72	695.85	358 95	327 48		111 76	1,432 26	32 75	555.19
13299	Washington	Baltimore ...	3,345	804.46	151.07	391.70	277 85	47 92	23 53	125 11	1,578 50	134 31	477 68
13300	Baltimore.....	Lancaster....	2,497	671 09	143.50	401.36	64 01	5 89	8.03	67 00	963 87	58 10	287 79
13301	Philadelphia..	Washington..	4,863	1,247 01	148 04	825 62	189 05	60 22	40 72	216 70	1,856 04	276 00	597 61
21271	Savannah.....	Statesboro...	516	134.82	33.29	127.49	3.90	.70		27.50	300 00	45 50	31.87
31313	Columbus.....	Zanesville....	847	208 51	40 00	210 85	27.15	30	2 00	29 33	287.21	3 70	37.23
Totals and averages			21,636	$5,325.64	$823.89	$3,426.92	$1,388.82	$528.08	$116 46	$864.86	$8,428.73	$860 67	$2,578.40

* Total direct expenses, $22,305.23; cost per mile, $0.1105. Percentage of indirect to total expenses, 23%.
† Total indirect expenses, $6,794.40; cost per mile, $0.0337. Percentage of direct to total expenses, 77%.

PROPOSED ROUTES, DISTANCES, AND NUMBERS OF TRUCKS FOR SECTION EAST OF MISSISSIPPI RIVER

routes already established fully justify this conclusion. Knowledge pertaining to the solution of the second condition mentioned above was obtained by keeping accurate cost data of operation on all the routes, including every conceivable cost of operation, both direct and indirect charges. Great care was taken in determining these costs, and they are as accurate as could be obtained without unnecessarily delaying the mails.

The accompanying table shows the method of cost keeping. The various items are so arranged that the cost on each route and the average of all the routes can be easily determined. This not only allows for a general average, but also, where routes are in different sections of the country, a good idea can be obtained of the operating costs under different climatic and topographic conditions. Items are also arranged in such a manner that the direct and indirect charges can be kept separate, so that at any future date an analysis of the results can be made along either line. It is not expected that the overhead charges will increase in proportion to the direct charges as the service is expanded, since the departmental charges will be the same in some cases in any event. Considering the different sections of the country in which the trucks operate, some of the charges are very uniform. The average miles per gallon of gasoline are 9.33, with a variation between 8 and 10. The average cost per mile is also very uniform, ranging from 11 to 16c., the average figure being about 14c. The col'.mns containing tons of mail and earnings are less uniform, and the earnings for such small tonnages

MOTOR PARCELS POST FOR SIX MONTHS, FROM DECEMBER 1, 1917 TO MAY 31, 1918

†Interest	†Depreciation	*Miscellaneous	Total Cost	Total Mileage	Cost per Mile	Miles per Gal. of Gas	Maximum Cost of Trucks	No. of Trucks	Service Established	Mail Transported Tons	Gross Earnings	Net Earnings
$33 05	$368 48	$154 66	$3,565 77	24,565	$0 1452	8 51	$3,771 92	2	Jan 9, 1918	35 50	$2,705 25	—$860 52
52 63	405 34	462.61	4,009.44	25,573	1568	8 92	4,545 32	2	July 1, 1917	107 50	33,604 82	29,595 36
61 67	496 13	168 32	5,279.02	33,524	1575	8 79	9,993 00	5	July 1, 1917	192 75	40,655 04	35,376 02
52 13	445 37	24 39	4,534 02	29,690	1493	8.88	5,601 70	3	Dec. 10, 1917	96 75	23,135 34	18,601 32
34 37	383 79	118.56	3,207 36	25,585	1254	10 25	4,023 59	2	Dec. 17, 1917	69 50	19,972 22	16,764 86
66 96	737 81	456.09	6,717.87	49,187	1366	10 11	5,796 33	3	Dec. 17, 1917	116 00	28,717 67	21,999 80
11 11	75 43	17.20	808.81	5,029	1608	9 75	2,222 77	1	Mar. 1, 1918	10 00	1,064 64	255 83
11 19	119 87		977 34	8,658	1129	10 22	1,920 76	1	Mar 4, 1918	10 50	2.362 76	1,385 42
$323.11	$3,032 22	$1,401 83	$29,099 63	201,811	1442	9 33	$37,875 39	19		638 50	$152,217.74	$123,118 11

Percentage of indirect to direct expenses 30%.

seem high. It must be noted, however, that the rate for transportation of mail matter is relatively high, and cannot be compared with that for general merchandise. Computing the cost of transportation per ton, it will be seen that it varies from $27.39 for Route 13,293 to $100.44 for Route 10,738. The latter route had the smallest tonnage, considering the time of operation, of any of the eight, being the only route which was operated at a loss. In every case it will be seen that the trucks carrying the greatest tonnage had the lowest operating cost per ton. The net earnings from the operation of all these routes was $123,118.11. Up to Jan. 21, routes 13,283 and 13,293 required only one truck and up to Jan. 11, route 13,299 required only two trucks. Until Feb. 4, route 13,300 required only one truck, and up to Jan. 10 route 13,301 required only two trucks. The extra trucks shown in the table were put on as the service grew in popularity. The cost of trucks given in the table does not include the cost of tires and tubes which is about $358 for each truck. The trucks were operated six days per week.

Good Highways are Essential

After the service is popularized and it is ascertained that it can be operated at a profit the third and most essential condition in the success of this operation is a good highway surface. Experience has shown that unless a highway is usable every day in the year, so that motor trucks can operate with reasonable regularity, no great revenues will be returned to the department. The resolution now before Congress is the result of this conviction, and the purpose is to produce a system of roads which will be available for motor-truck traffic at any time. Inasmuch as the tables show a considerable profit to the Government from this service, it hardly seems fair that the various states should be required to stand the cost of building and maintaining the highways over which it will operate. Therefore, the suggestion is made to make the service pay for its own roads, which, at the present rate of earnings, it will be capable of doing. The intention is to have this plan carried on in conjunction with the various states, but it is not intended in any sense to replace routes which the various states are building or to interfere with the existing systems already built.

With these ideas in view, the Post Office Department made a survey of possible through and connecting routes east of the Mississippi River, and found that there are approximately 7500 miles of highways which should be covered, and that at least 5000 miles would be absolutely essential to the successful operation of motor-truck service. For the section west of the Mississippi no map has as yet been prepared, but it is assumed that at least a similar mileage would be necessary in that region. The territory east of the Mississippi River has three general north and south routes and four east and west routes. Various minor routes are also shown. The larger cities connected and the distances between them are also shown.

An estimate made by the Post Office Department, which will be confirmed by qualified engineers, shows that a mile of permanent road, exclusive of bridges and municipal streets which are already completed, would cost about $20,000 per mile. This contemplates using every possible ecomical method of construction, including convict labor where available, prisoners of war, and local roadmaking materials. If it were decided to build the entire 7500 miles, this could be done at a cost of $150,000,000. The type of road to be built would consist of either concrete or brick surface and would be not less than 16 ft. wide. The thickness of the paving would be not less than 9 in., with a first-class foundation thoroughly underdrained for the entire distance. No other type of road construction would be considered, because, it is believed, only a hard surfaced permanent road will stand up without excessive maintenance charges under the stress of modern motor-truck traffic.

Economics of Problem Discussed

Admitting the foregoing conclusions and consulting the tabulated costs and earnings in the table, a statement of the economics of the problem may be shown by the following example: Suppose it is determined to operate one thousand routes in the territory east of the Mississippi. It will be seen from the table that the eight routes already established are showing gross earnings of more than $300,000 per year. This is nearly $40,000 per route yer year, and it is fair to assume that when business is further developed these figures will be considerably exceeded. On this basis the one thousand routes east of the Mississippi would produce $40,000,000 annually. From this sum must be deducted $5,000,000 for cost of operation; $10,000,000 for indirect cost of transportation of mails to and from routes, and $5,000,000 for extensions and additional service; leaving $20,000,000 per annum which could be applied for the construction and maintenance of national highways. In like manner, the addition of 5000 routes west of the Mississippi would raise the earning power of the entire system to $400,000,000 per year, which is more than the total annual postal revenues at this time. If the estimate of 10,000 routes is considered excessive, it is only necessary to consider that there are, at present, 60,000 rural and star routes in operation.

Postal Revenues not Endangered

It has been suggested that these new routes would cut down present postal revenues to a considerable extent, but assuming that there are 1000 routes which would not interfere with the postal revenues, then the surplus earnings of these 1000 routes would, in due time, build and maintain the proposed Federal system.

The Post Office Department feels that such a system of highways would not only be of great value to the transportation of parcel post, but also would be a great national asset. It would be a valuable addition to our system of national defense and would furnish a means for carrying the increasing motor-truck traffic necessitated by the lack of other forms of transportation. Of course, this scheme would have to be carried out with due regard to the present conditions and to the winning of the war, but a judicious program prepared now and partially introduced, would, the department feels, when entirely developed, be an extremely valuable national resource.

Construction Problems Many in Building Concrete Ships

How the Shipping Board Is Preparing for the New Government Construction Told by Messrs. Wig and Hollister at Meeting of American Concrete Institute

BUILDING concrete ships is a new art, though its elements are all old. Consequently, many problems arise in the construction which require solution before work can start. The concrete ship department of the Emergency Fleet Corporation has been studying these problems for some months, preparatory to starting construction of the 42 concrete ships now under contract by the Government, and the progress the department has made was outlined in a paper delivered before the recent annual meeting of the American Concrete Institute by Rudolph J. Wig, chief engineer of the department, and S. C. Hollister, engineer of design. In the following abstract is given the portion of the paper relating to the construction problems, and in a later issue will be abstracted that section devoted to the design of the concrete ship.

Concrete Must Be Light and Strong

The first thought of most engineers with regard to materials for the concrete for a ship is to use such as will provide the densest mixture possible. Concrete of high density also has a high unit weight. Our problem is fourfold: The concrete must be durable and impermeable to water; it must have a compressive strength of at least 4000 lb. per square inch at 28 days, and a minimum weight. To meet these conditions we have determined upon the use of a rich mortar mixture.

Any standard portland cement which will meet the specifications of the United States Government may be used, provided the fineness is increased so that at least 90% will pass a No. 200 sieve. The greater fineness is required in order to obtain greater strength and a more plastic mixture. Such a cement is also more volume constant.

For the present the maximum-size aggregate is limited to ½-inch. A sand and gravel or a volcanic ash or specially burned clay may be used. The commercial future of the concrete ships is in large measure dependent upon obtaining a light-weight concrete. Investigations made are quite promising. The strength and weight of one of these mixtures which meets our requirements is as follows: One part cement, to one part special fused clay below ¼-inch size to two parts same aggregate between ¼ and ½-in. size, had a compressive strength of 3380 lb. per square inch at seven days and 4350 lb. per square inch at 28 days. It weighed 106 lb. per cubic foot in a saturated condition.

With the use of this material the ratio of the deadweight to total displacement will be 62% for the 3500-ton ship as compared with 65 to 68% for a steel ship and 53% for a wood ship.

No integral waterproofing compounds of any kind will be used in the mixtures.

Forms Must Be Accurate

The form problem is a most intricate and difficult one. The forms for practically the entire ship must be placed before concreting starts. The accuracy of placing must be much greater than in ordinary building construction, for if the spacing is slightly oversized, it results in increased tare weight of the hull, which, of course, decreases the cargo capacity of the ship. The relatively high unit stresses and the small thickness of covering for the steel also requires unusual accuracy in placing the forms.

There are a number of ways of constructing the forms. They may be of wood or metal, or of wood lined with metal. It has also been suggested that plaster forms may be used. They may be built in panels or as one unit, to be later removed, board by board. The inside forms may be first constructed and the outside forms placed after the steel is fabricated. A more common method is to place the outside forms first, fabricate the steel, and then place the inside forms. The former method is being followed in the construction of one ship for the Emergency Fleet Corporation, but the latter method will be used on subsequent ships. Much time and money can be lost or saved in forming, and much thought and study can profitably be given to this work. In Norway there is one company building small craft by the so-called "upside down" method, in which the inside forms are fabricated in an inverted position. The concrete is shot into place with a gun, or applied by hand, a relatively stiff mixture being used. No ships are being built by this method in the United States.

Reinforcement Small and Accurately Placed

Reinforcing steel which we are using, other than fabric, is of rods or bars rolled from new billets to conform to the American Society for Testing Materials standard specifications for structural grade new billet steel. Plain round bars will be much easier to fabricate than deformed bars, but on account of the uncertainty of the effect of reversal of stress we are using deformed bars wherever the bond stress is high.

The accurate bending of the reinforcing steel is one of the most difficult of all the construction problems. With a wall thickness of only 3½ to 4 in., and two to three layers of steel, need for accurate bending of the steel can be readily appreciated. Furthermore, the curvature is constantly changing forward and aft in the vessel, which requires constant change in the location of the dogs on the bending table. The use of small steel is recommended, in that it is easier to spring into place if the bending is not accurately done.

With a very large quantity of steel, approximately equivalent to 10% of the carrying capacity of the ship, to be placed in a very small space in thin walls, there is much opportunity for the development of ingenious methods of fabricating the steel. Undoubtedly, much time can be saved by prefabricating, at least in part, the steel of the frames and placing them in the ship as units. These frames may be as much as 54 ft. in width and 35 ft. in height, and they must be accurate to within a fraction of an inch. Through a length of 60% of the ship the shape of these frames is constantly changing. All the steel must be supported and secured so that it will not touch the form surface. Numerous

methods have been suggested, and there are a number of chairs now on the market for supporting steel, but all of them have objectionable features.

A study has been made of welding methods and machines as a means of avoiding the lapping of the steel. The acetylene weld is rather uncertain and not satisfactory. The electric resistance weld appears to be the most promising. Several machines of this type have been ordered and are now being tried out. The bond stresses are exceedingly low in the longitudinal steel and there is more space available for lapping. In the frame steel, however, it is so close together that there is not room for lapping without increasing the thickness of some of the concrete members, which will in turn increase the tare weight of the hull. The weld by the electric resistance method can be made quite rapidly, and at small cost. It is not anticipated that welding any steel other than the main steel of the frames and possibly the main longitudinal steel will be required.

Mixing and Placing Concrete Important

Rich mortar mixtures will be used, and they must be carefully proportioned and mixed in order to insure the quality of concrete necessary. Special attention should be given to the selection of the mixer, as all mixers of common types will not thoroughly mix mortars. The concrete should not be transported from the mixer and deposited directly into the forms in continuous operation or in large batches, on account of the danger of not having it thoroughly worked into place about the reinforcing steel. For the present it is required that all concrete shall be shoveled into the forms in order to insure its deposit in small batches and its thorough working into place.

The actual placing of the concrete is a small item in the cost of construction of a ship, and therefore there should not be the incentive to rush the work as in ordinary building construction.

It is preferable to place the concrete as one continuous operation in order to avoid construction joints. This will require approximately three days (of 24 hours each) for a 3500-ton ship and six days for a 7500-ton ship. While it may appear difficult to work the concrete thoroughly around and through the reinforcing, no trouble is anticipated from this source. The rich mortar mixture proposed is quite fluid, even though it is not mixed to a wet consistency, and with a slight tapping of the forms it settles readily into place about the steel. A number of test panels have been made, and the results in all cases have been entirely satisfactory. It is very different to make a construction joint in a section in which is embedded a large quantity of steel. Most leakage troubles occur at construction joints. The uncertainty of the bond obtained at construction joints is also objectionable on account of the large shear stresses. Several mechanical methods of placing mortar and concrete have received consideration, but the results of investigations do not up to the present warrant their use.

Treatment of Hull Surfaces

It has been suggested by some that rough lumber be used for the outside forms, and a plaster coat be applied to the surface of the cast concrete. The application of such a plaster coat is not recommended, for the following reasons: The surface to be covered is very large, and the application of such a coat would have to be completed in a very short time. There is absolutely no way of assuring positively a perfect bond between the plaster coat and the concrete surface. The application of such a coat will increase the weight of the hull without compensating advantages.

Barnacles and sea vegetation will adhere to concrete in the sáme manner as they develop on steel and wood. It is therefore necessary that the bottom of the hull be coated with some antifouling paint. The same paints can be used as are now used on steel ships, except that special means must be taken to insure a thorough bond. Investigation of a number of paints and coatings of different types is now being made. It is quite probable for the present that a bituminous coating will be employed on the bottom of the Government ships.

There has been much discussion relative to the advantages and disadvantages of constructing the ship on ways which will permit of side-launching or end-launching. Ways built for side-launching permit of the construction of the ship on an even keel, thus making all the lines plumb. There have been very few accidents by sidewise launching of steel or wood ships, and it is believed the concrete ship can be safely launched somewhat earlier in this manner. In endwise launching the conditions of sagging or hogging depend upon the accurate positioning of the ways, and determination of the weight and conditions of buoyancy of the ship just before it leaves the ways. Slight settlement of any of the way piles may cause very serious hogging or sagging stresses. Two of the vessels being built by the Emergency Fleet Corporation will be launched endwise and the others will be launched sideways.

Certain of the equipment, such as the hawsepipe, stern frame, stern tube, etc., are cast into the concrete. The major portion of the equipment and all the machinery are secured to the concrete by anchor bolts. These must be accurately placed in the forms and completely detailed before the concrete is poured. Aside from the connections, the installation of machinery and equipment does not differ from the conditions met in either wood or steel ships. Wherever possible, through bolts rather than anchor bolts will be used. Under all deck machinery and fittings suitable waterproof gaskets should be placed so that there will be no leakage around the holding-down bolts. Too much attention cannot be given to the careful detailing of the fastenings and their exact location in the hull.

What Is the Durability of a Concrete Ship?

If durability is to be obtained, special attention must be given to many elements of the ship. The most serious problems is to provide means of adequately protecting the steel from corrosion. There is a large quantity of steel embedded in the concrete and much of it cannot be covered by more than $\frac{5}{8}$-in. of mortar. This of itself will not protect the concrete, particularly in the interior and in the upper portions of the hull. There are two means of allaying, if not wholly preventing, the corrosion of the steel. The steel may be galvanized or painted with some protecting medium which will not appreciably affect the bond, or the concrete may be coated with some thoroughly impervious

membrane which will prevent both air and water from reaching the steel. A large number of tests are being made, and it is quite possible both methods of protection will be tried. The results are promising and a satisfactory protection should be developed.

Another possibly disintegrating element which may have great importance is the effect of constant reversal of stress, as the ship alternately is subjected to hogging and sagging stresses in a heavy sea. Our allowable steel stresses are such as to cause the concrete to crack. There are few analogous structures on land to which we can refer for guidance on this subject and only experience can tell what may be expected. Reversal of stress tests are now under way.

No trouble from chemical disintegration is anticipated except as the hull may be seriously abraded.

The Concrete Ship Department estimates the life of the concrete ship without any special protection at several years, and known methods which can now be applied should extend the life several years longer. It believes adequate protection will be developed to insure reasonably permanent life to the concrete ship.

The use of direct current on a concrete ship should be avoided wherever possible, on account of the possibility of electrolysis from stray current. A very small leakage for an appreciable time, as demonstrated by the experiments of the Bureau of Standards, will cause a weakening of the mortar at the cathode, thus decreasing the bond strength. If the current leakage is large it may cause an oxidation of the steel at the anode, which will result in splitting and spalling of the concrete. The use of brass or bronze castings adjoining the concrete reinforcing should also receive consideration, on account of the possibility of local electrolytic action in the presence of the electrolyte.

With the quality of concrete being used no special provision will be needed to hold the heavier fuel oils. Investigations of various coating materials are being made with a view to their use as a lining if such is found desirable.

Sugar and certain vegetable oils, such as the cocoanut and peanut oil, will disintegrate the concrete if it is exposed for an appreciable length of time. If the ships are to be used in this class of trade, a protective paint coating should be applied to the inner surface of the hull.

The economy of the concrete ship cannot be determined until we have had experience over a term of years. The estimated cost of the concrete ship at the present time is approximately $125 per ton dead weight. The cost of a steel ship averages about $200 per ton, and that of a wood ship, $165 per ton dead weight.

If proper coatings can be developed to prevent deterioration, the concrete ship should be a competitor of the steel ship. With further experience it is believed the weight of the concrete can be very materially reduced, thus making the cargo capacity more nearly equal to that of the steel ship.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

How Laws for Relief of New York State Contractors Operate

Sir—During the past legislative session three laws were enacted which affect the New York State highway situation. The first of these laws consists of amendments to the highway law. These amendments provide for the acceptance of the completed portion of an unfinished contract and for the postponement until after the war of work on any portion upon which no work has been done. All portions of the contract upon which work has been begun must be completed unless proof can be shown that it is impossible to obtain some essential material.

The law was enacted with the support of the Highway Commission, and a statement which was given out concerning it contains the following:

" . . . It will be noted that any cancellation of contracts is in no way contemplated by which the contractor or the surety company is to be relieved in any degree from the contractural obligations now existing. . . . We hope by its provisions to be able to present such inducements to the contractors and the surety companies as will encourage them to make a special effort to complete those portions of the roadway under traffic which are torn up and which now impede traffic. . . . the state and any political subdivision . . . are protected to the same extent as at present by the renewed assurance of the completion of the road at the original contract prices."

It is here clearly reiterated that by no device is the contractor to receive anything but payment at the pre-war prices for his work. The only possible financial relief to him is the paying of the retained percentage on a completed portion of the contract, and the relief from its maintenance. Anything further is merely conjectural, and is dependent upon a return to normal conditions in regard to wages and prices within a few months of the close of the war. This is so improbable as to need no discussion.

The second law is the so-called Walters law, which embraces all unfinished, pre-war, public contracts. It is a progressive piece of legislation and appears to be very fair in its provisions, both to the contractors and the public. In brief, it recognizes the existence of "emergency conditions" in connection with the execution of these contracts; provides for the cancellation of the contracts on the condition that the contractor file a stipulation agreeing, among other things, to complete the work or any part thereof at actual cost; and provides for the raising of any necessary funds. The contractor will be paid actual losses incurred since the United States went to war with Germany.

The bill also provides for the postponing, with the consent of the contractor, of any work deemed to be in conflict with the public interest or necessity, or

for the releasing of the contractor "subject to such conditions as may reasonably be imposed." It repeals any law or portion of a law "inconsistent" with its provisions.

It will be seen that this law and the amendments to the highway law were framed from opposite viewpoints of the ethical question involved; which is, whether or not the war and the consequent tremendous increase in costs is a legitimate "hazard" from which there should be no relief for a contractor other than a postponment of the removal of the "pound of flesh."

The question seems hardly debatable, for to maintain that war is a legitimate risk is to maintain that contractors should assume in all their bids that a war is to ensue, which is, of course, absurd; or else to maintain that the business of contracting is gambling, pure and simple, and that a contractor takes a gambler's chance from which he should never be relieved, which is equally absurd.

From the legal point of view the question has been more complex, but, as was pointed out by William B. King in *Engineering News-Record* of April 2, p. 727, there have been opinions, by former Attorney General Wickersham and others, and decisions by the Supreme Court of the United States, which support the point of view now recognized by the Walters law, and also by the third law above mentioned. This law authorizes the State Court of Claims to audit and determine any claims arising on state contracts by reason of increased costs due to statutory enactments subsequent to the signing of the contract in question. This is entirely just at any time and especially so at this time, as the war increases undoubtedly come within the scope of the bill.

STATE HIGHWAY SITUATION

In view of the passage of these acts a glance at the state highway situation is of interest. A memorandum recently filed by the Governor states:

"There are upwards of 200 contracts in force, aggregating $12,000,000 in amount and 900 miles in extent. About 600 miles of work remains to be done, amounting to about $7,300,000 . . ."

It would appear, therefore, that the contractors holding the contracts for this $7,300,000 worth of work may proceed to complete their contracts, and then file claims for the extraordinary increase in the cost of so doing; or they may ask for a cancellation of the contracts and proceed with the completion of the works at actual cost.

Undoubtedly, those contractors who have contracts nearly completed will choose the former method of procedure. Those who are not so far along will choose the latter, for the reason that it will be impossible for most of them to proceed without the relief offered in the Walters law. Bituminous material, which was bid on a basis of and bought for about 7c. just prior to the war, will not now be delivered at any price, the last quotations being nearly 20c. Crushed stone, that was 50c. to 70c. is now $1 and more. Freight rate and labor increases are well known, and any immediate relief from present prices is out of the question.

The opportunity is therefore offered for the completion at actual cost of such portions of this 600 miles of road as are deemed by the Highway Commission to be essential at this time, and for the releasing of the contractor on any portions which are deemed unessential.

Unfortunately, both for the state and the contractors, the Highway Commission has chosen not to accept this opportunity and has announced that it will take no action under the Walters law. It has notified these contractors that they must proceed with their contracts under the pre-war prices immediately, or accept the provisions of the amended highway law, which, as outlined above, merely provides for an extension of time in certain cases, and the acceptance of which would apparently prevent the contractor from ever obtaining any of the relief that is contemplated in the Walters law.

The ground on which the commission has assumed the authority to ignore entirely a law of this character is not entirely clear and has not been stated, other than that the act is "permissive" and does not compel any public agency to proceed under it. It is understood that numerous other public agencies are preparing to proceed under its provisions, having readily recognized the justice of affording the relief outlined.

From a practical road-building point of view, the attitude of the commission is even more difficult to understand, for it is not to be supposed that the contractors will accept, without every recourse to law, this interpretation of their rights. Neither is it to be supposed that the surety companies will do so. Meanwhile, the completion of the roads will be at a standstill, and the partially completed work will be suffering a tremendous loss. DANA W. ROBBINS.

New York, N. Y.

Why Pavements Are Crowned

Sir—In your issue of May 9, p. 925, I notice a correspondent's inquiry under the heading, "Why Pavements are Crowned." In reply I have to say: With few exceptions, the only purpose of the crown is to cause a quick run-off of water to the gutters.

So far as traffic only is concerned, a flat level cross-section is preferable. However, the run-off from it would be slow, and, due to inevitable slight undulations in the paved surface, numerous shallow pools would be in evidence a large part of the time. This would make the surface slippery and unsightly.

A crown of 6 in. is enough for any street not more than 40 ft. wide between the curbs. A good cross-section is one with a vertical curve about 10 ft. long at the center of the street, with tangents from it to the gutters. However, the shedding of water and the avoidance of pools would be accomplished best by a vertical curve extending from curb to curb.

In side-hill locations it is often desirable to have one gutter about a foot higher than the other. In this case, a straight line from the upper gutter should fall to a tangential meeting with the curve near the center of the street. This cross-section throws all the water to the lower gutter. The same result may be accomplished by a vertical curve from curb to curb.

Albany, N. Y. RICHARD W. SHERMAN.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Life of Rubber Pump Valves Greatly Lengthened by Easy Repair

REPAIR of pump-valves in which the stem holes have become worn by friction can be easily accomplished by bushing them with plugs cut from old valves, says Timothy Ryan in *Coal Age*. Valves thus worn cause a great deal of trouble and replacing them is no small item of expense.

It is not uncommon for practically new valves to develop such large holes that the efficiency of the pump is much reduced by the escape of water. To overcome this, the valve is taken out and the hole punched somewhat larger than desired. A plug cut from a discarded valve is then pressed into the hole with rubber cement. This leaves a blank valve in which a new hole of any desired size can be punched. When this bushing becomes worn, it is easy to remove it and insert another. It is possible to bush valves to fit worn spindles in this way, and keep the spindles in service for a long time after they would ordinarily be discarded.

The above method of repair has been used, says Mr. Ryan, for several months with excellent results.

It's stimulating to *your* think-tank to see how the other fellow has been using *his* head.

Even if you can't apply the thing he tells about directly, just to know he has pulled a good one puts you on your toes.

You say, "———, I can beat that."

Do it—and then tell us all about it in

HINTS FOR THE CONTRACTOR

Haul Eighty-One-Foot Girders Two Miles on Five-Ton Truck and Trailer

A PAIR of 21-ton girders 81½ ft. long were recently transported, in the manner shown in the photograph, from the nearest railroad siding to the Eastman Street bridge recently built over the Rahway River at Cranford, N. J. The forward end of each girder in turn was wired on a pivoted bolster centered over the rear wheels of a 5-ton Garford truck, while the rear of the girder was carried on a heavy low truck set one-third of the way from the back end. Both girders were hauled without difficulty, the 2-mile trip being made over good roads. At the freight yard where they were unloaded, however, the ground was soft, and it was necessary to make a roadway of 6-in. plank from the cars to the edge of the nearest pavement.

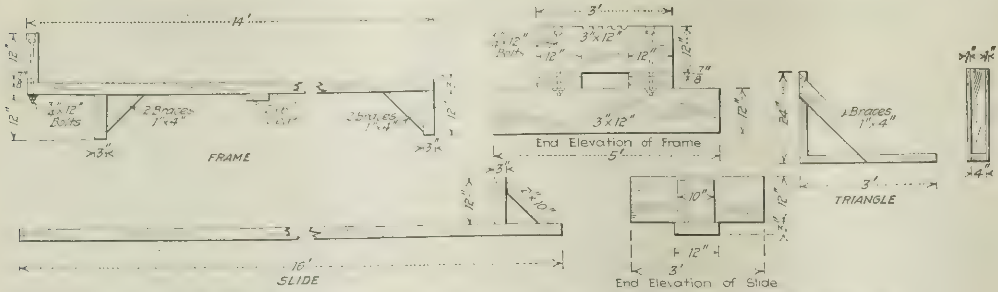
The hauling was done under the direction of R. R. Sprague, for the Dover Boiler works which furnished the steel for the erection of the bridge.

Round Trestle Timbers Sawed in Big Miter Box on Car

REPAIRS to a coal dock trestle, in which rotted pile tops were replaced with mine timber, were recently made by sawing off these irregular posts in a device which acted as a big miter box. The work was described in *Engineering and Mining Journal* for July 6 by L. D. Davenport, chief engineer of the Oliver Iron Mining Co., Hibbing, Minn.

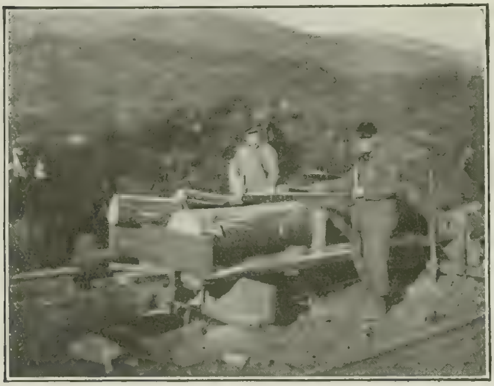
The majority of the bents were of square timber, resting on a pile foundation. The piles were badly rotted at the surface of the ground, while the square timber was in good condition. The repair work con-

TWENTY-ONE-TON GIRDER CARRIED BY BOLSTER ON REAR OF TRUCK



CROOKED MINE TIMBER SAWED TO EXACT LEVEL FOR TRESTLE REPAIR IN BIG MITER BOX

sisted of holding up the square timber bents with false work and cutting off the piles 12 in. below the surface of the ground, building forms, pouring concrete mud sills and retimbering. The bents were taken alternately, as the trestle was in daily use. When the concrete had



ALTERNATE BENTS WERE REPLACED

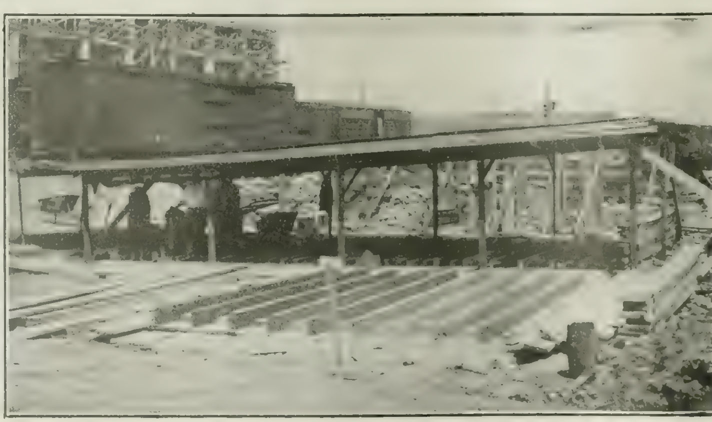
set for 10 days, round timber posts were placed from the concrete sills up to the square timber sills. There were five posts in each bent. The three inside posts were plumb, and the two outside posts were battered 1 in. to the foot. The false bents were also made with five posts. The round timber used was mining timber from 10 to 16 in. diameter. Much of it was far from straight.

To facilitate cutting off the posts, either square or with the proper bevel, the device shown in the sketch was built and in effect is a large size miter box. In operation, a $\frac{3}{4}$-in. hole is bored in the center of each end of the post to be cut off and a short pin of $\frac{3}{4}$-in. round steel placed in each hole, so that the steel projects about 6 in. The post is then put on the device with the pins resting on the notch in the slide at one end and on the center notch in the frame at the other end. The two triangles are then tacked on either side of the post, square with the frame, where they serve as a guide for the crosscut saw. One end of the post is then sawed two-thirds of the way through, and the triangles are moved to the other end, where a second cut is made. The post is then wedged up at each end, the pins are removed and the cuts finished.

When a batter post is to be cut, one pin is placed in the center notch of the slide and the other in one of the outer notches in the frame, according to the length of the post (before it is cut) and the batter desired. For example, with a 9-ft. post and a desired batter of 1 in. to the foot, the pin at the frame end will be set 9 in. from the center notch. This device is easily made, insures accurate cutting and saves considerable time, especially in cases when the timber is crooked.

Miniature Blockyard Furnishes Reinforcing Supports

A CONCRETE-BLOCK casting plant on the job provides the precast blocks for supporting during concreting the 29 acres of floor-slab reinforcement employed in constructing the new quartermaster's depot at Chicago. The blocks are 4 x 4 x 6 in. and 110,000 of them were required. Set on the floor form lagging they support the slab bars during pouring and become



CONCRETE BLOCKS TO SUPPORT REINFORCEMENT CAST IN THIS YARD

WOOD FRAME STAGING USED OVER AND OVER CARRIES FORMS FOR VIADUCT

an integral part of the concreted slab. The picture shows the casting yard and the curing shed. The forms for molding the blocks consist of 2 x 6-in. planks 12 ft. long, separated by steel plate dividers 6½ in. long and 4 in. high. Saw cut grooves ¼ in. deep at intervals of 4 in. in the sides of the planks hold the ends of the dividers. Clamps keep the plank sides from spreading. The forms are filled with the same mixture as is used in the floor slabs. The cast blocks set for 36 hours, when the side planks are knocked down and the divider plates are picked out, and both planks and plates are set up for a new batch of blocks. The contractors for the depot building are the E. W. Sproul Co., of Chicago.

Light Frame Bents Hasten Form Shifting

THE staging illustrated above reduced by one-fourth the time of shifting steel forms from section to section of column and cloister girder piers employed in recent Chicago track-elevation work. About 60 ft. of steel form is employed to mold long lines of pier columns and girders, requiring several shifts of forms. The staging, like the forms, is used over and over. It consists of framed bents and two lines of stringer timbers, with enough spare boards for bracing the bents together. In practice the bents are set up and leveled, and then the bracing is nailed in place as the foreman decides it to be necessary. Then the lines of stringers are placed and spliced by nailed battens. The column capital and girder forms are then put in place on the stringers. Finally the shaft forms for the columns are erected. Two facts will be noted; first, the staging carries the whole load of the girder forms and the shaft forms bear none of the load from above; second, the leveling is all done in erecting the staging so that the form erectors have only to assemble and set the steel molds in place. In dismantling the forms, the staging units are set free by merely knocking out the braces and battens, after which they are carried ahead and set up again.

Trained Dogs Guard Equipment of St. Paul Contractor

THE GEORGE J. GRANT CO., St. Paul, Minn., contractors, has been using Airedale dogs, specially trained, for watching plant out on their various jobs, according to the Bulletin of the American Hoist & Derrick Co. It is said that the experiment has been very successful. The dogs are tied by long, light chains to trolley wires so placed that it is not possible for a prowler to reach any article of value without encroaching on the beat of one of these sentinels.

The instruction of an Airedale for watch dog duty of this kind is begun when the puppy is about six months old. It does not take these intelligent dogs more than a month to learn the "business," and they are at their prime when they reach the age of three

years. This does not mean, however, that they are not useful for several years longer. It is said that since the idea of using these dogs to guard plant has been tried out much pilfering of small articles, such as picks, shovels, wheelbarrows, boiler fittings, etc., has been stopped. One harrowing experience with these very earnest watchmen is a great plenty for the average petty thief.

The only drawback about these dog guardians is that their method is to "shoot first and investigate afterwards." They make slight distinction between friend or foe when they find a prowler, and in more than one instance workmen who had gone back to the job after some article which they had forgotten have been fiercely attacked by the watch dogs.

One watchman with several well-trained dog assistants can take care of a large quantity of equipment and the expense would be much less than if several men had to be employed.

Steel Pipe Erected from Derrick on Sections Already Built

A READILY movable small derrick mounted on a steel pipe line already built was used to erect new sections at the Trenton Falls development of the Utica Gas & Electric Co.'s new plant in the Adirondacks.

The 12-ft. line is composed of plates from $\frac{9}{16}$ to $1\frac{1}{16}$ in. thick, in sections or rings $7\frac{1}{2}$ ft. long, in general. They were erected principally by the derrick shown, having one stiffleg and being side guyed with light wire rope tackles to nearby trees, etc. The foot block was arranged to bolt to open holes in a circumferential seam, while the foot of the stiffleg was provided with a heavy bent strap, with several holes in the horizontal leg. By bolting through the proper holes in this strap to the open holes of the second seam back of the stiffleg the mast could be adjusted to the vertical on any of the grades met with.

TWELVE-FOOT PIPE HANDLED FROM SMALL DERRICK

The boom fall was operated by a hand crab, and the main fall also for a time. Later the main fall line was carried back along the pipe line and through a snatch block attached to a column of the surge tank to the electric hoisting engine housed in the low building shown just to the right of the pipe line. Plates were dragged some distance at times and were erected by this rig at a maximum rate of three complete rings per nine-hour day. Five rings could be erected at one setting of the derrick.

Yukon Mining Methods Keep Hydraulic Fill Soft

HYDRAULIC fill, made in winter at the Junction Dam, near Wellston, Mich., was kept thawed by steam jet outfits similar to those used by Alaskan placer miners. From November to March, inclusive, the fill was made at temperatures generally well below freezing and frequently well below zero. At times the thermometer registered —30°. When a reasonable amount of attention was given very little ice was deposited in the embankment, and there was no tendency for the sluiced material to freeze as long as the water was allowed to run over the surface. When the temperature remained below 15° F. for more than a few hours, sluicing was stopped. When it was started anew the embankment surfaces under construction were cleared of snow and ice. In some cases, where it was impossible to make a continuous fill, the ground froze, and thawing was necessary before sluicing was resumed. Steam jet outfits performed the thawing satisfactorily. Live steam at a pressure of 10 to 30 lb. was used. A steam main or header was run to the area to be thawed. This header had numerous 1-in. hose branches connected to $\frac{3}{4}$-in. pipes, 6 to 8 ft. long. Under the action of their own steam these pipes could be jetted down into the soil to effect a mud seal around the ends. Standing vertical, the pipes were left to feed down by the jet action and their own weight. Some steam escaped through the mud seal, but by the attention of one or two men with shovels the loss of steam was kept small. In frozen sand the jets would be spaced about 6 ft. apart in both directions and allowed to remain in one place from four to six hours. During this time the sand would be thawed for a depth of 3 to 5 ft. The Junction Dam was built for the Consumers' Power Co. by the Fargo Engineering Co., Jackson, Mich.

Municipal Franchise Rates Subject to State Control

Municipal franchises in New Jersey are not inviolable contracts between cities and utility companies, but instead are conditional grants subject to the sovereign power of the state, according to a decision handed down by the State Court of Errors and Appeals on June 17. Accordingly, the New Jersey Public Utility Commission may order changes in municipal utility rates, even though these were fixed in franchises. The decision was rendered in Atlantic Coast Electric Railway Co. vs. the Public Utility Commission. A directly contrary opinion was recently handed down by the New York Court of Appeals in the Rochester 6c fare case.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

New York Road Builders Lose Test Case

Hewitt, Not Walters, Law Applies to Highway Contracts, Under Court Decision

Application for a peremptory writ of mandamus, compelling the State Commissioner of Highways to cancel all road contracts not completed when war was declared, was denied by Justice Chester in a special term of the state supreme court at Albany, N. Y. The application was made by the New York State Roadbuilders' Association, using as a test case a state road contract in the village of Rosendale, Ulster County, N. Y. The decision is important because it affects practically every road contract in the state.

Two laws were enacted by the last session of the state legislature relating to state highway contracts. The first, known as the Hewitt bill, provided for the acceptance of completed portions of unfinished contracts, the cancellation of contracts and the postponement of the remainder until after the war, postponement being contingent upon proof of inability to obtain essential materials. It was also provided that contracts upon which work had not begun could be postponed until after the war. The second, known as the Walters law, embraces all unfinished pre-war public contracts and provides for their cancellation provided the contractor will agree to complete the work or any part thereof at the actual cost, the contractor to be paid for actual losses incurred since the United States entered the war. It also provides for the postponing of all work, with the contractor's consent, or the cancellation of all work which conflicts with the public interest.

The Highway Department elected to operate under the Hewitt law, while the contractors wish to utilize the greater relief offered by the Walters law. The test case was instituted to compel the department to follow the provisions of the Walters law.

The attorneys supporting the application argued that the Walters law made it mandatory for the Commissioner of Highways to cancel all state road contracts which were not completed at the time war was declared. Deputy Attorney General Rose contended that the law gave discretionary power to the Commission of Highways. In denying the application Justice Chester says that in his opinion the words "empower and authorize" in the law are not mandatory but confer the power of discretion. If this opinion is finally held to be correct, the various departments of the state government can use whichever law they see fit.

No Concrete Ships Permitted for Private Account

Concrete ships for private account can not be built at present. Such construction is forbidden, under a ruling of the United States Shipping Board that reads as follows: "Owing to the large increase in our program by reason of the demands of the War Department and the necessity of expanding existing boiler and engine facilities, the board deems it unwise to permit the construction of any concrete ships for private account, and hereby announces as its policy that it will grant no permits for such construction until facilities have been expanded to meet the needs." Control of construction is effected through control of priority orders for materials which are withheld from private shipyards.

In regard to the possible private construction of concrete barges or towboats a recent letter from Howard Coonley, vice-president of the Emergency Fleet Corporation, says: "In the resolution a reference is made distinctly to concrete vessels, and the question involved is one of machinery and equipment. The Shipping Board has not made a hard and fast ruling in connection with the construction of concrete barges for private account or for other ships that are not self-propelled. In any case involving the question of the construction of this class of ship for private account, the matter will be considered on its own merits, and a permit may be given by the Shipping Board in this connection."

Appeal for Funds to Defend Septic Tank Suits

An appeal for funds to enable the National Septic Process Protective League to continue helping the city of Shelbyville, Ky., defend the patent infringement suit brought against it by the Cameron Septic Tank Co. is made in a circular being distributed by Frank G. Pierce, Marshalltown, Ia., secretary-treasurer of the league. An outline of the case, which is about to be tried on its merits, is given in the circular. The appeal is addressed to all users of septic tanks in operation prior to Oct. 16, 1916.

Bill for Government Licensing of Water Power

The special House committee on water power development reported a water power licensing bill to the House modeled, in general, on the so-called administration bill, which was drawn by direction of the Secretaries of War, Interior and Agriculture, and introduced in Congress some months ago.

John Purroy Mitchel

As Mayor of New York He Relied On Expert Advice, Say Engineers of His Administration

[Maj. John Purroy Mitchel, killed last week in a flying accident, enjoyed as administrator of the largest city in the world during the period when the greatest municipal engineering enterprises ever undertaken were under way, the reputation of being one of the few great public executives who appreciated the value of engineering advice, and who consistently sought and acted on such advice. *Engineering News-Record* has asked two of the engineers most closely connected with Major Mitchel's administration as mayor of New York for appreciations of his work, which follow.—EDITOR.]

J. Waldo Smith, chief engineer, Board of Water Supply, New York City, writes:

"The tragic death of Maj. John Purroy Mitchel, former mayor of New York City, has brought to me not only a deep sense of personal grief and loss, but of the loss to the country and the world by the untimely cutting off of a career so bright with promise.

"The interest in him as chief executive of New York City was nation-wide, and not limited, as is usually the case, to the city and the state. The splendid way in which he upheld the dignity of the city during the visits of the representatives of the foreign governments made us all proud that we had such a man to represent the city on so important an occasion and called forth from those distinguished delegates the highest praise; from that time it could be said that his fame was international.

"Throughout his long experience in public affairs in the city he was fearless in upholding truth and right, and when he was convinced that a certain line of action should be taken he absolutely ignored the effect which his advocacy of a movement or action might have on his political career, or his own personal interests, thus demonstrating the highest degree of courage in a public official. In the conduct of the city's affairs, and especially in connection with the many improvements undertaken during his administration, he was a firm believer in the value of the expert advice of technical men, particularly that of the engineers, and he had the highest admiration for the work which was being done by them in the upbuilding of the city. He freely employed as advisers experts in work pertaining to education, engineering and all branches of science and industry. From the time of its inauguration by Mayor McClellan, he had a deep interest in the

work of the additional water supply, which was continued until the time of his death, and no small part of the credit for its successful completion is due to his consistent and persistent coöperation and help as well as his singular ability to grasp the broad principles of the recommendations made and and to state the case simply, clearly and forcibly.

"His patriotism was of the highest order and because of his keen interest in preparedness and advocacy of universal military training at a time when this principle was looked on with great disfavor by those in high places, he gained the cordial respect and interest of the engineers throughout the country, who were among the first to see the necessity for preparedness.

"He accomplished more in his short life than others who have had the good fortune to live the full allotted span of years, and of him it may truly be said that we will never see his like again."

From Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City, comes the following: "Almost the entire period of Mr. Mitchel's life was devoted to municipal administration. Such work was regarded by him as a science and in this science he was a recognized expert. His alertness of mind and his unusual capacity for work enabled him to accomplish much in a short time, but he continually made use of and depended upon the advice of others with special training and experience in the various fields of municipal activity.

"The fact that the City of New York should have availed itself of the unusual experience and qualifications of Mr. Mitchel by making him its chief executive, may justify the belief that municipal administration will some day be considered a profession, the highest rank in which will be within the reach of its most capable and industrious students.

"No better example could be given of the result of whole-hearted devotion to such a profession as a career than the life of John Purroy Mitchel."

Tunnel Explosion Attributed to Marsh Gas

Five workmen were killed outright and another was seriously injured in an explosion that occurred June 26 in the tunnel being driven for the East Bay Water Co., Oakland, Cal., by Bates & Borland, contractors. The heading had been advanced about 1500 ft. and some previous difficulty with gas had been experienced. The five men killed were working at the heading; the sixth man, operating a storage battery locomotive, was some distance from the heading. It is believed that a spark caused by the striking of a pick on rock may have ignited the gas. The explosion caused a cave-in which prevented rescuers from bringing out the bodies until the débris had been excavated.

A Brigadier at Thirty-Four

Memories of Civil War times, when boys in the twenties became generals, were aroused by the latest list of promotions approved by the President, which contains the elevation of Col. John N. Hodges, U. S. N. A., to the rank of brigadier general. General Hodges, a brigadier at 34, is the youngest general officer in the United States Army. He was graduated from West Point at the head of his class in 1905 and immediately entered the Corps of Engineers, serving first in the Philippines and later on station in the United States. He was a captain when the

BRIGADIER GENERAL HODGES

United States declared war. He went to France with the earliest railway regiments last summer and has served continuously with the 6th Engineers since that time, taking command of the regiment a few months ago. At the famous retreat from St. Quentin, he headed several companies of his regiment who joined General Carey in the formation of a hasty army which stopped the gap between the British and French lines and prevented the further advance of the German army toward Paris. For gallantry in that action he has been decorated by the English, the French and the American Governments.

Jersey City Wants Bids on 72-In. Steel Pipe

Bids on supplying 34,590 ft. of 72-in. riveted steel pipe to duplicate its gravity water-supply conduit from the Boonton reservoir to the Watchung tunnel are wanted on July 16 by Jersey City. For 34,125 ft. the plates must be 5/16 in. and for 465 ft.. 7/16 in. thick. The new conduit is being rushed, to guard against a repetition of the water shortage of last winter's cold spell. M. I. Fagen, City Hall, Jersey City, is director and Charles A. Van Keuren is chief engineer of streets and public improvements. Clyde Potts, 30 Church St., New York City, is consulting engineer.

Mr. Fagen informs *Engineering News-Record* that separate bids for laying the pipe will soon be asked. He adds that "this is the initial experience of Jersey City in subdividing large public works contracts" so as to get "bids from manufacturers direct." In 1919, Mr. Fagen states, bids will be taken for enlarging the concrete portions of the water-supply conduit from 70,000,000 to 90,000,000 gal. a day. Still later, the reservoir storage capacity will be increased in like amount. The entire program will increase the water-supply possibilities of Jersey City from its present limit of 50,000,000 gal. to 90,000,000 gal. a day.

Illinois Rejects All Highway Bids Taken June 26-28

All bids taken by the division of highways, Department of Public Works and Buildings, State of Illinois, on June 26-28 inclusive, have been rejected as too high. In view of this fact, it is thought that no awards will be made and that the work will be put off until after the war. The roads in question include nine sections of the Lincoln Highway, six sections of the Dixie Highway, and six sections of various county highways. For concrete highway 18 ft. wide and 7 in. thick the low bids ranged from $19,677 to $26,437 per mile, the average of low bids being $22,008 per mile; for concrete highway 1C ft. wide and 7 in. thick the low bids ranged from $14,495 to $25,215 per mile, the average being $19,304; two bids were received upon 4-in. brick laid upon a 4½-in. concrete base at $25,836 and $24,788 per mile.

District Directors and Federal Managers for West

F. G. Pettibone, formerly vice-president and general manager of the Gulf, Colorado & Santa Fé Ry., has been appointed district director of the railroad administration for the state of Texas, Southwestern regional district, and William Sproule, president of the Southern Pacific Co., has been made district director of that part of the Central Western regional district west of Ogden, Utah; Albuquerque, N. M., and El Paso, Texas.

W. B. Storey, recently vice-president of the Atchison, Topeka & Santa Fé system, has been made Federal manager of that system. Mr. Storey is an engineer. He was chief engineer of the Santa Fé system from 1906 to 1909, and is a past president of the American Railway Engineering Association. E. E. Calvin, president of the Union Pacific R.R., has been made Federal manager. W. R. Scott, vice-president and general manager of the Pacific system of the Southern Pacific Co., has been made Federal manager.

J. E. Gorman, recently president of the Chicago, Rock Island & Pacific Ry., and A. Robertson, vice-president of the Missouri Pacific system, have been made Federal managers of those re-

spective systems. J. A. Edson, president of the Kansas City Southern, has been made Federal manager of that and several smaller roads. L. Kramer is made Federal manager of the St. Louis-San Francisco and the Missouri, Kansas & Texas systems north of Texas, excluding the former's Memphis-Birmingham line.

Three Federal managers receive jurisdiction over most of the railroads in Texas. J. L. Lancaster, receiver of the Texas & Pacific, has that system, the Texas lines of the St. Louis Southwestern, and several other roads. J. S. Pyeatt has the Gulf, Colorado & Santa Fé, the St. Louis-San Francisco, the Missouri, Kansas & Texas and other lines. W. B. Scott has the Southern Pacific lines and the San Antonio & Aransas Pass.

Congress Gets Bill for New York-Jersey Highway Tunnel

A bill providing for the payment by the Federal Government of half the cost of the proposed highway tunnel between New York City and New Jersey under the Hudson River, upon plans approved by Maj. Gen. George W. Goethals, was introduced a short time ago simultaneously in the Senate and House of Representatives by Senator Calder of New York, and Representative Eagan of New Jersey. The bill appropriates $6,000,000 on condition that the States of New York and New Jersey shall each appropriate the sum of $3,000,000.

New Jersey has already committed itself to the project and a bill was pending in the New York legislature when that body adjourned. Favorable action is expected upon the reassembling of the legislature. The authors of the bill say that the tunnel, which will be used for vehicular traffic, will not cost more than $12,000,000, and this amount, they say, is about one-fourth of what it would cost to build a bridge between the two states. Plans for the tunnel have been made by General Goethals, and other engineers have favorably passed upon them.

District Buys Reduction Works

Since July 1 the garbage-reduction plant of the Washington Fertilizer Co., at Cherry Hall, Va., has been operated by the District of Columbia, which has taken over the works at a price of $85,000. It is expected that a percolator will be added. The works will be operated under the direction of J. W. Paxton, superintendent of the street cleaning department of the district.

Barge Canal Is Given Favorable Freight Differential

The United States railroad administration on June 25 put into effect a freight differential in favor of the New York State Barge Canal over the competing railroads. On that date freight rates on the railways were raised 25%, but at the same time differentials were established which make the canal rates about the same or slightly higher than they were on the railways before the increase. These differentials vary from 10c. to 3c. per 100 lb. for different classes of freight varying in cost per 100 lb. from 60 to 20c., respectively, on the New York-Buffalo rate.

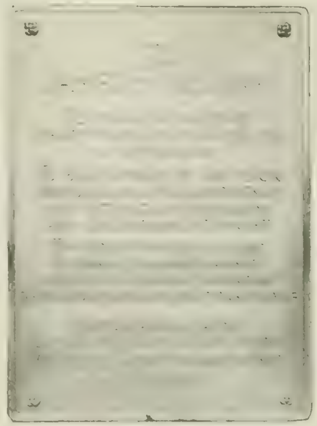
When the Government took over the canal it established rates somewhat higher than those already in force by the private carriers, which were much lower than the present standard rates.

James H. McGraw Presented With Tablet

Employees and Associates Commemorate His Third-of-a-Century Service as Technical Publisher

James H. McGraw, president of the McGraw-Hill Co., Inc., publishers of *Engineering News-Record*, who has completed a third of a century as a publisher of technical journals, was the guest of employees of the company and associates in the publishing industry at a recent meeting held to commemorate the event.

The employees of the company presented Mr. McGraw with a bronze tablet, which will be mounted in the building at Tenth Ave. and Thirty-sixth St., New York. A photograph of the tablet is reproduced herewith.



At a dinner given to Mr. McGraw by associates in the publishing business speakers gave reminiscences of early days and described the growth in influence and power of the engineering press. Mr. McGraw in responding touched on the large opportunities for service and the serious responsibilities of the publishers in these times.

Rural Motor Express Suggestion Well Received and Applied

The suggestion of the highways transport committee of the Council of National Defense that motor trucks be utilized to facilitate the movement of perishable food products to shipping and consuming centers, has been well received, and new applications of the principle are being developed, according to the Committee on Public Information. The purpose of this service is to relieve the farmers, as far as possible, from the labor of hauling their produce to market and bringing back the necessary merchandise and tools for carrying on their business. This is considered a very important matter, in view of the labor shortage.

In the vicinity of Washintgon an arrangement has been made whereby loads of fruit and vegetable for canning will be delivered from the producers to canning club centers in the city. This produce will be sold wholesale to members of these clubs for canning in their homes. In this manner a more direct system of marketing has been devised which, it is expected, will not only assure an increase in home canning of perishable foods and vegetables, but will also induce the farmers to keep up production, which they were inclined to decrease, on account of the difficulty of hauling the produce to market. The system also relieves the local freight and express traffic, now much congested, of these extra loads. In sections where there are no short-line railroads, rural motor express is especially convenient. State food administrators in many sections report that this innovation will be very valuable, as there are many outlying districts which cannot be served by the railroads, but which can produce foodstuffs.

Surveys conducted by the Highway Transport Committee show that trucks can be made available for operation in fleets in the important fruit-growing sections, to supplement the usual shipments of food by rail in the rush period of the harvest. All that is necessary is to mobilize and use continuously large numbers of trucks owned by farmers, and used at present only a few days per week. Many permanent rural motor express routes are also being established in communities where there is need of regular daily service for farmers to and from the market, and several of the state food administrators are assisting in this work by discovering districts where such highway transport is needed.

Russian Utilities Nationalized

Water-works, gas-works, canals and railways in Russia are to be nationalized by decree of the Soviet Council, according to a recent cablegram. Nationalization will also extend to coal, iron, copper, silver, lead, salt and nearly all gold mines; metallurgical, textile, electrical, explosives, wood, tobacco, rubber, glass, pottery, leather and steam mill industries.

Unfavorable Commission Report on "Free Energy" Engine

The special commission appointed by resolution of Congress to investigate the invention for utilizing "free energy" known as "Garabed" has rendered an

unfavorable report on the invention to Secretary of the Interior Lane. The report reads as follows:

"We, the undersigned, who are members of the commission duly appointed in accordance with the provisions of Public Resolution No. 21, 65th Congress, hereby certify that Mr. Garabed T. K. Giragossian showed us on Saturday, June 29, 1918, a model embodying the principles of his invention known as the "Garabed." We found that the model was not in shape to run or develop power. The inventor admitted that he had no working machine and that he was merely explaining principles. We do not believe that his principles are sound, that his device is operative, or that it can result in the practical development or utilization of free energy."

The report is signed by the commission, consisting of James A. Moyer, director of the Massachusetts State Board of Education, and Edward F. Miller, M. deKay Thompson, Edwin B. Wilson and Charles L. Norton, all of the Massachusetts Institute of Technology.

Federal Health Control Unified

All sanitary or public health activities carried on by the executive branch of the Government "especially created for or concerned in the prosecution of the existing war" are to be "exercised under the control of the Secretary of the Treasury" hereafter, according to an order by President Wilson dated July 1, under Congressional authority approved May 28. Excluded from the order are the Surgeons General of the Army and Navy, the Provost Marshal General in the performance of military health functions, and the Bureau of Labor Statistics, as regards investigations of vocational diseases, shop sanitation, and hygiene. It is understood that the administration of this order falls on the United States Public Health Service. That organization has not yet made any public statement interpreting the exact effect of the order.

Additional Water-Supply Proposed for District

Congress has before it a joint resolution directing the Secretary of War to appoint a commission to report on available sources of water-supply for the District of Columbia. Three of the commissioners would be selected from the Corps of Engineers, U. S. A., one from the Washington Suburban Sanitary Commission, and one from the Engineering Department of the District of Columbia. The investigation would cover available sources of water-supply from rivers and streams near Washington, the additional supply to be sufficient for the present needs of not only the District of Columbia, but also the territory within the jurisdiction of the Washington Suburban Sanitary Commission, and the Federal military reservations contiguous to the District of Columbia. The resolution carries an appropriation of $15,000. The report would be made to the Secretary of War and submitted by him to Congress with recommendations. In this connection attention may be directed to a report on the possible use of Patuxent, Middle Patuxent and Little Patuxent Rivers of Maryland as a possible source of additional water-supply for the District of Columbia and as affording also a supply for the Washington surburban districts. This report was made quite recently by Robert B. Morse, chief engineer of the district and of the Maryland State Board of Health. The report indicates that a daily supply of at least 160,000,000 gal. would be delivered from these sources. The supply contemplated by Mr. Morse would be filtered and would serve the whole of the District of Columbia without pumping, whereas now the water has to be pumped for a high-service area.

Engineering Societies

The Colorado Association of Members of the American Society of Civil Engineers elected the following officers at the recent annual meeting: President, L. R. Hinman; vice-president, E. C. Jansen; secretary-treasurer, A. M. Miller.

The Binghamton Engineering Society, Binghamton, N. Y., was addressed at its meeting June 27 by F. L. Wheaton, division engineer, Delaware, Lackawanna & Western R.R., who spoke on the design and construction of the New Jersey and Pennsylvania cut-offs of the Lackawanna.

The North Carolina Society of Civil Engineers adopted a constitution and by-laws at the recent convention held at Greensboro. The next meeting of the society will be held next January at Raleigh; the board of directors will report then on affiliation with the American Association of Engineers.

The Cleveland Engineering Society elected the following officers at the recent meeting of the old and new boards of directors: President, E. B. Thomas; vice-president, R. I. Clegg; secretary, A. F. Blaser; treasurer, C. E. Drayer; librarian, E. S. Carman.

The Northwestern Society of Highway Engineers, the Portland Association of Members of the American Society of Civil Engineers and the Oregon Society of Engineers will hold a joint meeting in the Public Library Building, Portland, July 13, in connection with the regular meeting of the first-named society. Herbert Nunn, president of the Northwestern Society of Highway Engineers, will speak on the importance of coöperation between highway and other civil engineers. R. H. Thomson, of Seattle, will address the meeting on the enactment of legislation for the registration of professional engineers. The advisability of establishing an engineers' club in Portland will be discussed by Orin E. Stanley, president of the Oregon Society of Engineers. R. M. Gillis, district engineer, State of Washington Highway Department, will speak on the advisability of changing the title of county surveyor to county engineer, coördinating the duties and salaries.

Personal Notes

WILLIAM C. PICKERSGILL has resigned as designing engineer, water supply board, Providence, R. I., to enter the service of the division of shipyard plants of the United States Shipping Board.

J. M. HAMMOND, formerly assistant to the chief engineer, Kansas City Terminal Railway Co., has been commissioned as captain in the construction division of the Quartermaster Corps, and assigned to duty at Washington.

B. F. CRESSON, JR., consulting engineer for the State Board of Commerce and Navigation, Trenton, N. J., has been appointed chief engineer to the New York and New Jersey Port and Harbor Commission.

ROY S. BONSIB, of the safety, welfare and employment department of the United States Metal Refining Co., Chicago, has been appointed safety engineer, District No. 7, Emergency Fleet Corporation, including California and a part of Oregon. His duties will consist of accident prevention work in the shipyards.

J. M. R. FAIRBAIRN, assistant chief engineer of the Canadian Pacific Ry., has been appointed chief engineer, succeeding J. G. Sullivan, who has retired to enter private practice.

J. C. PATTERSON, office engineer of the Erie R.R., has been appointed principal assistant engineer. The position of office engineer has been abolished. Mr. Patterson entered the service of the Pennsylvania R.R. in 1905 immediately after his graduation from Pennsylvania State College. In 1906 he entered the employ of the New York Central & Hudson River R.R., and was successively connected with the Big Four R.R., the Northern Pacific and the Chicago & Great Western R.R. until 1913, when he entered the service of the Erie as chief draftsman. In 1916 Mr. Patterson became valuation engineer of the system and in 1917 he was made office engineer, from which position he now succeeds to that of principal assistant engineer.

PROF. ALLEN B. MCDANIEL, head of the department of civil engineering, Union University, has entered the Government service at Washington, D. C.

E. H. PAGENHART, hydrographic and geodetic engineer of the United States Coast and Geodetic Survey, has been transferred by ex-

ecutive order to the Engineers Reserve Corps, with the rank of captain.

E. E. TALMADGE, who has been connected with the General Electric Co. for several years as a valuation and construction engineer, has received a commission as captain in the Quartermaster Corps, and assigned to duty at Richmond, Va.

The HON. H. H. WICKWIRE, who was appointed to the recently created position of minister of highways in the Nova Scotia Government, has been elected by acclamation as member for Kings County, confirming his appointment.

DR. D. B. STEINMAN, mentioned in *Engineering News-Record* of June 27, p. 1250, as having resigned from Waddell & Son, Inc., consulting engineers, New York City, to devote his entire time to his work in charge of the departments of civil and mechanical engineering, College of the City of New York, was employed by the firm as associate engineer. Dr. Steinman was not a member of the firm.

CHARLES E. ASHBURNER, city manager of Springfield, Ohio, since Jan. 1, 1914, will become city manager of Norfolk, Va., Sept. 1. He was the pioneer city manager, having filled that position at Staunton, Va., from April, 1908, to July, 1911, after which he was with the American Railways of Philadelphia at Lynchburg, Va., until he went to Springfield.

E. L. FLAD has been appointed construction superintendent and efficiency engineer of the Carnegie Steel Co. for the Youngstown district, succeeding F. Hubbard, who recently resigned to undertake construction work in connection with the new Government ordnance plant at Neville Island.

DR. WILLIAM C. WOODWARD, District health officer, Washington, D. C., since 1894, has resigned to become health officer of Boston, upon appointment by the Mayor. Doctor Woodward's resignation will take effect Aug. 1. He will be succeeded by Dr. William C. Fowler, the present assistant health officer. Doctor Woodward's service with the District of Columbia began in 1892, when he was appointed physician to the poor, after which he was appointed coroner, and in 1894 he became health officer. He is a graduate of Georgetown University, and is a member of the bar of the District of Columbia as well as of the District Medical Society. Doctor Woodward is a past president of the American Health Association.

PROF. F. B. SANBORN has resigned as head of the civil engineering department of Tufts College to devote all of his time to the business of the Sanborn Co., makers of scientific instruments, Boston. For the nine years previous to his appointment as assistant professor of civil engineering at Tufts College in 1899, Professor Sanborn was employed in engineering work by the Factory Mutual Insurance Cos. In 1901 he became professor of civil engineering at Tufts.

LIEUT. JOHN W. KELSEY, now on active duty at Camp McClellan, Alabama, has been appointed superintendent of the bureau of water, St. Paul water-works, through competitive civil service examination, and the position will be held open for him pending his return. Lieutenant Kelsey will succeed G. O. House, who resigned to become superintendent of the St. Paul City railway lines, as mentioned in *Engineering News-Record* of May 2, p. 885.

WILLIAM HOLDEN has resigned as engineer, department of streets and sewers, St. Louis, to become general secretary of the Commercial Club, Sioux City, Iowa. It is said that an engineer was selected for this position primarily to further industrial development and obtain better organization of industries for the production of war materials.

WILLIAM S. MOORE, Indianapolis, has resigned as state highway engineer of Indiana on account of the recent decision holding the state highway law unconstitutional and enjoining the Highway Commission from doing any work.

R. TRIMBLE and W. C. Cushing, who under private management were chief engineers maintenance of way of the Northwest and Southwest systems, respectively, of the Pennsylvania lines West of Pittsburgh, have been assigned by the new Federal manager of these lines to construction and maintenance, respectively, of all of his territory. Mr. Trimble's title is chief engineer—construction; Mr. Cushing's, chief engineer—maintenance.

F. C. BLACK, Hoquiam, Wash., was recently named city engineer of Hoquiam. Mr. Black has been a member of the high school faculty as instructor of mathematics.

L. RAYMOND SMITH, Jersey City, N. J., has been appointed by the United States Shipping Board as principal of its tenth marine engineering school, opened recently in Newark, N. J., to train men to become officers in the American merchant marine.

ALVIN HORWEGE has resigned as city engineer of Petaluma, Cal., to become assistant engineer for the Emergency Fleet Corporation of the United States Shipping Board, with headquarters at Alameda, Cal.

STEPHAN J. HAUSER has resigned as superintendent of the city filtration plant, Youngstown, Ohio.

F. L. STOCKBERGER, superintendent of the city garbage reduction plant of Cleveland since the administration of Newton D. Baker, has resigned to become associated with the Champion Stove Co. Charles C. Smith, of the municipal lighting plant, who was assistant superintendent of the garbage plant several years ago, will succeed Mr. Stockberger.

WILLIAM L. HAKER has been appointed resident engineer in the Seward division of the Alaskan Government Railways. He succeeds J. F. Waller, who has resigned to enter military service.

A. T. RHODES, street commissioner, Worcester, Mass., for the past five years, has been appointed field engineer of the Granite Paving Block Manufacturers' Association, with office at 31 State St., Boston.

W. R. B. WILLCOX, of Seattle, has been appointed superintendent of the Puget Sound Navy Yard Government housing program at Bremerton, Wash., under A. H. Albertson, also of Seattle.

OBITUARY

DANIEL C. CORBIN, pioneer railroad builder of Spokane, Wash., died of pneumonia in that city June 29. He was 83 years old and had lived in the West since 1862. Mr. Corbin built the Spokane Falls & Northern R.R., from Spokane to Nelson, B. C., and the Spokane International Ry., from Spokane to Kings Gate, Canada. He built and operated other and shorter lines in the mining districts in Idaho and Washington.

ROBERT BROWN CARNAHAN, JR., vice-president of The American Rolling Mill Co., was killed in an accident June 22. After his graduation from the University of Pittsburgh in 1891, Mr. Carnahan was actively associated with the Dewees-Wood Co. at McKeesport, Penn., from 1893 to 1899, when he went to the Homestead Works of the Carnegie Steel Co., soon after which he went into the present central works of The American Rolling Mill Co. as chief chemist and open hearth superintendent. It was under Mr. Carnahan's direction that Armco American Ingot Iron was developed. Mr. Carnahan was a member of The American Iron and Steel Institute, The American Institute of Mining Engineers and The American Society For Testing Materials.

S. F. MOELLER, civil engineer and contractor of Rockwell City, Iowa, died by accident June 25. Mr. Moeller was nearly 47 years of age and had been practicing for 20 years, specializing in drainage work. He designed and built some of the first drainage works in Calhoun County and at the time of his death was engineer for the Big Cedar Drain, a work calling for 150 miles of ditch and designed to reclaim 208,000 acres.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

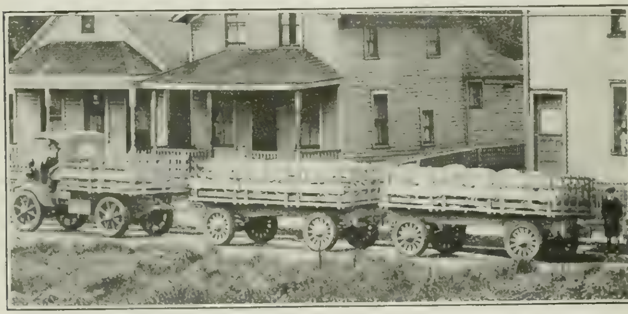
Developing Freight Routes on Highways with Motor Trucks and Trailers

Existing Detroit-Cleveland Line to Be Extended and Provided with Terminals, Feeders and Division Points

The use of motor trucks, with trains of trailers, capable of carrying loads up to 15 tons is a further development in relief of the railroads. A freight route of this kind was started between Cleveland and Toledo, and the return load procedure set forth in a recent issue of *Engineering News-Record* has been carried out from the first. The route was later extended to Detroit and eventually will be provided with terminals with feeder trucks, to gather and distribute shipments, as well as division points at intersection of routes where trailers will be routed to destination.

trucks. This is a practical demonstration, as pointed out by the Troy Wagon Works Co., of the original theory that trailers would make transportation possible over roads that would otherwise be impassable, and would cause less wear on good roads. This they point out is of vital importance in this day when the roads are taxed to their utmost.

These outfits run on a daily schedule, out of Toledo every morning at 8 a m. and every evening at 10 p.m. each train carrying springs, bearings and other essentials of the automobile industry in Detroit. During the past four weeks the average load on each trip has been in the neighborhood of 12½ tons. The trip is made in from 7½ to 9 hours, weather and loading conditions affecting the time of the trips. The same program is carried out at Detroit, the trains leaving at the same hours, the only difference being in the character of the material hauled. Up to the present time, motors are being transported from Detroit to Toledo for use in an automobile plant in the latter city. On this trip each train carries 28 motors, weighing 650 lb. each. The motors are mounted in crates with 12 crates on each trailer and four on the tractor.



MOTOR TRUCK WITH TRAILER TRAIN ON OHIO FREIGHT ROUTE

The accompanying illustration shows one of the trains operated by the Liberty Highway Co., on its initial trip. The cargo carried one way is rims and springs, and motors are brought back on the return trip.

The service was started primarily to serve the automobile industry in that part of the state. Later it will be extended to handle all classes of freight. Between Toledo and Detroit, a distance of 70 miles, these trains have maintained a continuous service, making two trips in three days. The motive power is a Walter four-wheel drive tractor, manufactured by The Walter Motor Truck Co., New York City, with a capacity of five tons, and the trailers are 5-ton capacity, manufactured by the Troy Wagon Works Co., Troy, Ohio. There is a stretch of twelve miles of mud road in the Detroit-Toledo trip over which it is impossible to operate large and heavy motor trucks. The dividing up of the loads on the trailers makes it possible to follow the more direct route, whereas the Government was compelled to build a detour for its

Plans are now being discussed for increasing the capacity of each train by installing another 5-ton trailer that will handle 12 more motors, which will bring the capacity of the train up to 40 motors, but at present 28 motors constitute a train-load shipment. The motors that leave Detroit in the evening are brought into the assembling

(Concluded on next page)

Japanese Foreign Trade in South America

Japan's export and import trade since the year 1913 has increased more than 120%. In 1913 the export to Chile amounted to about $121,000, in 1917 this was increased to $2,225,000; that to Argentine in 1913 was $1,364,000, in 1917 it was $3,471,000. Imports from Chile in 1913 were $2,773,000, in 1917 $9,015,000.

Prior to the war, although there had been a considerable immigration of Japanese colonists into South America, trade with that country was comparatively small. Since the war commenced the Japanese have taken prompt advantage of the shutting off of European trade, and have learned the needs of the South Americans as well as their convenience and wishes. They are sending men to study the business conditions and practices. These men are establishing banks and banking facilities and storing up raw materials, and in many other ways building up a stable market, which, it is believed, will last for many years after the war.

Wholesale Lumbermen Co-operating with the Government

The accomplishment of full coöperation with the Government is the purpose of Bulletin No. 8, issued recently by the National Bureau of Wholesale Lumber Distributers. They urge that "now is the time for the wholesaler to prove his economic necessity and his patriotism by assisting the Government and its agencies in carrying out the spirit of the Government orders regulating prices."

The bulletin states that the right of the wholesaler to participate in Government business is now conceded, but that compliance with certain rules is necessary, such as conducting the business through emergency bureaus and the furnishing of certain information regarding the supply of material, its origin, and points of shipment, etc. It is pointed out that unless wholesalers abide by the rules laid down by the Government board, especially in regard to prices, they will suffer accordingly.

Reserve Stocks of Portland Cement Reported Low

Smaller reserve stocks of portland cement than at any time in the history of the industry is reported. In the Lehigh district the entire daily output is shipped as it is made. Notwithstanding the cessation of the building trades generally, the Government demand is so heavy and so steady that there will be no replenishment of reserve stocks for a long time.

Large Salaries Reported by Federal Trade Commission

Salaries ranging up to more than $360,000 per year for presidents, vice-presidents, chairmen of boards of directors, office managers, accountants, etc., in the metal trades is interesting information included in the report on profiteering of the Federal Trade Commission to the Senate. It is pointed out that these amounts are exclusive of income derived from holdings of the various officials in the stock of the companies, and include only salaries and bonuses or "tantième" which have been charged to expense account. The highest salary was that of a president of one company, $364,326; vice-president, $221,596; chairman of the board of directors, $179,662; office manager, $148,530, and others ranking down the list to a minimum of $5200.

Payment of "Tantieme"

In a reply by the company regarding the "tantième" (a French word meaning a commission or proportional amount) it is stated that the payment of this is an established custom whereby the profits of the company are shared by the officers. The report of the Federal Trade Commission, however, states that these amounts formed a part of the expense account of the company.

Near the bottom of the list is an American name, a mining engineer in the West, receiving a salary of $6350. Close to him is a man with a German name in New York who receives a salary of $6190 for the position of "bookkeeper."

Report Is Comprehensive

The report of the Federal Trade Commission covers steel, copper, zinc, nickel, sulphur, lumber, coal, petroleum and its products, meat packing, leather and leather goods, flour, canned milk, and salmon canning companies, and in all of these an abnormal profit, since the war commenced, is reported. In one case, the volume of sales has been increased 150% only, whereas the profits have increased 400%, and it is pointed out that in a number of cases reports had been circulated of a dangerous shortage in the various commodities merely, it was asserted, to justify the high prices asked, this being especially alleged in the petroleum products and in leather. A number of steel companies have continued to make abnormal profits after the prices were fixed by the Government, although the prices were advanced in some cases up to 400% of the pre-war level when they were fixed.

That part of the report covering lumber states that this industry, except in one or two lines, does not show abnormal profits. This was pointed out in a recent issue of *Engineering News-Record*.

The report was submitted to substantiate the charge of profiteering made by the President in a recent address to Congress.

Freight Routes on Highways

(Concluded from preceding page)

room of the automobile plant in Toledo early in the morning, so that production continues without interruption. Tests have demonstrated that this tractor can handle three of these trailers over this road without undue difficulty, but should the 12-mile stretch of mud road become worse under weather and traffic so that three trailers would be too much for the motor, the trailers can be uncoupled and taken over the bad part separately.

In addition to this route, plans are now under way to extend the line to Pontiac, Mich., and also east of Toledo to include Akron, Canton, Alliance and Massillon, Ohio, the plan being to use trains running west of Massillon to a division point, which will most likely be Elyria or Norwalk, where the tractors will be unhooked from this train and the trailers coupled to the Michigan train for points north. In this way solid trains of trailers can be run through, while the tractors will only make half the runs. Thus an opportunity will be afforded for keeping them in good shape by eliminating the long grind. This, it is pointed out, inaugurates a manner of handling freight almost identical with that of the railroads.

The rates being charged between Detroit and Toledo are based on express rates, but where fixed amounts of tonnage are contracted for, lower rates are quoted. Negotiations have been practically completed whereby the Liberty Highway Co. operating these trains is to utilize the surplus space of the Troy Trailer warehouse in Detroit for a terminal. The line will be in a position then to handle miscellaneous shipments of all goods, the plan being to educate the Detroit shipper to bring smaller shipments direct to the terminal in Detroit; that is, on all shipments of less than two tons a pickup truck will be run to gather up the larger loads to make up the train. This plan is now in successful operation in Cleveland, by the Highway Motors Transport Co., although some difficulty was experienced at first in educating the public. The transportation difficulties were so large, however, they soon appreciated the fact that by resorting to this practice they were helping to build up the service.

Business Notes

G. W. Coleman, Boston, Mass., was appointed director of information for the Department of Labor June 30. He recently returned from a European tour in which he studied industrial problems in France and England especially.

Henderson W. Knott, formerly general manager of the Morgan Crucible Co., New York City, has been appointed by the United States fuel administration manager of the field force of engineers and inspectors who will work among the power plants of the country carrying out a campaign of instruction and inspection designed to bring the use of fuel for the production of power to the highest possible efficiency and economy.

Frank E. McDermit has been appointed receiver for the American Pipe and Construction Co., incorporated in New Jersey. The company is the owner of 17 subsidiary public utility companies. It is pointed out that the receivership was made not on the grounds of insolvency, but on the fact that it had been shown that the company was operating at a loss. The Federal courts of Pennsylvania appointed a receiver for this company last year.

Grace Motors, Ltd., with headquarters in Toronto, and branches in the principal cities of Canada, is now the Canadian distributer for the Sterling Motor Truck Co., Milwaukee.

The Crescent Truck Co., of Elizabeth, N. J., has purchased all rights, title and interest to the Crescent Electric Industrial Truck, from the Bethlehem Shipbuilding Corporation.

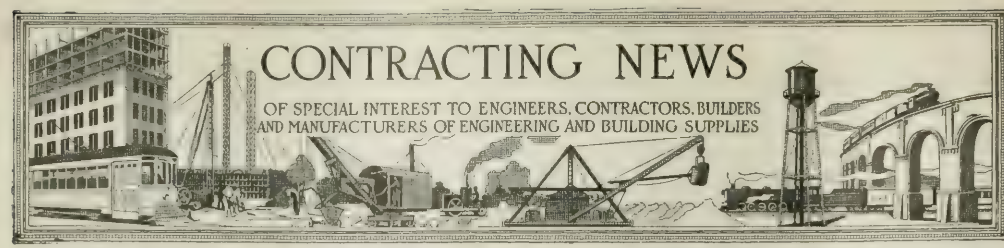
The Chicago Pneumatic Tool Co. makes the following announcements: L. C. Sprague, recently in the railroad department of the H. W. Johns-Manville Co., New York City, has been appointed special representative in connection with the sale of pneumatic tools to railroads. W. H. Callan, general plant manager, and W. P. Pressinger, general sales manager, have been elected vice-presidents of the company.

Trade Publications

"Motor Trucks of America, Vol. 6, 1918," has been received from the B. F. Goodrich Rubber Co., truck tire department, Akron, Ohio. It is a book, in pamphlet form, of 168 pages, containing a descriptive list of the motor trucks manufactured in North America.

A 20-page catalog of reversible ratchet wrenches has been received from the Lowell Wrench Co., Worcester, Mass. It illustrates this type of wrench in many sizes.

The C. H. & E. Manufacturing Co., Inc., Milwaukee, has issued a loose-leaf catalog of the saw rigs, pumps, hoists and mortar mixers which it manufactures. Besides numerous illustrations it contains diagrams and data sheets. These sheets are standard 8½ x 11, making it convenient to file the data.



Proposals

For Proposals Advertised See Pages 54-56 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
July 15	Clovis, N. M.	July 11
July 15	Haledon, N. J.	July 11
July 16	Livingston, Mont.	June 27
July 16	Akron, O.	July 11

SEWERS

July 15	Clovis, N. M.	July 11
July 16	Leavenworth, Kan.	July 11
Aug. 1	Akron, O.	July 4

BRIDGES

July 15	Ukiah, Cal.	July 4
July 17	Prineville, Ore.	July 11
July 20	Tullulah, La.	July 11
July 23	Warrensburg, Mo.	July 11
July 24	Clarksburg, W. Va.	June 27
July 26	St. Louis, Mo.	July 11
July 31	Santa Domingo	May 16
Aug. 5	Duluth, Minn. Adv. May 16.	July 11

STREETS AND ROADS

July 12	New York, N. Y.	July 4
July 12	Jersey City, N. J.	July 11
July 15	Pineville, W. Va.	July 11
July 15	Peoria, Ill.	July 11
July 16	Detroit, Mich.	July 4
July 16	Ohio	July 4
July 16	Pittsburgh, Pa.	July 11
July 16	Sanford, Fla.	July 11
July 16	Jersey City, N. J.	July 11
July 16	Auburn, Neb.	July 11
July 16	St. George, S. I., N. Y.	July 11
July 17	New York, N. Y.	July 11
July 17	Chicago, Ill.	July 11
July 17	Grand Island, Neb.	July 11
July 17	Cleveland, O.	July 11
July 17	Brooklyn, N. Y.	July 11
July 18	Hastings, Neb.	July 11
July 18	Cleveland, O.	July 11
July 18	Spokane, Wash.	July 11
July 18	Newark, N. J.	July 11
July 18	Paris, Ill.	July 11
July 19	Bluefield, W. Va.	July 11
July 19	Newton, N. J. Adv. July 4 and 11.	July 11
July 19	North Platte, Neb.	July 11
July 19	Woodsfield, O.	July 11
July 19	Pennsylvania. Adv. July 4 and 11.	July 11
July 20	Gandy, Neb.	July 11
July 25	Indiana.	July 11
July 25	Bisbee, Ariz.	July 11
July 26	Indiana.	July 11
July 26	Pittsburgh, Pa.	July 11
July 29	Seattle, Wash.	July 11
July 29	Los Angeles, Cal.	July 11
July 29	Louisiana.	July 11
Aug. 1	Cleveland, O.	Mar. 28
Aug. 15	New Mexico. Adv. June 27.	June 27

EXCAVATION AND DREDGING

July 15	Cresco, Ia.	July 11
July 15	Palm Beach, Fla.	July 11
July 16	Rockwell City, Ia.	July 11
July 23	Albany, N. Y. Adv. June 27.	June 27
July 23	Yankton, S. D. Adv. July 11.	July 11

INDUSTRIAL WORKS

Bids Close		See Eng. News-Record
July 15	Norfolk, Neb.	July 4
July 15	Three Rivers, Que.	July 11
July 17	New York, N. Y.	July 11
Aug. 1	Racine, Wis.	July 11

BUILDINGS

July 15	Phila., Pa.	June 20
July 15	Cattaraugus, N. Y.	June 27
July 15	South Bend, Ind.	July 4
July 15	Norfolk, Neb.	July 4
July 15	Claremont, N. H.	July 11
July 15	Toronto, Ont.	July 11
July 15	Wanaque, N. J.	July 11
July 17	Schenectady, N. Y.	July 11
July 19	Cleveland, O.	July 11
July 20	New York, N. Y.	June 27
July 20	Windsor Locks, Conn.	July 11
July 22	Boston, Mass.	July 11
July 22	Mattapan, Mass. (Boston P. O.) Adv. June 27.	July 11
July 30	St. Louis, Mo.	July 11
Aug. 6	Richmond, Ky. Adv. July 11.	July 11

FEDERAL GOVERNMENT WORK

July 11	Receiving Barracks—Spec. No. 3147—Brooklyn, N. Y.	July 11
July 15	Water System—Spec. 3074—San Diego, Cal.	June 27
July 15	Electric School Ship Building—Spec. 3064—Hampton, Va.	July 11
July 15	Railroad — Spec. 3050 — White Plain, Md.	July 11
July 15	Submarine School — Spec. 3140—New London, Conn.	July 11
July 15	Generating Plant, etc. — Spec. 3129—Norfolk, Va.	July 11
July 15	Boiler and Mechanical Stoker—Spec. 3149—Brooklyn, N. Y.	July 11
July 15	Sand Handling Apparatus—Spec. 3174 — Washington, D. C.	July 11
July 16	Canals—Clint, Tex.	June 27
July 18	Post Office—Eldorado, Kan.	June 27
July 18	Supply and Distributing Systems—Shiprock, N. M.	June 27
July 19	Dredging — Philadelphia, Pa.	June 27
July 19	Jetty Repairs—Wilmington, Del.	June 27
July 22	4 Radio Buildings—Spec.	
July 22	Electric Power System — Spec. 3131—New York, N. Y.	July 11
July 22	Surface Condensers and Auxilary Pumps—Spec. 3085 — Puget Sound, Wash., (Bremerton P. O)	July 11
July 22	Pay Office and Paint Shop—Spec. 3109—Pensacola, Fla.	July 11
	3069—Haiti	June 20
July 22	Fuel and Diesel Oil Storage —Spec. 3071—New London, Conn.	July 11
July 22	Gunnery School, etc.—Spec. 3148—Pensacola, Fla.	July 11
July 25	Lockkeepers' Houses—Wheeling, W. Va.	July 4
July 29	Dispensary, etc.—Spec. 3188 —Washington, D. C.	July 11
July 29	Dredging—New York, N. Y. Adv. July 4 and 11.	July 11
July 31	Assay Office—New York, N. Y. Adv. July 11.	July 11
Aug. 6	Dredging—New York, N. Y. Adv. July 11.	July 11

MISCELLANEOUS

July 15	Levee—Baton Rouge, La.	July 11
July 16	Steel and Pipe Line—Jersey City, N. J. Adv. July 4 and 11.	July 4
July 24	Telephones—Potsdam, N. Y. Adv. July 11.	July 11
July 25	Cement, etc.—Bisbee, Ariz.	July 11
Aug. 1	Levee—Baton Rouge, La.	July 11

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

WATER WORKS

In the matter of contracts from $100,000 up, the East leads the list by over $400,000, Pennsylvania being first with one contract of $700,000 at Yorktown for a concrete reservoir and pump well. Oklahoma is a close second with two contracts aggregating $535,000 and a third project of $100,000 to be voted on, all for new water-works. A trunk sewer at Corona, N. Y., is third at $346,493, and Texas fourth in the list with a gravity water supply and dam at $240,000, with Ann Arbor, Mich., at $200,000 next for the same purpose. Mitchell, N. D., and Milwaukee, Wis., are planning sewers and water-works at $185,000 and $150,000, respectively.

Proposed Work

Conn., Hartford—Bd. Water Comrs. soon lets contract for 4800 ft. 48 in. rein.-con. pressure conduit, built in place or precast pipe. C. M. Saville, 1026 Main St., engr.

N. C., Wilmington—City plans to issue $14,000 bonds to improve water works. F. F. Pilette, city engr.

Fla., Pensacola—City plans to vote on $100,000 bonds for water works system, etc.

Mich., Ann Arbor—Dept. Water Works soon lets contract laying 18,000 ft. 20 in. c. i. water pipe. G. S. Vandwarker, mgr. Noted Mar. 28.

Mich., Cassopolis—Village plans to improve water-works. Work involves one 80,000 gal. steel tank, one 350 gal. motor driven, centrifugal pump, one 750 gal. motor driven, centrifugal pump and chlorinating apparatus. Holland, Ackerman & Holland, 122 Fourth Ave., Ann Arbor, engrs.

Ill., Witt—City soon lets contract improving water works system. About $30,000. H. Hammack, clk. Noted June 27.

Minn., Argyle—See "Sewers."

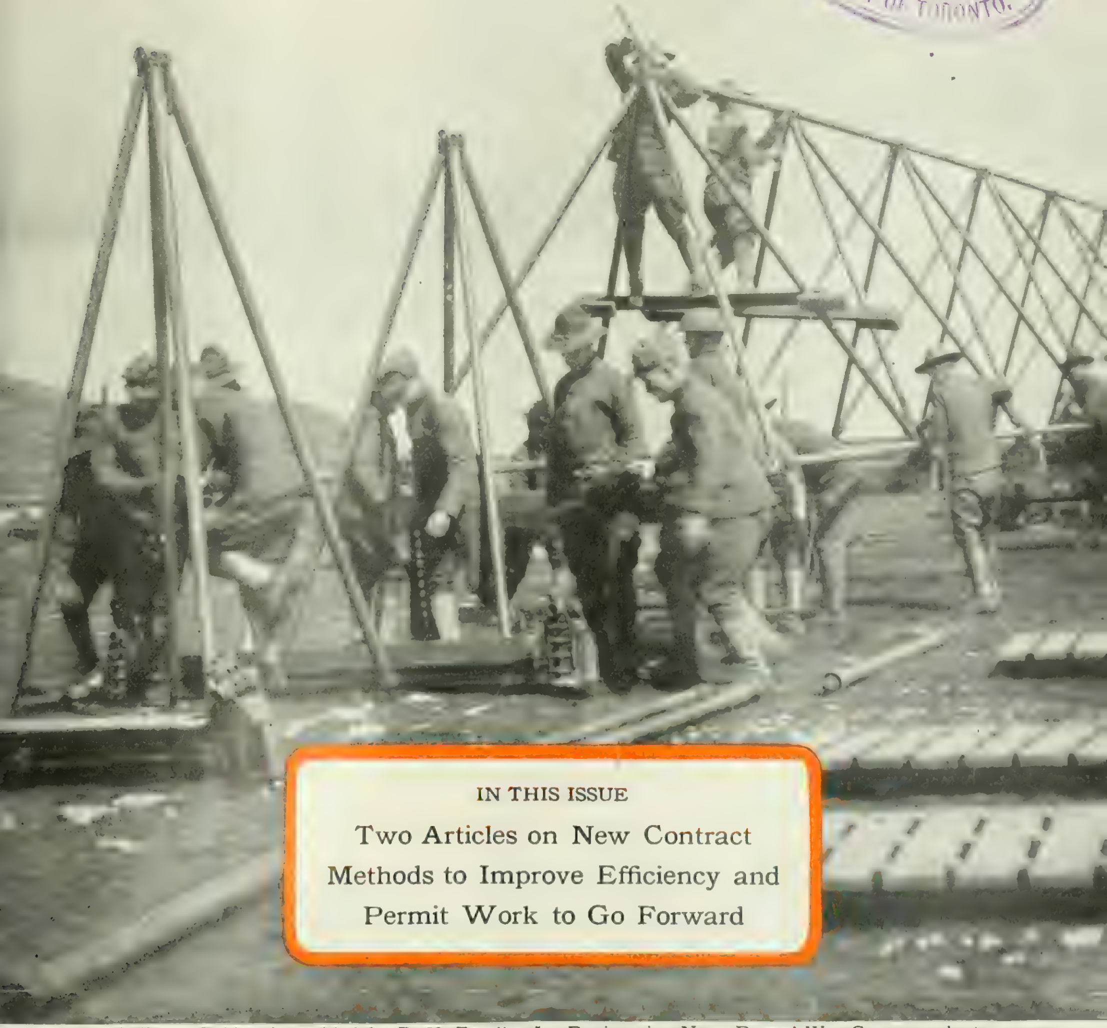
Kan., Junction City—City having preliminary plans prepared to extend water and sewerage systems. Burns & McDonnell, 400 Interstate Bldg., Kansas City, Mo., engrs.

Kan., Lawrence—City passed ordinance to improve water-works system to include 16 mi. new mains. About $100,000 available for project. E. H. Dunmire, city engr.

Kan., Sedan—City plans to improve water-works system, involving 7,588 ft. new main, connections, etc., and lowering 2,000 ft. present main. Bonds for $14,209 will be issued for project. H. W. Loomis, clk.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
July 18, 1918



IN THIS ISSUE

Two Articles on New Contract Methods to Improve Efficiency and Permit Work to Go Forward

Military Bridge Assembled for R. K. Tomlin, Jr., Engineering News-Record War Correspondent, at Our Army Engineer School in France, Described by Mr. Tomlin in This Issue

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Who Will Save the Contractor?

ELSEWHERE in this issue is editorial comment on the hard position in which the freight rate increases have put the public-works contractors. This recalls the indifference of government agencies toward the contracting industry. In the War Industries Board we find a section on conversion. With the greatest solicitude, it is trying to find war occupations for peace industries—and is succeeding admirably. But of the contractor it knows nothing. The nearest sentiment to solicitude for him is in the section of the board which recommends the placing of contracts and whose cheerful word is that the contractor must go out of business. No looking to the future. No survey of possible future need for contracting organizations. No thought as to ways of conserving for the country the great investment represented by the experience of contractors. Possibly a careful scrutiny would disclose no hope. To assume that such would be the result savors, however, of the guesswork conduct of business whose futility the war has revealed. What about hydroelectric development if the pending bill becomes law; what of highway work, railroad work and concrete ships—all war measures, all likely to reach goodly proportions under a matured, vigorous, win-the-war policy? Whose business is it to find out whether the contracting organizations should be saved, if not that of the War Industries Board?

Are There Alternatives to Motor Trucking?

MR. WHINERY, in his letter to the editor, on p. 142 of this issue, makes the interesting suggestion that it is feasible to construct on the side of our highways a railway track or tracks to carry motor trucks fitted with flanged steel treads, so attached as not to interfere with the use of the trucks on ordinary road surfaces or city pavements. When roads were encountered that were fitted with the track system, both power and the road surfaces could be saved. We need to take a broad view of our highway transportation problem, study all the factors, reach an unassailable conclusion, and have the courage to act upon it. If some system other than transportation by motor truck over present types of highways is less expensive, the new plan must be adopted. The amount involved annually in trucking charges and road upkeep is so tremendous that even relatively small savings per mile of road or per ton-mile of traffic reach an enormous aggregate. We need to inquire, for example, into the merits of narrow-gage railways as substitutes for motor-truck transportation. Mr. Tomlin, war correspondent of the *Engineering News-Record*, in his recent articles (June 13 and 20) showed that the light railways back of the British front are carrying a tremendous traffic. They can be put down at relatively small expense and the upkeep is light. Many difficulties, of course, suggest themselves—matters of safety, legislation, finance—but the difficulties cannot be properly appraised until we get more facts. If the costs on careful investigation are shown to be low, then will be the time to consider what legislation will be necessary, what are the financial difficulties, etc. And even if this scheme and Mr. Whinery's prove to be chimerical, the close scrutiny of present methods which will result from the studies will very considerably advance our knowledge of the essentials of the most economical highway transportation scheme.

Municipally-Owned Garbage Reduction Works Increase

WASHINGTON has followed close upon Indianapolis in making the local garbage-reduction works a municipal enterprise. Still earlier, this had been done by Cleveland, Columbus, Chicago, Schenectady, Akron, and Rochester. New Orleans has a municipal plant in prospect. Other cities are sure to build or buy garbage-reduction works soon. War conditions will check the movement in some places and hasten it in others. The argument for municipal ownership is strengthened wherever for any reason authority is lacking to let disposal contracts for sufficiently long periods to warrant reasonable bids without the risk of losing invested capital by failure to secure a renewal of the contract. Broadly speaking, a reasonable garbage disposal bid in these days of high grease and tankage prices should yield the city a revenue, instead of causing it an expense—assuming that the contract does not include collection as well as disposal. As a general rule, where for any reason a city cannot embark on garbage reduction because of the high capital outlay involved, it may still insure the utilization of its garbage, and perhaps a handsome revenue, by establishing a municipal piggery or letting a contract for disposal by feeding. This is no time to burn garbage—especially where coal has to be used for the purpose.

Court's Vacation Blocks Road Improvement

HIGHWAY improvement in Indiana, long needed and fought for, is delayed for at least a year by the adjournment of the State Supreme Court for its three-month summer vacation without rendering its expected decision as to the constitutionality of the new

highway law. Delays due to such vacations have been a standing source of complaint against our judiciary system for many years. It would seem that at least in these times of stress the courts might defer their vacations in order to handle important cases. Under the new Indiana law a state highway commmission was established and active planning of a program of improvement was initiated. One of the lower state courts then held the law to be unconstitutional, and the commission was enjoined from doing any work. The case was appealed to the supreme court, and it was hoped and expected that an early decision would be given so that, if favorable, work might be carried on this season. On June 28 the court adjourned for its vacation without having taken any action in the matter. As it will not be in session again until October this puts a stop to all preparatory work and prevents even beginning construction work this season. It also results in the disorganization of the highway commission's staff and engineering force and effectually blocks Indiana's attempt to improve its public highway system. We sorely need such an organization of the engineering profession as will take cognizance of such conditions and bring the influence of the profession to bear.

Robbing Peter

WHILE the railways were under private management, rate increases were either niggardly or entirely denied. Now that the Government is operating the properties the shoe is on the other foot, and rates go up. We cannot argue against that decision. It should have been made years ago. What we do object to is its ruthlessness—instistence that the Government get its due even though others suffer grossly. We refer to the public-works contractors.

There are in existence today many contracts for road work, for example, entered into prior to the freight-rate advances. In only one or two states can the contractors be relieved. By act of the Federal Government these men, without fault of their own, must suffer serious loss; some of them may be forced into bankruptcy. That rising labor prices have also caused the contractors loss is not an extenuating argument. The one is a specific act of Government, a fiat that cannot be overcome by better management; the other a result of general conditions. The former can be relieved by instant action of the Government; the latter cannot. The raising of rates, so far as it affects many public-works contractors, runs counter, too, to the Government's general war attitude toward industry. War contracts are uniformly on a cost-plus or a limited compensation basis, the purpose being to protect the contractor against the very conditions which the Government itself now imposes on builders of public works. Moreover, the exaction of higher railroad rates is due to a desire to deal fairly with the railroad employees, while the contract between the Government and the railroad owners will insure the latter their pre-war dividends.

Somehow, the same consideration has not been shown the public-works contractor. Builders on private work can reason with the owners. Builders on public work find it useless to reason, for the owner, the public, has fortified himself with laws that force completion of the job even though it drive the contractor to bankruptcy.

Some weeks ago the railroad administration was asked to give relief to highway contractors, but refused it. Last week the matter was again brought to the attention of the railroad administration, this time on reconsideration of the road-materials rates as a whole. The case for reconsideration is regarded by rate authorities as strong. If hearings are granted the whole highway situation will come strongly before the Administration, and out of the presentation, let us hope, will come the same consideration for the highway and public-works contractor that the Government has shown its war contractors, its railroad employees, and the owners of railroad stock.

Seeking Federal Aid for a Hudson River Vehicle Tunnel

THERE is growing a belief that New York City's freight-handling problem, which has been under investigation and discussion for fully a score of years, can best be solved by building a vehicle tunnel under the North River so that the motor trucks of Manhattan merchants can receive and deliver freight at stations on the New Jersey bank of the Hudson River. Both New York and New Jersey have commissions which have long been studying the problem of bridges and tunnels but have thus far failed to develop a financially feasible scheme.

Meanwhile the relation of traffic congestion in New York to the Government's war activities is such that bills have been introduced in Congress appropriating $6,000,000 toward the cost of the projected tunnel, provided the states of New York and New Jersey will within two years each contribute $3,000,000. As neither state can take action until its legislature meets next winter and as a state appropriation of such an amount for this work would have to receive approval by a popular referendum vote before it could be effective, it will probably be nearly two years before construction of the tunnel could begin, even if no opposition is encountered. Allowing two years for construction, this would mean the lapse of four or five years before the tunnel could begin to relieve traffic congestion.

Since the traffic congestion is steadily increasing it is evident that work on the tunnel should be begun as soon as possible. It does not follow, however, that this argument will convince Congress, which may object that a work which will be available only four or five years hence should not be undertaken as a war measure. It is well known also that congressmen from many sections generally oppose Federal expenditures for the benefit of New York's commerce, even where the responsibility, as in appropriations for harbor improvement, is clearly upon the Federal Government. The opponents will have in this case the added argument that Congress in granting Federal aid to a vehicle tunnel would be establishing a precedent under which heavy drafts might hereafter be made on the Federal treasury for the construction of projected bridges and tunnels in all parts of the country, wherever such structures could be shown to be carriers of interstate traffic. All this, with the well-known difficulty of getting any legislation through Congress not directly related to the war, leads to the conclusion that New York and New Jersey should

not count on aid from the Federal treasury for this work.

The two states have now a special commission studying the port of New York, and some authoritative statement may well be looked for in its report as to the relation of the proposed tunnel to port congestion. It is to be hoped that the project may be there presented in such clear and convincing shape that the difficulties which have hitherto prevented the two states from financing the tunnel enterprise may be overcome.

Stop Chicago Water Waste

UNIVERSAL metering of all water services in Chicago in ten yearly installments seems nearer accomplishment than ever before. The finance committee of the city council has reported favorably on such an ordinance and the matter comes up today for consideration.

For many years the city engineer, who builds the works and purveys the water, and the superintendent, who handles the finances, have made strenuous, though futile, efforts in season and out to persuade the city council to adopt some metering policy to check waste and reckless consumption. At last various civic bodies have awakened to the fact that Chicago is 20 years behind the times in its sale methods.

Perhaps the emphasis of the war on the need of public economies has crystallized the opinion that now is the time for Chicago to "confess conversion," face about and abandon the policy of needlessly burning 100,000 tons of coal a year, building a new pumping station without getting any appreciable benefit and pumping more water than any other city in the world, only to waste half of it.

Possibly the numerous arguments put forth in the report of the Bureau of Public Efficiency, an engineer's report written for lay consumption (see *Engineering News-Record*, Feb. 7, page 268) were not without effect. However, it is more likely that the real spur to action, if action is taken today, will come from mass education and mass demand from the great sweltering lower classes. Those who live in the congested districts are tiring of conditions under which they cannot get water on the second and third floors. Of this class are the constituents of a socialist alderman on the West Side who forced him to seek a solution. The water department officials welcomed the opportunity thus afforded to point out the only remedy.

Aldermen in the silk-stocking wards have always favored metering the city, while those from the congested districts were not interested, were apathetic or were violently opposed to meters, because they represented unenlightened voters who have an inherent fear of being led into something prejudicial to their interests. These are the political aspects of a strictly engineering problem and too often they control. The sooner engineers learn to analyze these controlling civic influences, to plan active campaigns of education, and to act on the plans effectively, the quicker will they be doing their full civic duty.

Already much work has been done in Chicago—good so far as it has gone. The engineers' sub-division of the Chicago Association of Commerce is responsible for aligning that body on the side of meters. Various engineering societies have passed the customary resolutions favoring water-waste elimination by metering, but none of them has made any effort to enter the political arena, where the real decision will be reached. No better opportunity exists for active participation in a clear-cut case on which all can agree. Engineers should get into the fight. It is a righteous cause.

Centralization of Educational Functions of War Department

ALL the educational functions of the War Department carried on with the coöperation of educational institutions have been centralized. Under an order dated June 28, the Committee on Education and Special Training will have direction not only of courses for mechanics and of the training of college students, but will supervise furloughing and enlistment in the technical students' Enlisted Reserve Corps, and represent the War Department in its relations with educational institutions. It was a consummation devoutly to be wished.

As was set forth in this journal some months ago, we were facing confusion in these matters. Medical students had been given a furloughed status and efforts were being made to secure somewhat similar rulings for other classes. There were differences in the requests being made. At the same time the Federal Board for Vocational Education was pressing to take over the mechanics' training work, while there was utter neglect of planning for the military instruction of the ripening officer material, the boys in college. Happily wise counsel prevailed. Instead of experiments in separated control, the efforts have been headed in one direction, culminating in the order of June 28.

It should be noted that this order settles definitely and satisfactorily the military control of students whether engineering or otherwise. It does what Dean Richards of the University of Illinois contended for—allows the board to hold all promising men in school.

Simultaneously with the new order details are published of the regulations governing the new Students' Army Training Corps. The corps is a most promising addition to our army organization and our educational system. He fails to appreciate the disciplinary and physical achievements of the National Army camps who entertains the thought that this corps, established as a war measure, will be dropped after the war.

Fortunately the work of the committee so far assures a vigorous and broad handling of the new corps and, as well, of the broadened duties. During its brief existence it has so ably handled its assignments that 40,000 men detailed from the army are now in school receiving intensive mechanical instruction. The development to date of plans for the new corps is its work, while in the mechanics' instruction its broad grasp is shown by the institution of courses on the causes of the war and our aims in entering it. Each of the soldiers in these schools will go out as a missionary fortified with correct views on the reasons for our participation in the war.

The committee and its civilian advisory board are to be heartily congratulated on their progress and on the confidence reposed in them in the enlargement of their duties.

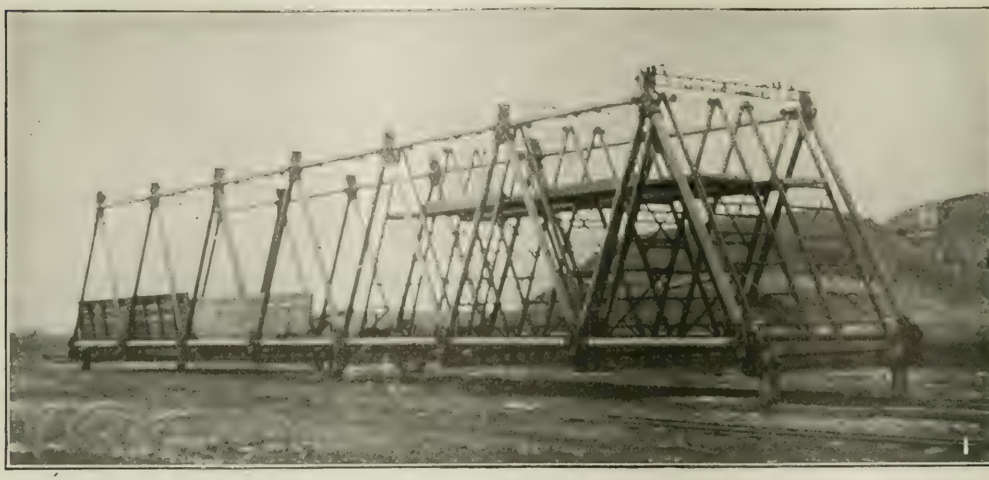


FIG. 1. HEAVY TYPE OF PORTABLE STEEL BRIDGE—RESEMBLES LIGHTER STRUCTURE SHOWN IN FIGS. 5 TO 11

Army Engineer School in France Standardizes Work in the Field

Gives Courses of Training to Men Recommended for Commissions—Operations Conducted Mostly in the Open—Classes Trained in Mining, Pioneering, Bridging, Topography, Camouflage, Sound Ranging and Interpretation of Aërial Photographs—Model Battle Sector Laid Out and Completely Equipped

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record
All Photos by Engineering News-Record

TO SUBSTITUTE standardization for improvisation in the conduct of military engineering operations, in both field and office, and to give the man in the ranks an opportunity of becoming a commissioned officer, are the two main objects of the Army engineer school of the American Expeditionary Forces in France, which was formally inaugurated Apr. 1 with a class of 110 enlisted men from various technical units. This school is, in effect, a super-Plattsburg, where facilities for instructing our men in the latest phases of military engineering practice are being mobilized.

The need for such training is great, for many of the standards of practice laid down in former engineering field manuals have either become entirely obsolete or need substantial revision to bring them up to date; and, in addition, there is a host of new phases of the work of the engineer under the conditions of modern warfare. For example, the latest methods in the erection of barbed wire entanglements, the location and construction of trenches, the excavation of dugouts by rock tunneling, the interpretation of aërial photographs, the registering of enemy batteries by sound and flash ranging, the detection of enemy sapping operations by microphone, the rapid assembly and launching of new types of bridges, measures for gas offense and defense, the location and protection of machine-gun emplacements, the camouflaging of gun positions—these and scores of other subjects go to make up the curriculum of our newly established overseas engineer school.

Where training camps in the United States gave candidates for engineer commissions a grounding in the duties of the engineer service, the work at the school here on French soil begins where the others terminate, corresponding to a postgraduate course for commissioned officers and an intensive period of instruction for noncommissioned officers aspiring to higher rank. Just as the air-pilot candidate who has become proficient in straight flying must master the "circus stunts" which are an essential part of modern aërial combat, so must the Army engineer's education be topped off with a course in the less sensational, but equally specialized, phases of the new military engineering which the war has developed.

How Courses Are Conducted

It was my good fortune to be present at the opening of the American Army Engineer School over here and spend the day in an inspection trip with its commandant, a colonel of engineers well known readers of this journal by reason of his series of articles on the engineer in war which appeared in *Engineering Record* about two years ago. I say "an inspection trip," for the school's work is not all done within the four walls of the classroom which we generally associate with the word "school." This engineer school conducts the greater part of its operations in the open, by means of practical demonstrations, and to cover its field of activities Colonel B—— and I started out in the morning and

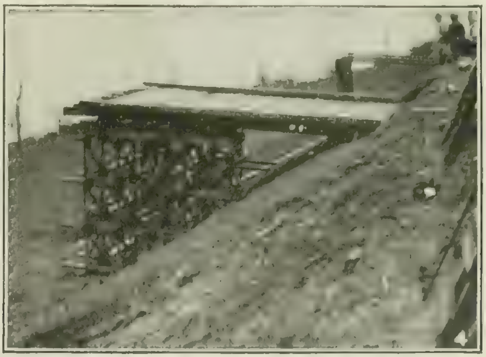
traveled over many miles of French highway by automobile before we got back to his headquarters late that afternoon. Of course, it must not be supposed that classroom work and lectures are omitted from the curriculum. The indoor work is an important part of the course, for, in addition to lectures by our own officers, candidates have the opportunity of attending conferences conducted by specially selected men from the forces of our allies, so that the experiences of those who have been playing the war game for a longer period than we have are made available for our use.

Training Covers Many Specialties

The school of "military engineering" is departmentalized under three main subdivisions, as follows: (1) mining; (2) pioneering and (3) bridging. Closely allied with the so-called military engineering courses are six others covering the fields of camouflage, flash and sound ranging, topography, mapmaking and the interpretaion of aërial photographs; orientation (artillery) and, finally, gas attack and defense. From the nature of things and the constantly increasing number of American troops in France, it is not possible to give every officer a course at the engineer school. Nevertheless, selected men are sent to the school for a period of training and are then available as instructors either in the corps schools or in their own organizations, to pass along to their fellow officers the knowledge they have acquired. This applies to the men with commissions now.

In the case of the man in the ranks who is found deserving of promotion the mode of procedure is thus: A regimental commander of engineer troops is authorized to recommend for promotion a certain small percentage of his enlisted strength. On reports from his battalion and company commanders he chooses certain men, generally corporals or sergeants, whose work has been of a high order and who, it is thought, have the qualifications of commissioned officers. These specially recommended men are then temporarily detached from their own organizations and sent to the engineer school for a course of instruction. Their work is carefully watched, they receive examinations of one kind and another, and, if the tests are passed successfully, they receive their promotions. The future policy, I was informed, will be to draw largely upon the ranks for all new commissioned officers in the engineer service.

It is not necessary for every engineer officer or candidate for a commission to take all of the courses previously noted. The idea is to produce a supply of specialists for each branch of the service. Certain courses, however, are obligatory, no matter what particular duty is to be performed later in actual field service. Among these is the course in gas defense. Nowadays, with the tremendous increase in the use of gas shells, rather than the gas-cloud form of attack, regions very far back from the front lines are never safe, and it is considered absolutely necessary that our engineer officers and men be thoroughly versed in the measures of gas defense. All officers on their way to the front, therefore, must either pass directly through the gas school, or else re-



FIGS. 2 TO 4. AT ONE OF THE FIELDS OF THE ARMY ENGINEER SCHOOL MANY DIFFERENT TYPES OF PARTIALLY COMPLETED WOODEN BRIDGES ARE AVAILABLE FOR STUDY BY STUDENTS. IN FIG. 4 NOTE PARTICULARLY THE FORM OF ABUTMENT, WHICH CONSISTS OF CUBES OF STRUCTURAL STEEL BUILT UP LIKE BLOCKS

ceive instruction at the hands of graduates of the school. During the time of my visit an experimental field was being prepared for gas work, both defensive and offensive, to take the place of a wooden gas hut located in the courtyard of the engineer school, which had been used principally to test the adjustment of gas masks. One of the chief functions of the gas school is to qualify men to act later in the capacity of instructors for their own units. For instance, a group of prospective division gas officers will arrive at the school, the commandant having been previously directed to "give them a week of gas." With the new facilities for instruction at the experimental gas field, both this work and offensive training can be readily handled. The week's course enables the men to go back to their organizations well equipped to take charge of all defensive gas instruction. The offensive course is longer and more elaborate and is not of universal application.

Model Battle Sector

In order to make the instruction as practical as possible a certain area of selected ground has been marked off as a battle sector for a division, and is being developed exactly as it would be if it were part of the front. In this sector one sees trenches in various stages of completion; dugouts just begun, with entrances finished, and finally with all underground passages excavated; machine gun emplacements; trench mortar batteries properly located; barbed wire entanglements of several different types; various exhibitions of camouflage work, and so on through the entire category of defensive and offensive measures. All of these works represent the efforts of students at the school. However, one man is not kept at trench digging day after day. He puts in a certain number of hours, let us say, on excavation, then he passes along to the point where revetment work is needed, and works there awhile. His next task may have to do with trench drainage, and after that with barbed wire entanglements, and finally with the more complex structures, such as observation posts, machine gun emplacements, and the like. And so it is with the dugouts. Successive groups of men each do a little work on each type of structure in each stage of the work—enough to familiarize themselves with the actual construction methods—and then pass on to something else.

"The principal idea of the school," Colonel B—— explained, "is to capitalize for war purposes American genius for quantity production. We have before us as an example our achievements in the quantity production of automobiles. Such results are possible only by standardizing parts and operations. We are trying to carry this principle into the work of the Army engineer school. We are trying to develop standard methods of building trenches, dugouts, bridges, machine gun emplacements and all of the other works needed at the front. Of course I appreciate fully that many cases will arise where our standards must be scrapped and where we will have to improvise, and improvise quickly. Nevertheless, the standards we are developing will be good at least seven times out of ten. A man must use his own judgment in departing from the routine way of doing things. In the development of our field engineering methods, however, we are combining our own ideas with the best experience of our allies, and are evolving a standard practice which will, I think, be a big factor in saving time at the front—and time is the all-important element these days.

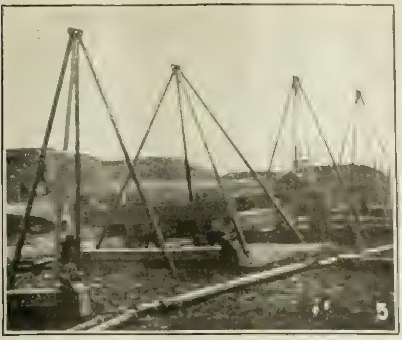
"Take the matter of dugouts and underground passages, for example. We have a set of standard casings or mining timbers which we are teaching the men at the school to use. When they get out into actual service they won't have to spend time devising a scheme of timbering for a tunnel. All that is done beforehand, and their job will be almost automatic, using the methods and material with which they have become familiar here at the engineer school. The same thing applies to bridge work and to what we call "pioneer' work; that is, trenches, obstacles, etc. We think we are now in a position to say what is the best way of doing all these things, and it is this 'best way' that we are making standard and driving home to the men by means of our recitations, demonstrations and actual work in the field by students."

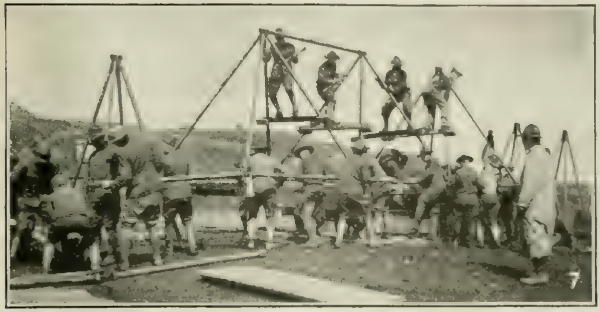
Bridge Built in Eight Minutes

On the inspection trip of the field work of the engineer school our first stop was at a point where instruction in bridging was in progress. In addition to pontoon bridges, a number of other types of structure, both wood and steel, were in various stages of completion. There were the heavy steel portable bridge made of steel tubing, Fig. 1, and wooden bridges and trestles as shown in Figs. 2, 3 and 4. In Fig. 4 the abutment should be particularly noted. It is made up of individual cubes of structural steel shapes piled one on top of the other like a child's building blocks. This form of abutment is of British origin, as is also the demountable bridge shown in Fig. 1. The bridges in Figs. 1 to 4, inclusive, serve as models which are first studied and then built by the students at the school.

Following the same design as the bridge in Fig. 1 is another, much lighter, which is especially adapted to conditions where very speedy work is required—in crossing a river or canal under shell fire, for example. This is the light Inglis portable bridge (British), which is made up of sections of drawn or welded steel tubing, with special pin-connected joints. The bays are 8 ft. long. The parts of this bridge were placed along the ground parallel to the moat of an old French fort when we arrived. "If you want to see how we handle this work," said Colonel B——, "I'll have them set up this bridge and launch it for you." I certainly did want to see such an exhibition; so the colonel summoned the lieutenant in charge of a detail of 34 men and gave orders for the erection of the bridge. I had my camera with me and the resulting photographs, Figs. 5, 6, 7, 8, 9, 10 and 11, will indicate more clearly than words what happened.

Just a few words of explanation, however, are necessary. The method is to erect the bridge on the ground parallel to the watercourse, swing it around through an angle of 90° and run it forward as a cantilever over the moat. It will be noted that the structure is mounted on a two-wheel truck, or "dolly," which makes the launching operation very simple, and that the rear end where the men are assembled, as shown in Fig. 10, is counterweighted. When the far end of the bridge rests





Building a Bridge in 11½ Minutes

FIG. 5. BEFORE ERECTION AND LAUNCHING. PARTS OF THE LIGHT PORTABLE BRIDGE ARE LAID OUT ON THE GROUND PARALLEL TO LINE OF STREAM TO BE CROSSED

FIG. 6. AT ORDERS FROM COMMANDING OFFICERS MEN OF BRIDGE BUILDING COMPANY START THE WORK OF ERECTION

FIG. 7. THE FIRST BENT ERECTED AT ABOUT MIDDLE OF STRUCTURE. DIRECTLY OVER TWO-WHEEL TRUCK USED LATER FOR LAUNCHING

FIG. 8. BY THIS TIME A CONSIDERABLE LENGTH OF BRIDGE HAS BEEN SET UP—NOTE BOTTOM-CHORD MEMBERS LYING ON GROUND AND POSITION OF JOINTS AT BASE OF FOUR-LEGGED SECTIONS

FIG. 9. FINISHING ERECTION OF LAST BENT —NOTE POSITION OF MEN, EACH HAVING SPECIFIC PLACE TO OCCUPY AT SPECIFIC TIME

FIG. 10. ERECTION HAS BEEN COMPLETED AND BRIDGE IS BEING SWUNG ROUND AND RUN FORWARD ON TWO-WHEEL TRUCK LOCATED JUST TO LEFT OF OFFICER IN LIGHT RAINCOAT

FIG. 11. BRIDGE LAUNCHED ACROSS MOAT OF OLD FRENCH FORTRESS AND IN PLACE ON ITS ABUTMENTS

on its abutment across the stream the dolly is removed, the extra bays at the counterweighted end are knocked down, and the near end is seated on its abutment. With these bridges it is, of course, the practice, for the launching operation, to construct a greater length of bridge than is ultimately placed in service. In the present case 104 ft. of bridge was erected to give an ultimate useful span of 56 ft. It is practicable, however, to place the bridge in position by means of a derrick on the far side without cantilevering. This latter method is slower than the cantilever method, but allows the launching of a longer span.

Here is how the work progressed on the bridge I saw erected and launched: Thirteen bays, each 8 ft., or a total of 104 ft. of bridge, were erected in 5 min. 10 sec. The launching required 1 min. 20 sec. The removal of the "dolly" took 50 sec. In 4 min. 10 sec. more the counterweights had been removed, the extra launching bays had been knocked down, and the bridge was ready for service. In other words, exactly 11 min. 30 sec. was consumed in the entire operation.

I have just received a note from Colonel B—— saying that on May 4 his men cut the time of this whole operation to 7 min. 50 sec. The erection of the bridge proper required only 4 min. 12 sec., nearly a minute better than the time made the day I saw the bridge-building demonstration.

64 Pounds per Foot of Span

This type of light portable bridge weighs 63.75 lb. per foot of span, and can be used for spans as great as 96 ft. when launched by the cantilever method, and for spans up to 120 ft. when launched by derrick and tackle. The flooring consists of portable wooden sections such as those shown in the foreground of Figs. 6 and 10. The bridge is intended primarily for the use of troops on foot, although horses are occasionally carried by it. In the latter case, I was told, the practice is to use canvas sheets stretched on siderails to cover up the openings in the floor and sides; otherwise the horses become frightened and it is difficult to get them across the structure.

The principal feature of this portable bridge is that it can be assembled and launched without tools of any sort, except several small spanner wrenches. The joints are an important part of the design and are well shown in Figs 6, 7, 8 and 9. Note also in Figs. 6 and 8 the bottom-chord members lying on the ground. Their ends are held fast, as are the ends of all the chord and web members of the bridge, when in position, by pins which extend through the holes shown. There is a steel tongue welded into each end of each tube, and provided with a screw and nut. To make the connection, the nut is run back on the screw, and the tongue inserted into the joint-box. The pin is passed through the hole in the tongue and through the pear-shaped slots in the sides of the joint-box. The nut is then screwed up, causing the tongue to draw out of the box until further movement is resisted by the pin. To prevent these pins from being lost they are attached to the joint blocks by short lengths of chain.

The heaviest single member of the bridge proper (except the transom) weighs but 56 lb. To attain speed in the assembling and launching of this bridge it is essential that each member of the crew have a specific job to perform, and that the sequence of operations, by reason of repeated performances, shall become practically automatic. The heavy bridge in Fig. 1, which will carry the heaviest of military loads, has a joint scheme similar to that described above for the light bridge.

Dugout Construction and Mine Warfare

From the bridge work we proceeded to the model "front," where the school's members were busy on dugout construction, barbed wire entanglements, trench digging and other activities. The school's battle sector is underlaid with rock, so that the dugout work was a regular hard-rock tunneling job. The entrances to two of these underground works are shown in Figs. 12 and 13. They assume the form of inclines extending to such depth that they have about 25 ft. of head cover over the roof where a horizontal passage begins. The incline was timbered solid with standard mining sets. Excavation required rock drilling with jackhamers fed by hose from a compressor driven by a gasoline engine. This plant was mounted on a steel frame so that it could be placed on a motor truck and moved from place to place. Blasting was done with light charges of explosives.

In addition to the construction of dugouts and shelters the course of instruction given by the mining section includes the principles of mine warfare and the subject of demolitions. In mine warfare it is necessary to gain information regarding the location and progress of the enemy's underground work, and in that way be in a position to forestall his plans of attack, or by noting a defect in his defensive system take advantage, for offensive action, of his weak points. To ascertain the enemy's underground positions it is necessary to employ very sensitive listening apparatus which greatly intensifies the sounds made in the rock during the progress of the work. By noting at different points the directions from which these sounds appear to come, it is possible by means of triangulation to locate the enemy's workings quite accurately.

The mining section is equipped with a listening circle and galleries where detailed instruction is given in the art of listening. The students are then given a practical course in actual listening and plotting of results, after which their papers are corrected and graded.

In connection with the listening work a course of mine rescue is given by the mining section, in which the students are required to wear oxygen helmets and are taught the methods employed in rescuing men who have become casualties in underground warfare. In addition to these subjects practical instruction is given in the employment of different kinds of explosives in the execution of military demolition.

Wire-Entanglement Work

In front of the dugouts were the barbed wire barriers. One of the most effective types consisted of circular hoops of stiff plain wire connected by strands of barbed wire, forming an obstruction that looked like an elongated squirrel cage, except that diagonal strands crisscrossing from one hoop to another blocked up the cylindrical longitudinal opening. This form of obstruction is made up in 20-ft. lengths behind the lines, and before it is placed in position, it is packed close like a

FIGS. 12 AND 13. THESE ARE THE ENTRANCES TO TWO MODEL DUGOUTS WHICH STUDENTS AT THE ARMY ENGINEER SCHOOL ARE EXCAVATING IN ROCK

coil of wire rope. It is then carried forward and opened out like the bellows of an accordion.

Iron stakes, of the screw type, are used to hold the framing hoops upright. These screw stakes, or pickets, possess an advantage over stakes that must be driven with a mallet, in that they can be set noiselessly. This is a very important feature when working in No Man's Land.

Other types of wire obstacles are constructed in advantageous locations by the students. There are regular drills for the erection of these various forms of entanglement, a certain crew being assigned to a definite length of obstacle. Each man of the crew has certain definite tasks, which he goes at in turn, so that the placing of a stretch of wire is like a silent game.

Further along we find a real front-line fire trench—this standard trench as well as the barbed wire entanglements being the work of the pioneer section. It is laid out to conform to the requirements of the ground. In this trench are all types of standard revetment, supporting the sides, there being several fire bays in each type. A real observation post has been put in, so cunningly concealed that it is impossible to detect it from the enemy's side. The drainage of trenches is always a problem—and here it is well worked out, so that the students can get real practice for use later when they are in charge of sectors at the front.

The tracing of trenches is worked out in this sector by the students, both in the daytime and at night. To be ready to do this work quickly and noiselessly when under the observation of the enemy takes much practice, and it is of the utmost importance that an officer should know just how to go about it. The method of placing a working party on the job is also practiced, after the trace of the new trenches has been laid down.

Under "pioneering" come also the construction and maintenance of roads, always one of the most vital problems with which military engineers have to deal, and there are at present at the school roads in every stage of construction, from the preliminary excavation to the completed product.

A light railway connects the front line with the rear of this "battle sector." When one sees the immense amount of rock and gravel that has been hauled over its rails, one realizes how important is the construction of such means of transportation at the front, and here again the student gets that practical instruction which is the only adequate training to prepare men for actual service in the field.

The conferences of the pioneer section not only prepare the students for outdoor work in field fortification, construction of roads and communications and light railways, but also take up in detail the study of French maps, billeting, construction of various types of huts, and layout of water-supply systems.

To see a class of fifty students earnestly studying a map to discover the best position for a strong point is to convince oneself that they mean business. This map study is of the greatest value, because an officer must be able to orient himself quickly on the ground and—with the aid of his map—know exactly how to lay out and hold his position.

Billeting was a new proposition to our Army when it came to France, and it really requires considerable study. Conferences of the pioneer section study this subject in detail, as well as methods of constructing huts when billets are not available.

(To be concluded)

Denver Getting Ready to Buy Water-Works

Purchase of the property of the Denver Union Water Co. by the City of Denver, which has been under consideration for a long time, has been brought a step nearer by the approval, by the Capital Issues Committee, of a bond issue of $13,970,000. The water company has agreed to accept the bonds in lieu of cash. It is expected that a bond issue election will be held as soon as it can be provided for.

New Contract System Which Stimulates Efficiency Gaining Favor

Method Might Replace Lump Sum, Percentage and Bidding on Fee, Shifting Risks to Owner and Making Certain Contractor Will Devote Best Efforts to Work

By Henry D. Hammond
Managing Editor, Engineering News-Record

BASED on the fact that anyone who takes a construction contract will carry it out to the best of his ability if the possibility of his obtaining further work and the size of the reward which he can demand for it depend on his establishing a reputation for doing work that is satisfactory to his client at the lowest possible cost, a new way of doing business between private owners and contractors has sprung up in this country. The superiority of this method, which discards the lump-sum and unit-price forms of contract in favor of the percentage form, has long been demonstrated abroad. It owes its superiority, however, to the fact that its workings differ as widely from those of the percentage contract, as commonly understood, and as applied at present on Government work, as they differ from those of the lump-sum or unit-price contract system.

The new system, on which has been built the business of many of the largest and most successful general contracting firms of this country, promotes efficiency because the contractor finds it possible to obtain more business and charge a higher rate of return on this business directly in proportion to his reputation for doing work quickly and efficiently. To make the system effective the owner must show complete confidence in the ability and intention of the contractor to deliver the structure which the owner desires at the lowest cost. The owner has this confidence both because the contractor has shown such ability on previous work, either for the same owner or for others to whom the owner can refer, and because the latter knows that should the contractor fail in point of cost, quality or time in meeting the requirements of the work the contractor would lose his reputation and be unable to obtain further business.

Owner Assumes the Risks

As the system employs the percentage or fee form of contract, the owner assumes the risks which are thrown on the contractor by the lump-sum form of agreement, and the latter is left free to devote his entire energy to completing the work in the most efficient manner. As the contractor is able to capitalize efficient work by getting a larger volume of business and charging a higher rate of return, his interest becomes one with that of the owner and the engineer in producing a structure which completely satisfies the requirements laid down in the contract. As a result, the system eliminates the expense of double control of the work and duplicate checking of all the contractor's operations. Moreover, it eliminates the large risk which the contractor assumes under a lump-sum contract in the interpretation placed on the specifications by the owner's engineer. For no matter what this interpretation may be, the owner is paying for the work done and the contractor is devoting his undivided attention to delivering it as directed. It may be said, then, that three things differentiate the system from percentage contracts as generally understood in this country: First, the intention of the owner to select the contractor on the basis of past efficiency, and to leave to him the carrying out of the work just as its design is left to the engineer. Second, this can be safely done in spite of the percentage form of contract, because, should the contractor fail in point of cost, time or quality to meet the requirements of the work, he would injure his reputation, and diminish his chances of obtaining future business and his ability to secure higher returns. Third, the system stimulates the distribution of the returns earned by the contractor through bonuses and increased wages among the working force, in the effort to build up the most efficient possible organization.

It is because the incentive of private profit which is the distinctive feature of the lump sum contract is absent in the percentage contract that the latter form of agreement is justly considered a dangerous one, which if persisted in will destroy the morale of the construction force, prevent the development of new methods and, finally, result in stagnation.

Employees Benefit by Plan

The critics of the system, which is gaining favor among private owners and contractors, however, make the mistake of assuming that there can be no motive for the improvement of methods or efficiency except the one of financial advantage to the proprietors of the construction firm. As a matter of fact, this motive, which is admittedly supplied by the lump sum contract system of competitive bidding, leaves much to be desired. It is partial in operation, impelling to action only the owners of the contracting enterprise. It cannot be expanded to the working force except through voluntary action on the part of these owners, and is rarely in practice so extended. The new contract system, however, supplies the motive of personal gain all along the line from the proprietors to the last laborer, through high rates of pay to efficient crews and bonuses for keeping the work within the estimates of time and cost.

This may seem a startling claim for any form of contract under which the owner of the structure being built pays all the bills and in addition gives the contractor an additional fee, whether fixed or a percentage of the total cost, for his experience and services. The entire contradiction, however, vanishes under scrutiny of the system in operation.

The contractor has to sell, besides the labor and materials which go into his work and the use of his equipment and capital, a definite, tangible thing. It is difficult to describe; but it may be outlined as his experi-

ence and ability and his reputation for using labor and materials to produce good work at the lowest attainable cost. Under the lump sum form of contract, there is no direct recognition of the fact that this thing is bought or sold. The contractor must take his chances of being compensated for it, and he receives payment for it only when he succeeds in accomplishing the work specific under the contract for less than he has led the owner to believe that it would cost. This compensation is known as profit. It extends only to the owners of the contracting enterprise. It is understood that the contractor is entitled to it, but from it must be deducted all expenses due to the risks involved in the work. These include damage and delay to the work from natural causes, changes of mind on the part of the owner, and expenses due to a lack of exact understanding between the contractor and the engineer—a thing bound to occur in some degree on every contract. There is always present the temptation to add to the contractor's profit by lowering the quality of the work performed, with no check upon it except the vigilance of the owner and his engineer. The exercise of this vigilance necessarily produces constant friction.

The percentage and fee forms of contract recognize this thing which the contractor has to sell, and fix a compensation for it. In so doing, they properly transfer the normal construction risk from the contractor to the owner. They also remove the cause of friction between the engineer and the contractor by making it impossible for the latter to affect the total compensation for his services by reducing the quality of the work. At the same time these forms of contract make it impossible for the contractor to affect the amount of compensation for his services by improving his methods and increasing his efficiency, and therefore they are justly considered failures.

System Improved in This Country

The actual form of contract used in this country under the new system usually includes time and cost penalty and bonus provisions which make it possible for the contractor to affect directly his compensation on the individual job. This, however, is an improvement which appears to have been grafted on the original system as commonly employed in Europe, where the experience, ability and reputation of the contracting firm are evaluated at so much on each new contract it undertakes, and paid for as such regardless of the cost of the work. In operation this system makes it inevitable that the contractor's efforts will have a profound effect on his reward. If the contractor does not maintain his reputation for doing good work engineers will not engage him. Thus he is put out of business and his returns cease, as he has nothing left to sell. If he lacks experience it is impossible for him to get work except by associating himself for a time with contractors who already have reputations. In practice this has not prevented a sufficient number of new firms from being established, and all public engineers have at one time or another wished heartily that there were some way of keeping out of the contracting field men wholly without experience. If the contractor does not possess ability to carry out work efficiently, if he does not develop new methods and does not improve the quality of his service, he cannot obtain an increasing price for it on succeeding jobs; and if he actually recedes in ability and suffers in reputation, he must expect a smaller return, and in a short time will be unable to obtain work.

In order to do his work better than the next man, and obtain an increasing volume of it on which to realize increasing returns, the contractor employs the best men that he can find. They contribute to his business by lowering the cost of his work, and he is able to pay them more by demonstrating to each succeeding owner that they are worth it. In this way the increasing rewards which can be won by the progressive contractor under the system are distributed all down the line instead of being concentrated in the hands of only those persons who have invested capital in the business. For a superintendent who has done a particular piece of work for 10% less than the original estimate, the contractor can easily ask and secure a large increase on the next job. In the same way, if he has an efficient crew of riggers or pipe fitters, the contractor can easily show his client from the cost sheets of past work that these men are worth more than prevailing rates. Not only is it possible for the contractor to do this, but it is the most natural thing for him to do under the system, because it is to his immediate interest to build up and hold the best organization that he can obtain.

Competitive Bidding Unsatisfactory

Under the system of competitive bidding contracting is a hand to mouth game. There is nothing to prevent persons without experience or organization, but who can secure financial backing, from stepping in and taking work from reputable contractors at figures that are too low to compensate for the work performed. As a matter of fact, just this happens every time some new class of construction gains the reputation of being profitable. Where it becomes known that large returns have been made in the past, bonding companies and banks are willing to back anyone entering the field. A few years ago this condition developed on state highway work throughout the country, and it was not equalized until the public and the reputable contractors had suffered severely and many would-be contractors with their backers had sustained heavy losses.

Under the new system the contractor is assured of work in normal times so long as he maintains his reputation. The business-getting methods employed are simple and eliminate all motives for disguising costs. The contractor estimates the work on the information which the engineer has available, just as in competitive bidding, and tells the owner the limits within which the construction cost, including overhead, will fall under his management, and sets a price, either a lump sum or a percentage of the cost of the work, on his own experience and ability to carry out the work.

Where the value to the owner of the completed structure is great, as is frequently the case, and a saving of time will warrant additional construction expense, this factor is considered in estimating the work.

It will thus be seen that the contractor's success under this system, both in procuring work and in building up the rate of return to himself and his organization, depends absolutely on his ability. If a contractor cannot progress, cannot build up and strengthen his organiza-

tion, he cannot hope to expand his business under this system. If he cannot hold him own with the field, it will be impossible for him even to remain in business.

There are many legal difficulties in the way of adopting such a system on public work, besides the great political difficulty of obtaining as good management by Government bodies which supervise construction work as there is by private enterprises which require new building. At the present time, however, the Government of the United States has swept away legal difficulties, has neutralized to a considerable extent political difficulties, and has awarded not only construction work, but contracts for the production of all sorts of materials and implements of war, on a percentage basis.

It would be an easy matter to convert this percentage system to the one outlined here. The Government has already set up machinery for evaluating the reputation and ability of construction contractors, munition makers and others who furnish the Government with supplies. It could well go a step further, use this machinery in measuring the performance of these contractors on the work which they have, award future work on the basis of this information, discard the present double-control system and trust the contractor to deliver the work. The Gordian knot of illegality has already been cut, and there is no reason why we should not go beyond the percentage system and institute really efficient methods.

Would Stimulate Production

Not only would the system stimulate production efficiency on all Government contracts, but it would throw a new light on all questions of difference between capital and labor over the division of the rewards. For there would be no profits to the owners which could possibly be increased or decreased at the expense of labor or by manipulation. The owners and managers would be paid for their services, skill and resources a just figure which had been publicly fixed after considering all the facts, and which would be subject to variation only as they proved themselves more or less efficient than they had originally been judged to be. Moreover, it would be possible to extend the increased rewards for efficiency to the working force through action of the management, with the sanction of the Government, which would be warranted by definite facts and figures of production. The management would have a direct incentive to pursue this course, since only in this way could it build up a more efficient force, decrease its unit cost, increase its output and secure higher returns. And the Government, confident that it controlled the contractors through its means of measuring their efficiency, could reduce its heavy expenditures under the present harassing and unproductive system of supervision and control.

Some improvement over the present methods of contracting followed by the Government must come, as the demand for it is practically universal. Everyone will admit that the system of competitive bidding cannot be relied upon to satisfy the needs of the present crisis, while the percentage and fee forms of contract, which give the contractor no immediate incentive to better and more economical work, are being assailed and have already been revoked in important cases, among which must be counted that of the Submarine Boat Corporation's contract with the Emergency Fleet Corporation. It would seem that the system which has proved so successful in Europe; which has established itself firmly after some years of trial wherever it can be legally used in this country; which furnishes an incentive to efficiency not only to the owners and managers but to the entire working force; which substitutes powerful motives to coöperation for the divergent motives which lead to constant friction under other contract forms; and which tends to stabilize business and increase production, should receive most serious consideration.

Private Industrial District in Chicago Growing

New Section Gives Company 400 Acres of Modern Warehouses and Factories with Tracks and Tractor Tunnels

A HUNDRED-ACRE area developed for manufacturing, warehouse and general industrial purposes in Chicago is the latest extension of the Central Manufacturing District, which is a private enterprise forming a feature of the city's commercial activities. This new section has a frontage of about one mile on 39th St., from the river to Western Ave., with a depth of about 1000 ft., its south side bordering on the site of what was formerly Bubbly Creek and the large freight yards of the Chicago Junction Railway.

On this new section have been built already a power station, a cold storage plant and the large combined freight station and warehouse, with 23 acres of floor space, described in *Engineering News-Record* of Feb. 28, p. 405. With the sudden development of an immense war business in material and supplies for the army, the Chicago depot of the United States Quartermaster Department recognized the advantages of this site for the new and extensive facilities required. It has leased half of the warehouse noted above and has built six large temporary one-story warehouses. It has also ordered the construction of two large six-story permanent warehouses, work on which is progressing rapidly.

Six-Story Industrial Buildings

A special development planned for this 100-acre tract is the construction of a large number of six-story buildings for manufacturing and industrial firms, which may lease a single floor or an entire building. Besides railway sidings at the ground level, these buildings will be served by a series of tunnels for electric truck and tractor service handling package freight between the several establishments and the central freight station noted above. Other tunnels will contain the water and gas mains, electric conduits, steam pipes and other utilities. Similar traffic and utility tunnels will serve the Government warehouses.

A rectangular area of about 300 acres extends to the Chicago River, which affords water transportation facilities, while railway tracks serve all the plants. The area is adjacent to the stockyards district. It was vacant land when acquired a few years ago, having been used for truck gardens, with lumber yards along the river. A separate 40-acre section south of 43rd St. and west of Lincoln Ave. was acquired later. On this is the 43rd St. Union freight station of the Chicago Junc-

tion Ry., together with large warehouses and manufacturing plants.

Most of the interior streets are private thoroughfares owned by the district. They are paved with brick, concrete and macadam, according to traffic conditions, and have concrete curbs and sidewalks, while grass parkways are provided in many cases. The district has its own street-cleaning department and gardeners. The main streets are 60 ft. wide between building lines, with paved roadways 30 ft. wide. Special attention has been given to the layout of streets, buildings, driveways and tracks, in order to secure ample light and service. Fire protection and low insurance rates are insured by fireproof construction of the buildings, wide spaces between buildings, and ample water supply with firefighting equipment. Private lines of water mains have been laid to supplement the city mains. Sewer systems have been installed, connecting with the city sewers on the boundary streets.

Buildings are of different sizes and styles to meet special requirements of the tenants. They are mainly reinforced-concrete or heavy mill-construction structures, with red face-brick or concrete surface and terra cotta trimmings. Steel-frame construction is employed for foundries and shops. Each building is located inside the limits of its lot, so as to afford light and air on all sides, and each has its own driveway and switch track. Electric elevators, plumbing, heating and electric current for light and power are provided in every case, while many of the buildings have sprinkler service.

Plans and specifications are prepared by the architectural and engineering department of the district, which also lets the contracts and supervises construction. Through the adoption of certain standards of design the district is able to purchase construction materials in large quantities, thus materially reducing the cost. Switch tracks are laid in each case before work is commenced, in order to facilitate the handling of material by the contractor.

Railway Service

Railway connections and freight service are provided by the Chicago Junction Ry. and constitute a special feature of the enterprise. A complete track system, with spurs and sidings to serve all the buildings, is operated by the Chicago Junction Ry. This road has large freight stations and yards in the vicinity and provides connections with all the trunk lines entering Chicago. It serves also the large union freight house on the river, so that freight can be handled to and from steamers or barges. Through the consolidation of less-than-carload freight, even the small shippers get the advantage of carload rates. Thus, the shipper may place separate small consignments in one car, and this will be taken to the union freight station, where the consignments will be transferred and combined in cars for separate consignees or destinations.

The management and control of the affairs of the Central Manufacturing District are in the hands of J. A. Spoor, Arthur G. Leonard and E. V. R. Thayer, as trustees. H. E. Poronto is industrial agent; F. L. S. Harman, assistant industrial agent; S. Scott Joy, architect; G. W. Hegel, chief engineer, and E. A. Bull, electrical engineer.

Eight-Year-Old Concrete Flat Slab Tested in Building

BEFORE the Western Newspaper Union reinforced-concrete building in Chicago was torn down in September, 1917, the engineering experiment station of the University of Illinois was permitted to make a load test on four panels of one of the flat-slab floors. The results of the test are given in brief in a paper at the annual meeting of the American Concrete Institute by Prof. A. N. Talbot and H. F. Gonnerman, of the University of Illinois. The floors were in panels 17 ft. 5½ in. x 19 ft. 4½ in., and were designed for a live load of 250 lb. per square foot. Tests were made in varying loads up to 913 lb. per square foot. The floor was designed for a thickness of 8½ in., but was found to measure from 7.5 to 9.8 in. Reinforcement was located as designed, except that there were an abnormal number of laps which in some critical cases gave more steel than was called for.

As a whole, the tests showed the eight-year-old building to be in good shape. The concrete, particularly, was of great strength. Prisms cut from the floor showed a compressive strength ranging from 3190 lb. per square inch to 5460 lb. per square inch., and an initial modulus of elasticity from 3,500,000 to 5,100,000 lb. per square inch. The steel proved to be high-carbon, having an average yield point by drop of beam of 63,600 lb. per square inch, and an average ultimate strength of 101,-300 pounds.

Deflections of slabs were plotted. The greatest deflection under a load of 913 lb. per square foot was 1.12 in., but the arrangement of the bars of this panel showed fewer laps than some of the others. The average deflection was considerably less. Slabs cracked in characteristic places in both upper and lower planes. Concrete strains, assuming a modulus of elasticity of 4,000,000 lb. per square inch, ranged between 3550 to 3880 lb. per square inch in the upper surface of the slab under the maximum load. Deformations of the lower part of the slab showed stresses running from 1760 to 4400 lb. Analysis of the moment, which necessarily has to be quite approximate, showed that reinforcing bars accounted for about 88% of the analytical negative moment in one direction and 92% in the other direction. Similarly, about 68% of the analytical positive moment was accounted for in one direction and 72% in the other, when the percentages for the two directions were averaged, 90% of the negative moment and 70% of the positive moment were accounted for by the stresses of the steel. The authors state that the amount of reinforcement for negative moments is on the average as much as that required for negative moments recommended by the Joint Committee. The amount of reinforcement available for positive moment was on the average about 50% greater than that required by positive moments recommended by the committee. Distribution of the reinforcement was, however, quite different from that recommended. All the slab thicknesses were somewhat lower than recommended by the committee; figuring on the extra strength of the concrete they were, however, approximately according to the specification.

How Shipyard Housing Work Is Organized and Operated

Division of Fleet Corporation Has Developed an Organization in Which Engineers Play a Large Part—Sixteen Projects Under Way

TWO departments are building houses for the Government's war workers. One, the Bureau of Industrial Housing and Transportation of the Department of Labor, has just received executive sanction and is proceeding to perfect an organization which for some months has been in the process of development, in the expectation of the recognition it has just received. The other, a part of the United States Shipping Board, has been in being for about four months and has already started construction on a number of projects. The former has had delegated to it all of the war housing; the latter takes care only of the shipyards or of plants manufacturing ship material exclusively. The two are similar in organization and methods of work, though heretofore entirely independent, but the Shipping Board's branch has progressed farther in actual construction. Its operation, therefore, indicates how the Government has gone about getting the first of the homes to take care of extra war labor.

Shipyards Get $50,000,000

Early this year it was recognized by the Emergency Fleet Corporation that provision must be made for housing the workers at the new and at the enlarged shipyards where the Government ships were being built. Accordingly, $50,000,000 was asked of Congress for that purpose and was appropriated in February. The organization of a department to expend this fund was immediately started, but the problem was entirely new and progress was slow. Plans were prepared for a number of developments, but the construction of only one, that for the Merchant Shipbuilding Corporation, at Bristol, Penn. (described in *Engineering News-Record* of Jan. 31, 1918, p. 227), was actually started up to a month or so ago. Reorganization of the department took place in April when the housing and transportation divisions of the Emergency Fleet Corporation were merged into a Division of Housing and Passenger Transportation under the direction of A. Merritt Taylor, for some years head of the Philadelphia Transit Commission and a man of broad experience in rapid transit and housing matters.

The new division is now functioning well and has approved housing projects in 16 cities, the total cost of which will absorb practically all of the $50,000,000 appropriation. It has also recommended the development of a number of other projects, estimated to cost more than $25,000,000.

The organization of the division is briefly outlined in the accompanying diagram. One section is devoted entirely to transportation matters and reports through its own officers directly to Mr. Taylor. The other section, concerned only with housing, is under the supervision of J. Willison Smith as assistant director, also reporting directly to Mr. Taylor. The two sections share a common general clerical force and an accounting and statistical department. Under Mr. Smith are two executive assistants, W. P. Taylor, who has charge of the bureau of investigations and housing requirements and of the special appointed committees on site determination. Mr. Taylor is concerned with the preliminary decisions on prospective housing developments. The other assistant, Robert Jemison, Jr., is in charge of the production bureau and the property bureau which take care of the actual housing operations.

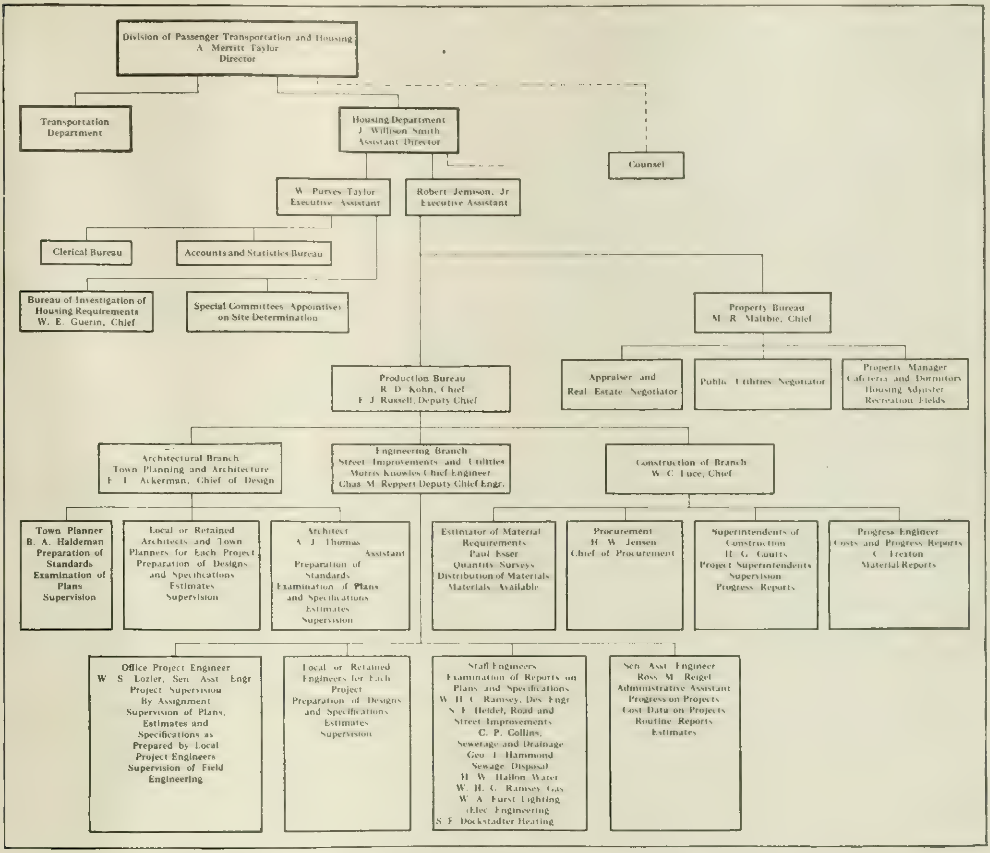
The production bureau, with R. D. Kohn, architect, of New York, as chief, has three branches, architectural, engineering and construction. The property bureau, under Milo R. Maltbie, experienced in the supervision of New York public utilities, has charge of the real estate appraisal and negotiations, the public utilities negotiations and the management of the property for which the Government has assumed responsibility. Architecture and town planning are under the direction of F. L. Ackerman, architect, of New York; engineering developments are under Morris Knowles, consulting engineer, Pittsburgh, with Charles M. Reppert, of the Pittsburgh sewer department, as deputy chief engineer, and the construction branch is in charge of W. C. Luce.

In operation the system works as follows: A shipyard needs housing accommodations. It applies for Government assistance. The application is first referred to the Bureau of Investigation. The preliminary investigation is made by representatives of the housing department and of the transportation department. If it is found that additional passenger facilities will not solve the difficulty and that houses are required, reports are submitted by the architectural, the town planning and the engineering branches of the division of production, and by the site selection committee. This preliminary investigation is made for the purpose of selecting the site, of determining its suitability and adaptability and probable cost of development. Availability and financing of the utilities are other local factors which must be considered. Transportation may be the solution of the difficulty, and then the transportation half of the division takes over the problem. If it is decided that new houses are necessary the main administration first decides upon the amount to be spent and the nature of the development. The production bureau then takes care of the matter and builds the houses and develops the property.

Preliminary Reports Made

The preliminary reports are made in conformity with instructions issued by the department. Blank questionnaires which are very elaborate are furnished, and when they are filled out they answer all of the necessary questions about which the production bureau must be informed.

When the department has decided upon the nature of a development and has appropriated the necessary funds, a local project board is appointed. This consists of an architect, a town planner and an engineer appointed by the housing division upon the recommendations of the heads of the various branches. This



ARCHITECTS, ENGINEERS AND BUILDERS REPORT THROUGH PRODUCTION BUREAU

local project board has responsible charge of the designing and preparation of plans, estimates and specifications for the entire project. It is organized with a chairman (generally the architect), who is appointed by the director. The board proceeds to make the necessary investigations, studies, plans and estimates and submit them for examination and approval of the production bureau. Each member of the local project board has to prepare the designs for his field; that is, the town planner has to make up the street layout plan, and consider the general locations of buildings and structures, landscape work, etc., the engineer has to provide the designs for the street improvements and utilities, and the architect the design of the houses themselves.

The local project board consults and advises with the representatives of the production bureau in conference and by correspondence about the development of the plans and keeps in touch with that department as to progress. It follows, moreover, a set of instructions and recommendations for designing in so far as the restrictions of the local problems permit. These general instructions are prepared in the home office and are not designed to fix arbitrary standards except in certain matters where standard practice is well understood and accepted, but they are intended to assist the local board and to reduce the general construction problem by the standardization of details. The local project board also furnishes estimates of quantities and materials required.

Meanwhile, the property bureau is at work on the real estate purchase and negotiations, and is studying the public utility relations. It is concerned mostly with the legal end of the public utilities question and depends upon the engineering branch for the technical details and for advice.

There is then appointed in the headquarters office a project manager for the job in each of the architectural and engineering branches. These managers may each have charge of more than one job. They are the headquarters' representatives responsible for the work.

The design having been prepared and approved at headquarters, the contract for the construction is let and the construction turned over to the construction branch, which carries out the work under a local superintendent. This local superintendent has under him the local project engineer and architect and town

planner, although these men also report back to their respective offices at headquarters. The construction branch also has sections on estimating and on procurement.

The engineering branch has an organization peculiar to itself. Under Mr. Knowles and Mr. Reppert is a staff of engineers, each of whom is a specialist in his particular line—that is, in road and street improvement, sewerage and drainage, sewage disposal, water, gas, electricity and heating. These engineers act as consultants with the office project engineers who have charge of one or more local developments. The project engineer, as has been stated before, supervises the plans, estimates and specifications as prepared by the local engineers but calls in to aid him as consultants in the supervision any or all of the staff engineers. The office engineers also, of course, have supervision of the standards in their own fields of engineering.

Engineering constitutes a large part of the preliminary design of a housing development. Highway systems, including sidewalks and pavements, drainage, water-supply, sewerage, sewage disposal, gas service, electric service and street and house lighting, are under the direction of the engineer. The house itself is taken care of by the architect, and the engineer does not enter into its design or construction except when requested.

The projects which have been approved, together with their approximate size, and the personnel of the project boards and contractors, are given in the accompanying table. Of these projects those at Bristol, Camden, Newport News, Hog Island, Philadelphia, Portsmouth, Chester and Wilmington are well under construction.

The method of financing the projects is briefly as follows: The Emergency Fleet Corporation lends money to a realty company formed by a shipyard particularly for that purpose and advances the full cost of house construction at a rate of 5% interest for a period not exceeding ten years. The shipbuilding company furnishes the land free of cost and in many instances contributes to the cost of utilities and the Emergency Fleet Corporation is given a first mortgage on the development as security. Provision is made for appraisal not earlier than two years and not later than five years after the conclusion of the war, at the option of the Emergency Fleet Corporation. As the result of this appraisal there may be a maximum write-off on the mortgage of 30% in recognition of excessively high construction cost.

The Emergency Fleet Corporation holds not only a first mortgage as security for its advances but the stock of the realty company is assigned to it as further security. The Emergency Fleet Corporation also controls the sales and renting and restrictions on property for six months after the conclusion of the war and has full charge of the design and construction.

HOUSING PROJECTS APPROVED BY THE EMERGENCY FLEET CORPORATION, DIVISION OF PASSENGER TRANSPORTATION AND HOUSING

Shipyards	Location	Character Proposed Housing (Approx.)	Men to Be Housed (Approx.)	Estimated Cost	Project Architect	Project Engineer	Contractor
Atlantic Corp....	Portsmouth, N. H..	300 houses, dormitories	1,000	$1,400,000	Kilham & Hopkins, Boston	Lockwood, Greene & Co., Boston ..	National E'grg Corp
Newport News S. B..	Newport News, Va	498 houses, 320 apts	1,636	3,000,000	F. Y. Joannes, N. Y.	G. F. Fancy, F. Bulot	Mellon-Stewart Co., Pittsburgh James Stewart & Co., N. Y.
New York S. B. Co	Camden, N. J.	200 row houses, 907 single and 1614 group hos. schools, stores, comm. bd. or 1000 single, 2,000 group houses and stores...........	400	7,800,000	E. D. Litchfield, N. Y.	Lockwood, Green & Co., Boston	Tidewater Bldg. Co., N. Y.
Pusey & Jones..	Gloucester, N. J....		1,400	2,470,000	Bissel & Sinkler.	Day & Zimmerman, Phila.	McArthur Bros., N. Y.
Belthlehem S.B. Co.. .... Pusey & Jones.	Wilmington, Del...	506 houses	1,012	2,500,000	Ballinger & Perrot, Phila	Ballinger & Perrot	McArthur Bros., N. Y.
Bethlehem S. B. Co..........	Sparrows Pt. Plant..	302 conv. apts., kitchens and mess halls 531 houses	2,868	4,300,000	E. L. Palmer, Baltimore	G. W. Stevens, Baltimore	Consolidated Engrg. Co., Baltimore
Chester S. B. Co.	Chester, Pa	277 houses, 108 apt. and boarding houses, dorm.	1,933	2,350,000	G. E. Brumbaugh, Chester...........	C. F. Mebus	McArthur Bros., N. Y.
Texas S. B. Co	Bath, Maine	150 houses, dormitories	600	750,000	R. Clipston Sturgis, Boston	Aspinwall & Lincoln	
Merchant S. B. Corp	Bristol, Pa	42 bunk houses, 14 bdg. houses, 161 apts., 75 single and 135 group.	3,816	4,350,000	Carrol H. Pratt, N. Y.	Emerg. Fleet Corporation	Fred F. Ley & Co.
American Int. S. B. Corp....	Philadelphia, Pa (Hog Island)..	960 houses, 16 dorm., ath field, 300 houses (requisitioned)	4,692	7,031,000	E. M. Bartlett, Phila...	Owen Brainard, N. Y.	William Crawford, Phila. Moss & Taylor, Phila. H. D. Schneider, Phila.
Sun S. B. Co....	Chester, Pa........	622 houses	1,000	2,250,000	Ernest Flagg, N. Y...	A. F. Demon	Johnson & Price
G. M. Standifer Cons. Co	Vancouver, Wash	100 houses, hotel	1,000	350,000			
Bayles S. B. Co.	Port Jefferson, N. Y.	Dorms. and frame houses	400	200,000	Alfred C. Bossom, N. Y.	Holbrook & Higgins..	
American S. B. Co	Lorain, Ohio........	200 frame houses....	400	720,000	Abram Garfield, Cleveland	R. Winthrop Pratt...	
Merril Stevens S. B. Co	Jacksonville, Florida	150 houses and dorm.	200	350,000	H. J. Klutho, Jacksonville		
Westinghouse E. & M.	Essington, Pa	200 houses and dorm..	420	800,000			
			300	250,000			
Terry S. B. Co	Savannah, Ga		400	750,000			
Traylor S. B. C.	Cornwells, Pa	Tents	300	5,000			

Would Rate State Highway Contractors on Past Performance

Propose Giving Contractor Part of Saving Under Estimated Cost and Advantage in Bidding Proportionate to Speed and Efficiency Shown

By S. E. Fitch
New York State Highway Department, Hornell, N. Y.

OFFERING the contractor an incentive to do better work both by giving him a percentage of the savings under any estimated cost which he may effect in carrying out the work, and by taking his record for efficiency into account through a rating system which reduces his bids in proportion to his speed on former contracts as compared with the estimated time of completion, is the chief proposal in a new system of carrying out highway work under contract which is here put forward both as an answer to the difficulties created by war conditions in carrying on highway work and as making for better and cheaper road construction in normal times.

To those who have been acquainted with the highway situation for the past few years it is very evident that the present method of letting state road contracts to the lowest bidder who can furnish bonds has serious fundamental defects. It is to be hoped that some of them will be removed while our country is passing through war's crucible in which the pure metal of civilization is being separated from the dross of false ideals.

To understand these defects better and to start with our wheels of thought out of the ruts along which they are prone to follow, let us inquire into the fundamentals of road contracting.

Characteristics of a Good Contractor

First, the contractor whom we want to build our road is the one who can do it better, more cheaply and more quickly than any other man. Second, he who is capable of doing this is entitled to a profit larger than that of the other contractor in direct proportion to his ability to save time and reduce costs. Third, in these days of scarce labor, he will do his best, cheapest and quickest work only when he has built up a good organization and has the proper equipment within reach. Fourth, such an organization can be built up and maintained only when the contractor has a reasonable prospect of keeping it busy year after year. Fifth, in order to get the best work out of any contractor or organization—to "keep it on its toes"—there must be competition, and there must be constantly in view an adequate incentive for extra effort. The best incentives seem to be furnished by placing a real value on reputation and allowing extra profits on whatever savings the contractor can make. Sixth, the less the risk of loss which a contractor must take the less the profit with which he will be satisfied. Seventh, it is everywhere recognized that the best results can be obtained only when contractors, engineers and all concerned work in harmony. Lastly, the amount of time taken to complete a road is very important and has an actual cash value which can be approximately computed. This should be taken into account in selecting the contractor and, directly or indirectly, in rewarding him.

Probably most men, whether familiar with road work or not, will concede the truth of these fundamental principles. To be logical we should take up each in turn and see how the present form of road contract meets the requirements. This seems hardly necessary, for the many articles appearing from time to time in the engineering and contracting journals show that practically none of the above requirements is at present being satisfied, a statement which I think all road men will accept without requiring detailed proof. The causes which have brought about this condition will be briefly reviewed.

State Road Work a Recent Development

A few years ago state road work as it is known today was new. Very few contractors knew the business well or had the necessary equipment and organization for doing the work. There was but little competition. Preliminary estimates were high and contracts were let at good prices. Specifications were not rigid nor so closely observed as today. Contractors consequently made large profits. The news spread rapidly. Engineers, foremen, farmers, merchants, editors and politicians became contractors overnight. They guessed the percentage that they could cut the engineer's estimate and secure the work. To the lowest guesser was awarded the contract, regardless of his reputation or ability, provided he could furnish bond. The bonding companies were out gunning for contractors and would furnish bonds to anyone who had a wheelbarrow for equipment and often to some who had not. Frequently, types of roads were selected which were not suitable for the location, some were poorly designed, and many more were not properly built. There was some dishonesty and plenty of politics mixed up with it all. Much money was wasted and many poor roads resulted. Then came the reaction. Specifications were revised and tightened up from time to time and their enforcement insisted upon to the letter. Additional laws were passed and various interpretations of the law, some of them absurd, were handed down. Invariably these things were in favor of the state and against the interests of the contractor. Low bidding forced the more able contractor out of the road business. Low bidding and poor management sent the less able one into bankruptcy. Successive crops of would-be contractors sprang up and trod the same rocky path until about two years ago, when the pendulum began to swing to the other side. Then war sent prices of labor and materials soaring, until today contractors are afraid to bid on work at all, and when one does occasionally obtain a contract, he finds it extremely hard if not impossible to induce bonding companies to furnish bonds. This is the situation today and is the reason why we find the various forms of cost-plus contracts being advocated and tried out.

It was the writer's good fortune to be in charge of the cost-plus-percentage road contract at the Camp

Custer cantonment, Battle Creek, Mich., and to have the opportunity to contrast the working of that form of contract on road work with the ordinary itemized, lump-sum contract which he has had under observation during the past eight years. The contrast is great and in most things in favor of the cost-plus contract. He feels very strongly, however, that somewhere between the two forms lies the real solution of the problem. He has no criticism for the cost-plus form of contract for such work as cantonment construction, where speed, and not cost, is the first consideration. But for state road work the cost-plus contract would be fundamentally weak in two particulars. First, in the cost-plus contract the contractor is merely selected by the officials in charge without reference to anything but his reputation and ability. History shows that the heads of highway departments have not always been selected from honest, capable men. To give a dishonest or weak head of department an opportunity to use such power would prove disastrous. Second, any condition under which a contractor's profits do not depend directly on his efforts is fundamentally wrong. No matter how honest or conscientious the contractor himself may be, this knowledge penetrates throughout the organization, and until human nature is changed it is bound to detract greatly from its efficiency.

Present Time Opportune to Make Changes

It is perfectly feasible, however, on state road contracts to retain all the advantages of the cost-plus contract and to eliminate the disadvantages mentioned. Also, the benefits of healthy competition may be retained and the advantages of increased speed and efficiency obtained by allowing the contractor to share financially in such savings of time and money as he may be able to effect through his efforts and ability. To do this will require some changes in the present laws, but this is a time when changes of many kinds are being made in all lines of human endeavor. If the advantages of a change can be made clearly apparent, it may be effected more easily now than ever before.

The form of contract contemplated is one in which the detailed plans and estimate would be prepared in the usual manner. A contractor would be asked to bid on each item an amount sufficient to cover his profit for the use of his organization only. This would correspond closely to bidding on the percentage in a cost-plus contract. The state would maintain a field auditor and have a complete system of time-keeping and material checking, and would pay for all labor and materials. The contract would provide a schedule of rental prices for such plant as was owned by the contractor and also for paying an approved rental price for such other plant as was considered necessary. Extra work, not itemized, would be limited to such as had been authorized in writing, and the cost of which could be kept separate from that of other work. The bids on extra work and on overhead costs would be on a percentage basis, and the percentage either specified for all bidders in the proposal, or else given narrow limitations, to do away with any tendency to pad the overhead and extra work at the expense of other items.

The fundamental idea in mind is to establish a "standard cost" for the work, and a "standard time" for its completion with which the actual cost and the actual time taken for completion by the contractor can be compared; then to pay the contractor a definite extra compensation in case the actual cost was less than the "standard cost" and pay a proportionally less compensation if it were more. In a similar manner those contractors showing the best speed as compared with the "standard time" on all work that they had previously completed would be allowed a definite scheduled advantage over other bidders on subsequent bids on similar work. This, very shortly, would automatically eliminate those slow, puttering contractors who have so many times obtained contracts and dragged their work along over several years. There are, of course, difficulties in reducing such a plan to a mathematical basis, but it need not be absolutely exact to be far ahead of the present system. It must, however, convince all men that it is 100 per cent. honest, even though it be but approximately accurate. It is plain that, provided the specified time for completion of a contract is reasonable in the first place, practically any job can be completed within that time by increasing forces, working overtime, etc. It may make the work more expensive to rush it through, but it involves no hardship on the contractor as long as he knows the exact condition when he is bidding.

Since the exact quantities of the various items and of extra work cannot be known until the job is completed and measured up, it will be necessary to revise the "standard cost" on completing the work by using the actual quantities, multiplied by the unit-cost prices used in the preliminary estimate. In a similar manner the revised "standard time" of completion would be found by multiplying the specified time by the ratio of the revised "standard cost" to the "standard cost" as used in the preliminary estimate. This would prevent injustice being done by reason of changes in the amount of work.

Basis of Settlement with Contractor

The contract should be so drawn up that settlement with the contractor will be made by multiplying the actual quantities of each item of work done by the bid price on each item. The sum of these results will give the fee to which he will be entitled in case the actual cost of the work is exactly the same as the amount of the revised preliminary estimate. Call this his "normal fee." The actual cost would, of course, differ from the "standard cost" somewhat. The contractor's actual fee then would be obtained by adding algebraically to the "normal fee," obtained as above, a definite, stated percentage (say 20%) of the difference, increasing the fee if the cost were less than the standard cost and decreasing it if it were more. It probably would be possible to modify this fee further in some manner by allowing another increase in it for completion before the standard time and a corresponding deduction for using more than the standard time. This would be more difficult, however, and would not prevent a slow contractor from obtaining a contract and dragging it along as before.

It is believed that the same result can be better accomplished by grading all contractors doing state road work by giving them a "speed factor." These speed factors would be calculated each winter and a list of such contractors with their speed factors published, or

held open to public inspection, before any lettings of the season. Each succeeding winter they would be recalculated, including the contracts of the season just passed. Thus each succeeding year would make possible a more and more definite index of each contractor's ability so far as speed is concerned. These speed factors would be obtained by dividing the number of days used on the construction by the number of days, as revised, allowed in the contract. Thus, if a contractor had a speed factor of say 90 it would really signify that on all contracts which he had completed prior to the computation of his speed factor he had used but 90% of the time allowed him by the terms of the contract.

In order that the contractors having good speed factors may reap the benefits of their speedy work, and also for the purpose of preventing the award of contracts to the slowest ones, thereby depriving the public of the use of the roads during a long construction period, it is proposed, for the purpose of award only, to modify each contractor's bid by multiplying it by his speed factor. The products thus obtained would be compared instead of the bids themselves, and to the contractor whose result was lowest would be awarded the contract at his bid prices. In this way the contractor would receive a substantial reward for the benefits arising from his fast work, and the state would get its road enough sooner to do more than pay for the difference in cost.

It might be thought that this would place too high a value on the time saved and that the state would be paying the contractor more than the time saved would be worth. If such should prove to be the case it would be an easy matter to calculate the speed factor by adding to or subtracting from 100 a half, a third or some other fraction of the percentage of time saved, thus retaining the principle of the idea but modifying the value allowed for time-saving.

Consider that the time specified for doing a quantity of work which was estimated to cost $143,000, as shown in the table, was 120 days, but more work was done than was estimated. Its total amounted to $145,700 when calculated on the basis of the same estimated unit costs. Therefore the revised standard time allowable would be 120 × 145,700 ÷ 143,000, or 122 days. Assuming that this is the only contract that this contractor has completed under this system his speed factor would be the time he used on construction (say 110 days) divided by the allowable time of 122 days, or 90.2.

The following year a similar proposal is advertised, and this contractor, who will be called A, has his time factor of 90.2. In a similar manner Contractor B, having used slightly more than the allowed time, obtained a speed factor of 105. Contractor C, who wishes to bid, has done no previous work for the state, therefore his speed factor will be taken as 100. The short table shows each contractor's bid, his speed factor, and his comparative rating on this proposal.

CONTRACTOR'S RATING AS DETERMINED BY SPEED FACTOR

Contractor's Name	Contractor's Bid	Contractor's Speed Factor	Contractor's Comparative Rating
A	$12,350.00	90.2	11,139.7
B	10,761.90	105.0	11,300.0
C	11,400.00	100.0	11,400.0

PROPOSAL

Preliminary Estimate				Contractor's Bid	
Estimated Quantity	Item	Estimated Unit Cost	Amount	Item Price	Amount
60,000 cu.yd.	Earth excavation	$0.70	$42,000.00	$0.06	$3,600.00
12,000 cu.yd.	1st class concrete pavement	8.00	96,000.00	0.70	8,400.00
Lump sum	Extra work		2,000.00	7%	140.00
Lump sum	Overhead		3,000.00	7%	210.00
Total estimated cost			$143,000.00	Total bid,	$12,350.00

Time of completion specified as 120 calendar days.

Final Estimate — Preliminary Estimate Revised by Using Actual Quantities of Work Done				Contractor's Profit	
Final Measured Quantities	Item	Estimated Unit Cost	Amount	Item Price	Amount
62,000 cu.yd.	Earth excavation	$0.70	$43,400.00	$0.06	$3,720.00
12,100 cu.yd.	1st class concrete pavement	8.00	96,800.00	0.70	8,470.00
As in preliminary Estimate	Overhead		3,000.00	7%	245.00
Actual Cost	Extra work		2,500.00	7%	175.00
Total of revised preliminary			$145,700.00	Total	$12,610.00
	Add 20% of saving made (see below)				1,140.00
				Total Contractor's Fee,	$13,750.00

Total of revised preliminary estimate, or "Standard Cost"	$145,700.00
Total actual cost of work as shown on auditor's books	140,000.00
Saving made over revised preliminary	$5,700.00

In this case Contractor A has the lowest comparative rating and the contract will be awarded to him although his bid, which will be the basis of final settlement, is higher than either of the other two. This is but justice, for he has proved by his previous record that he will complete the work sooner than his rivals, even if he has to sacrifice some profit to do so. The time saved is worth more to the public than the extra cost due to the speed factor, and the prime purpose of getting the road completed and opened has been accomplished.

The annual cost of a mile of improved road is the sum of interest on first cost, annual ordinary maintenance cost, and an annuity sufficient to pay the cost of reconstruction when it becomes necessary. This annual cost will average about $1500 per mile per year. The annual cost may safely be taken as the minimum value per year, otherwise it would be a mistake to build the road at all. The annual report of the Highway Commission of the State of New York shows that of 164 county highways accepted during the years 1916 and 1917 the average length was about 3½ miles and the average time elapsing from the award of contract to its acceptance was about 18 months, or about 5 months per mile of road. The minimum value to the public of this 3½ miles is $1500 × 3½, or $5250 per year. Plainly, then, the state could afford to pay the contractor a considerable percentage of this $5250 if by so doing it could shorten the construction period by a year.

After this scheme had been in operation for a few years, the undesirable contractors would be automatically eliminated, the improvements in the details of the contract would work themselves out, and experience would enable the engineers to specify very closely the most economical time for completion. Contractors would then bid with the idea firmly fixed in mind of completing the work in the time specified even at a somewhat increased cost with a consequent decrease of profit. The speed factor and the sliding scale of profit would act as an automatic governor to maintain the proper relation between the time of construction and the cost of the work.

Stone-Filled Sunken Barges Form Basis of Temporary Dam

High River Level for Pittsburgh Water-Supply Intake Was Maintained After Government Dam Went Out

SEVEN 90-ft. wooden barges were filled with stone and sunk in the Allegheny River during May to form the core of a temporary dam across the 350-ft. break in Government Dam No. 2, just above Pittsburgh, which was wrecked when the ice went out of the Allegheny River this spring. Rapidly completed by placing a mound of stone across the river, the work prevented a possible interference with the operation of Pittsburgh's water-supply system.

The break in the dam, which is one of the Federal Government's improvements on the Allegheny, did not seriously interfere with traffic on the river, but it did lower the water level to such an extent that the operation of the pumping station in the City of Pittsburgh's water-supply system was interfered with. This station is located one mile above the dam and supplies raw water to the filter plant. The curtailment of its supply of water would have resulted disastrously to the city. Owing to the great variation in the water level between high and low water, the pumps in the station had to be so placed that in ordinary low stage of the river there is a suction lift of about 23 ft. The break in the dam would have required a suction lift of 29 to 31 ft. during the summer months when water was most needed.

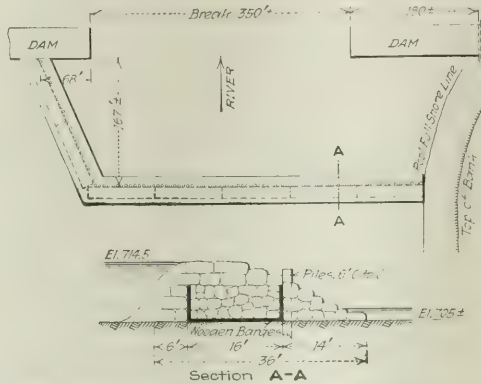
Plans were first made to install low-lift pumps on the river bank to pump water during low stages through the tunnel to the suction lines of the main centrifugal, and a water siphon system in the suction line of the

DERRICK MOUNTED ON BARGE PLACED LARGE STONE ON TEMPORARY DAM ACROSS THE ALLEGHENY

100,000,000-gal. pump was also considered. These were all rejected, and it was decided to make temporary repairs to the dam by building another dam on the upstream side of the break, holding the water level at a point that will permit continuous normal operation of the pumping station.

At this location the river bed is mostly sand, which made it impracticable simply to dump rock into the water, as the current would soon have washed the sand away and undermined the temporary mound. The sunken barge method was then adopted.

A line of wooden piles was first driven on 6-ft. centers across the opening of the break on a broken line, as shown in the accompanying drawing. On the upstream side of these piles seven regular wooden river barges loaded with stone were sunk, two along the wing ex-



DAM REPAIRED BY THROWING TEMPORARY STONE MOUND ACROSS RIVER ABOVE BREAKS

tending out from the center section of the dam and five along the straight section which is parallel to the main dam. Upon these sunken barges as a mattress stone of large size was piled to form the main mound.

The laying of this stone was accompanied with considerable difficulty, on account of the strong current in the river. The stone was unloaded from freight cars to barges which were towed out alongside of the sunken barges, and was deposited as shown in the photograph by a derrick boat carrying a Dravo "whirler" equipped with an 81-ft. steel boom. In spite of the fact that the river current prevented the machine working at its full capacity, an average of 550 tons of stone a day was placed with the equipment.

Work continued from Mar. 21 until May 4. In spite of some difficulties in connection with the shipment of the stone, which was obtained from a point west of Cleveland, the 8500 tons of stone was all placed by the later date, and the possibility of low-water troubles at the pumping station was eliminated. The total cost of completing the work was about $55,000 Time was the essence of the contract. The work was done for the City of Pittsburgh by the Dravo Contracting Co., Pittsburgh.

Illinois Waterway is Authorized

Barge traffic between Chicago and the Mississippi will be made practicable by the improvement of the old Illinois & Michigan Canal, which improvement has been authorized by the United States Government. For this new waterway link, extending from the Chicago Drainage Canal at Lockport to a connection with the Illinois River at La Salle, the channel will be dredged and cleared to give a 6-ft. depth.

Cast-Steel Anchor Chain Developed To Meet War Need

Electric-Furnace Steel Product Stronger Than Iron Chain Though Less Ductile—Drop Tests and Proof Tests Made

How successfully American industry adapts itself to urgent but radically new demands of the war administration finds striking illustration in the development of a new kind of anchor chain last winter. This development was sketched in a remarkable paper read by H. Jasper Cox before the American Society for Testing Materials at its recent meeting. Two prepared discussions of the paper added much information on the course of the development and the qualities of the product. Short extracts from Mr. Cox's paper and discussions, the first by W. I. Merrill and the second by C. K. Brooks, are reproduced here.—Editor.

In August, 1917, the shortage of anchor-chain production was brought to the attention of the ship-welding subcommittee of the general engineering committee of the Council of National Defense. W. L. Merrill of the General Electric Co., chairman of the ship-welding subcommittee, undertook a study of anchor chain production; while this work was going on, and under date of Sept. 13, the general purchasing officer of the Emergency Fleet Corporation addressed a letter to Prof. C. A. Adams, chairman of the general engineering committee above mentioned, noting the deficiency of anchor chain production and asking for recommendations as to the possibility of increasing this production by the employment of electric welding.

At that time Mr. Merrill had several proposals in hand, covering: (a) Straight electric welding; (b) drop forging of alternate links and electric welding of connecting links; (c) cast-steel chain. The last of these proved to be most promising and its development was rapidly pushed.

Tests of Short Lengths of Cast-Steel Chain

In October short lengths of cast-steel chain had been produced which, on being tested at the Charleston Navy Yard, showed a much greater tensile strength than that of wrought-iron chain, but with slightly less ductility. The uniformity and reliability of this chain was made possible by the employment of the electric furnace.

It was the general opinion that, in addition to tensile strength, toughness or resistance to shock was an extremely important feature of a satisfactory anchor chain. A series of shock and impact tests was then carried out by the General Electric Co. at Schenectady, N. Y., and later by the National Malleable Castings Co. at Sharon, Penn. As a result of these tests Lloyds' Register of Shipping determined to approve of the use of cast-steel anchor chain in merchant vessels.

Wrought-iron chain, either hand- or steam-hammer welded, has been used almost exclusively in ships to this day. Mild-steel chain has been tried, but has so far proved either too ductile to retain its form under stress or too hard to insure reliable welds.

In its first attempt to make cast-steel chain, the General Electric Co. used electric furnace steel, adopting the die-casting process with metal molds.

The links produced were perfectly sound and of good finish, but it was not found practicable to develop this process for commercial production, for the following reasons: (a) It was necessary to open the mold at a very critical time, while the metal was congealing; if left for a few seconds longer the links break, due to the core being solid; (b) if the mold was opened too quickly, the link being in a plastic state tended to deform.

They then made a considerable amount of chain, using sand molds and cores, experimented with heat treatment and photomicrographs, and eventually obtained links which pulled at from 60 to 100 per cent. above wrought-iron chain.

The general conclusions from tests were that the quenched link was somewhat superior to the annealed link and that the yield point of both was much in excess of that of wrought iron.

Experiments at Sharon, Penn.

At this time the subject was brought to the attention of the National Malleable Castings Co., of Cleveland, which immediately saw the resemblance between the problems of cast-steel anchor chain and car coupler knuckles. These knuckles not only transmit the entire tractive effort of the locomotive in pulling the train, but also receive shocks of great suddenness and intensity, both jerks and huffs, due to the surging of trains, the running out and in of "slack" during the application and release of brakes, and in coupling by impact.

After exhaustive tests and experiments some years ago this company had developed a special electric steel which combined with a high tensile strength a remarkable ability to withstand shock without distortion. This material they called "Naco" steel. They were invited to participate in the further development of cast-steel chain and prepared samples of 1⅜-, 2-, 2¼- and 2⅞-in. chain, including both couplets of the common link of each size and the end combinations of special links and shackles. These samples were made of Naco steel and were tested on Mar. 1 and 2, 1918, at the Sharon plant.

Of the four different sizes of Naco chain tested statically the 1⅜-in. chain showed an average breaking load about 73% above the specified breaking load of wrought chain, the 2-in. chain showed 86%, the 2¼-in. showed 75% and the 2⅞-in. showed 77%, or an average improvement of about 78 per cent.

In the dynamic tests, consisting of tensile shock tests applied through a Master Car Builders' drop testing machine to short sample pieces of chain, the 2-in. commercial wrought-iron chain in three tests averaged 142,680 ft.-lb., the Navy Yard wrought chain in two tests averaged 623,200 ft.-lb., and the Naco cast-steel chain in three tests averaged 1,902,400 ft.-lb., showing the *comparative* shock-absorbing capacity of the different chains. Using the figure 1 as the basis for commercial wrought-iron chain, the Navy Yard chain showed 4.3 times, and the Naco cast-steel chain 13.2 times as much capacity for resisting a jerk shock of this nature.

The general conclusion was that Naco cast-steel chain not only fulfilled all the requirements of a good anchor chain but was superior to welded wrought-iron chain.

The Emergency Fleet Corporation has ordered a considerable quantity for its new tonnage.

Work on the Chain Problem at Schenectady

The General Electric Co. assumed that wrought iron has been and still is a satisfactory material, and therefore set out to make a commercially practical composition of cast steel which, while it was easily cast into the necessary forms and sizes, would be soft and ductile. Softer or milder steels can be cast, but not quite so readily as the 0.30% carbon steel selected. The required degree of ductility in such a steel may readily be obtained by simple heat treatment. The result is a steel not especially high in strength, although far stronger than wrought iron (in fact, the yield point is equal to or slightly higher than the ultimate strength of wrought iron), but which has sufficient elongation and reduction of area to indicate a good degree of ductility. The average of the tests made on a great many heats would be about 35% reduction and 21% elongation. This metal, then, is not radically different from wrought iron in its tensile properties, and the approach to the physical characteristics of wrought iron is the more satisfactory when one considers that it is cast steel whose grain refinement is the result simply of heat treatment. Chain made from such steel would be stronger than wrought-iron chain; that is, under either a static load or impact, a higher stress would be required to deform it, while, when tested to destruction, it would be deformed nearly, if not quite, as greatly as wrought-iron chain when fracture finally occurred. The General Electric Co. felt it had offered a good answer to the problem set it, namely, a cast chain stronger than and equally as tough as the wrought chain universally used.

Warning Against Too Broad Conclusions

Ductile material will stretch before it fails and "short" material will break short. These are the inherent characteristics of the material. Therefore, the results showing, on the basis of the shock test, that with commercial wrought chain valued at 1, Navy Yard chain is 4, and cast-steel chain is 13, may be misleading if applied to the materials as such and used as an indication of their relative shock-resisting qualities." I wish in no way to give the impression that I do not believe that the Naco chain is not superior to any anchor chain ever produced, but wish simply to bring out the fact that too broad conclusions must not be drawn from the shock tests," said Mr. Merrill.

The usual way for engineers to make use of stronger material is to lighten sections, thereby increasing fiber stresses while keeping them in safe proportion to the elastic limit; but when the form and dimensions are fixed, the use of stronger material increases the safety of the structure. Weight per unit of length, and hence cross-section, of an anchor chain is fixed for a vessel of given proportions. Therefore, advantage may not be taken of the increased strength of cast steel to decrease the size of the links as compared with wrought-iron chain for a given vessel. Cast-steel chain must, therefore, be stronger than wrought-iron chain. In fact, it is probably the case that no impact stress great enough to cause failure of the Naco chain will ever occur in service; hence the shortness of Naco steel is not a disadvantage in anchor chain, while the stiffness of Naco chain is an enormous gain.

Car Coupler Experience Utilized

Several months ago, when The National Malleable Castings Co. was invited to participate in the experimental development of cast-steel chain, the first problem which required attention was the working out of suitable foundry methods for producing chain links in sand molds, and uniting them into continuous lengths of chain. A number of entirely successful equipments for making the molds was the result.

Connecting up the links into chain was accomplished in either of two ways: (1) The continuous process, in which the entire chain is poured from one heat, into previously prepared and united molds, by filling one interlinked mold impression after another; and (2) the precast link process, in which half the links comprising a complete length of chain are cast separately, shaken out, cleaned, inspected, and made ready for incorporation into the finished chain. Subsequently these links are placed in mold cavities and coupled up into continuous chain by pouring metal into other molds containing impressions for similar links, interlinked with the precast links.

Importance of Sound Castings

Another part of the foundry problem was the character of the mold. Recognizing the vital importance of sound castings in a product of this character, we came to the conclusion quite early in our experiments that all of the links should be produced in dry sand molds. The methods of application of gates and risers have also required some study, the details of which need hardly be set forth here. Suffice it to say that we have been able to secure very excellent results both in pouring through the stud and through the side of the link. In our preparations for manufacture, the adaptation of the method of heat treatment used for our car-coupler knuckles to 90-ft. shots of chain has involved some problems, but these have been solved and the process will be practically identical in method and results.

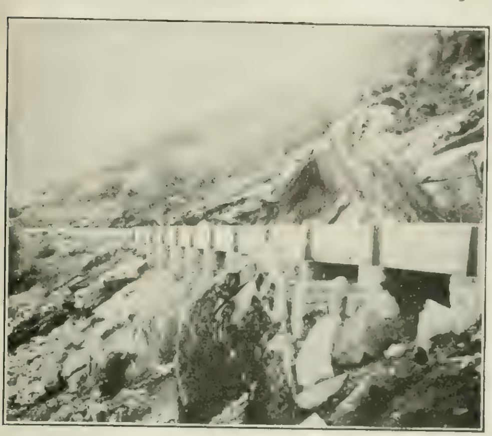
There are so many points of resemblance between the coupler-knuckle problem and that of cast-steel chain as we understand it, that we were able to start at a point which otherwise must have taken years of study and development, with the results set forth. In our opinion, a proper specification for cast-steel chain would require the making of links in dry sand molds or cores, but other details of manufacture should be left optional with the manufacturer. For the chemical requirements, the steel should be made by the electric-furnace process, with phosphorus and sulphur limits of not over 0.04%. The physical requirements should be sufficiently rigid to insure sound material, and should embody a dynamic test sufficiently severe to put the ability of the steel to withstand shock beyond any question of doubt. For this latter purpose we believe the standard M. C. B. drop testing machine presents the most readily available commercial machine, and a shock test on short pieces of test chain similar to the tests carried out at our Sharon plant seems to be as closely representative of the service to which anchor chain is subjected as any laboratory test can be.

Precast Concrete Slabs Make Durable Flume

After Five Years of Use Vertical Sides Are In Good Condition—Construction Found to Be Cheap and Simple

BY S. L. STOVALL
Stockton, Cal

FIVE years ago the writer built a five-mile conduit on the Kaweah River in Tulare County, California, of which a large part had precast reinforced-concrete side slabs. At that time the use of this method was somewhat of an experiment, but the successful performance of the flume through these five years of service entitles it to consideration, particularly at the present time, when economy in labor and materials is called for.


PRECAST FLUME CARRIED IN PLACES ON BENTS

The conduit is 9 ft. wide and 4 ft. deep and about 25,000 ft. long; of this some 18,000 ft. has the precast sides, the remainder being a concrete lined ditch of trapezoidal section. About 3000 ft. of this cast section was on bents, as shown in one of the views, and the remaining 15,000 ft. was about equally divided between one-sided and two-sided flume resting directly on the ground, which was paved with concrete after the sides were placed.

Side slabs were made 12 ft. long, 3 in. thick at the top and 5 in. thick at the bottom. They had an L-shaped cross section. Wire fabric used as reinforcement was left projecting from the slabs as shown in the view, and later was carefully tied to the reinforcement as placed in the bottom of the conduit. All slabs were reinforced so as to form a cantilever with the bottom of the conduit, thus giving an ample factor of safety against overturning.

The yard for casting slabs was near the head works and covered nearly an acre There was abundance of rock and sand close by. The concrete was poured and left in the forms five days. The slabs were then edged up and left to cure two weeks. They were covered with burlap and kept wet two weeks from the time they were poured. When cured they were loaded into a car, two making a carload, and distributed along the conduit line over a narrow-gage railroad. Handling and moving slabs proved to be very easy and cheaper than handling an equal quantity of loose concrete material.

The forms used for the slabs were simple. A platform of the proper size was made by nailing 1½ x 8-in. boards, surfaced one side and tongued and grooved, to three 4 x 6-in. studs. These last were some 6 in. longer than the width of the platform. A collar was made that fitted around the platform and rested on the extended 4 x 6 in. studs. The four sticks making the collar were fastened together with hinges and hasps. It was a simple operation to sweep off the platform, brush with crude oil, and place the collar in position. It was necessary that the ends of the three 4 x 6-in. studs be solidly supported; otherwise there was settlement when the concrete was poured, and the resulting slab came out warped.

The forms lay flat and close to the ground. It required remarkably little work to dump the concrete into the form, get the reinforcement properly placed, and finish the slab.

A form for slabs cost complete $7.50. It was good for the making of 20 to 25 slabs.

All slabs were set 2 in. apart at the ends. A sheet-iron form was then hung over the joint on the outside and the pilasters were poured. The pilasters, in addition to closing the joint, added materially to the beauty of the structure and greatly reinforced the strength of the side slabs against overturning. After all slabs had been placed and sufficient rock and sand distributed, the railroad was taken up and the bottom of the conduit was plastered 4 in. thick with concrete.

The rock and sand for concreting the bottom of the conduit were distributed at the same time as the slabs and formed excellent material for use as ballast for the railroad.


TWO-SIDED FLUME IN FOREGROUND IN BACKGROUND THE FLUME IS ONE-SIDED

This conduit has been five years in operation. The writer went over it not long ago and gave it a careful examination. It was found to have stood up to expecta-

tions. What troubles have developed are small and such as always are incident to jobs first of their kind. Nothing has come up that cannot be easily handled on future installations. For instance, it is very essential that any gulch crossed be carried underneath the conduit in a culvert. This was not done in the case of some small gulches. During a long rainy spell water collected above the conduit in two of these gulches and made its way underneath. The conduit was undermined. This could not have happened if proper drainage had been provided.

The necessity at the present time for increased efficiency and conservation in the use of materials calls for radically new methods in the construction of flumes.

PRECAST FLUME SIDES HAVE REINFORCEMENT PROJECTING TO TIE TO BASE

There are serious objections to the use of timber and steel. Their installation and upkeep are expensive. They make a serious fire risk. The life of timber is short, and if the water carries much sand a steel flume is soon cut out at the bottom. Concrete, as a material for flume construction, meets all requirements most successfully.

Wherever flumes are to be built there usually is found an abundance of suitable rock and sand close at hand. With a concrete flume there is no fire risk, no decay, and practically no upkeep or depreciation. Such a flume, as a matter of fact, grows stronger and better with age.

Concrete flumes usually have been poured in place. Handled in that way, there are two serious objections to concrete as a material for flume construction. A great deal of lumber is required for forms—nearly as much as would be necessary for building a timber flume.

The deep narrow walls into which the concrete has to be poured make necessary the use of more material than the required strength demands, and the placing of this material in the restricted working space available is slow and expensive. Both of these objections are overcome in the precast flume. If, then, it is durable it is an admirable form of construction.

Season Cracking of Brass Discussed by Manufacturers and Laboratory Men

FACTS and opinions that add materially to our knowledge of cracking of brass and bronze—the so-called season-cracking—were presented before the American Society for Testing Materials two weeks ago in a symposium on season-cracking. The discussion told of two methods by which the season-cracking disease can be cured. It also indicated that much cracking trouble will be forestalled in future by using the mercury-solution test.

Opposing claims concerning the value of this test were made by W. Reuben Webster, of the Bridgeport Brass Co., and two representatives of the Bureau of Standards, P. D. Merica and R. W. Woodward. Mr. Webster, in a brief paper, reported that tests of good brass articles, taken from lines of manufacture known to show no failures in service, gave a large percentage of failures in the mercury-salt test. The test consists of immersing the article in a solution of either mercurous nitrate or mercuric chloride for a short time; the corrosive action of this solution on the brass brings about the formation of cracks at points where the initial stress in the superficial material from the cold working of the metal was very high, and where, according to experience, subsequent cracking in storage or service would develop—the so-called season cracking. Mr. Webster took such articles as lamp parts, finished parts of bicycle pumps, automobile hub caps and the like, as well as brass rods and sheet brass, none of which give any trouble in service ("complaints have very seldom, if ever, been reported"), and subjected them to the mercury test. Out of 36, 25 were injured while 11 showed no effects of the solution. For this reason he asserts that the test is too severe.

Messrs. Merica and Woodward, discussing the subject mainly from the standpoint of the amount of initial stress involved in the cracking phenomenon, said that many tests have shown that "a rod or tube which will crack in this test will also season crack, and conversely." On this account they described the test as being desirable and indeed necessary in the inspection of brass, but they asserted that for rods, tubes and the like which are to be subjected to tensile stress in service the test is not sufficient. "The authors can cite a number of instances," they said, "in which material, samples of which did not fail in the mercury salt solution test, did crack in service under the application of moderate service loads. The tensile stress at the surface of these articles was not alone sufficient to produce cracking, but when augmented by a moderate, externally applied stress, failure occurred." They therefore recommended measuring the initial stress at the surface, if possible, either by strain-gage measurements during successive removal of layers of the material, or by noting the amount of bend of a V-shaped longitudinal strip cut from the sample; as an alternative to this they suggested applying the mercury salt solution test while the specimen is stressed in tension.

How annealing reduces and eliminates initial stresses was investigated by the same observers. Using temperatures from 100 to 400° C., in all cases a temperature slightly over 200 resulted in practically complete removal

of the initial stresses. The times of annealing ranged from ½ to 7 hours.

The authors also investigated the effect of cold straightening samples of drawn rod. This procedure replaced the severe initial tension in the outer layers of the bars by compression, the stresses throughout the cross-section of the bar being redistributed at the same time. In view of the fact that annealing is "not readily adapted to present commercial practice and equipment," the authors say, such mechanical methods of relieving initial strain are the most promising.

Further practical facts on the value of annealing were given by W. B. Price, of the Scovill Manufacturing Co. The articles in question here were cartridge cases, which are severe cold work in manufacture and which in certain specific lots under test failed to pass the mercuric chloride immersion. Annealing for one, two and three hours at 500° F. was tried, and to measure the result of this treatment tensile tests were made, also microscopic examinations of the structure of the metal. The heat treatment did not produce any noticeable change in the physical properties of the brass. "Nevertheless, heat treating certainly diminished the degree of internal strain," he said. "Not one of the twelve cases which were tested from each of the four lots as heat treated failed in the mercuric-chloride test." The microscopic examinations also were satisfactory. The conclusion is "that a heat treatment of 500° F. for one hour does not effect a recrystallization even on the hardest portion of the shell, and yet is sufficient to relieve all internal strain and prevent the case from cracking in the mercuric-chloride test." A review of various factors influencing the occurrence of cracking in brass and bronze, given by W. H. Bassett, of the American Brass Co., included the results of an original study concerning the effect of cadmium on 70 = 30 brass.

Effects of Impurities and Admixtures

The evidence obtained did not show cadmium to increase the cracking tendency. The author also reported that lead, tin, iron and other common impurities or admixtures appear to have no distinct effect; antimony and bismuth also were cleared of responsibility for producing cracking. Fire-cracking, which occurs when a hard-drawn tube or rod is suddenly brought into a hot furnace, or when a spun or drawn shell is brought in contact with a polishing wheel, is held to be similar to season-cracking; but when thermal effects are not present corrosion is a necessary factor, and brass that is polished does not crack.

Henry S. Rawdon, of the Bureau of Standards, studied the mercury-solution test. The International Aircraft Standards Board specifies immersion in acidified mercurous nitrate; the Ordnance Bureau and the New York Board of Water Supply use mercuric chloride. He found that mercurous salts are considerably more active than mercuric, for the same concentration of mercury; that the size of the specimen need be given but little consideration; that polishing the surface of a specimen delays the cracking; that specimens should be examined for some time after removal from the solution; and that the cracks formed pass between the crystals of the metal (except when the action is quite violent), and are probably due to solution of the mercury in the alloy.

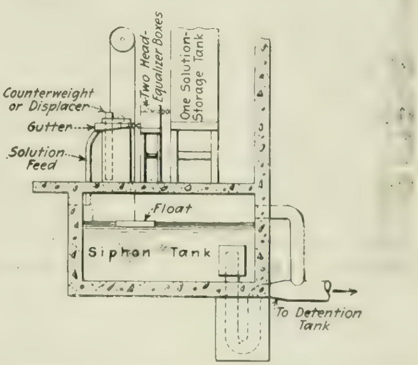
Siphon Operates Proportional Chemical Feeder

Displacer Automatically Proportions Feed of Chemical in Sewage Treatment Plant—Could Be Used for Water

By W. S. Lea
Consulting Engineer, Montreal, Canada

FOR automatically applying a chemical solution in proportion to the flow of the liquid to be treated, a design recently worked out for a sewage-disposal plant in Canada consists of float-operated displacers dropping into a constant-head solution box. Two siphon boxes are used, working alternately. The apparatus is also adaptable to water-treating plants.

In the plant described, the sewage will be passed through settling tanks, treated with a bleach solution and held in a detention tank before being discharged into a stream. As the necessary head is available



SIPHON OPERATES PROPORTIONAL CHEMICAL FEEDER

above the detention tank, it is proposed to provide two small tanks to receive the discharge from the sedimentation tanks, and install a siphon in each, with an individual discharge capacity somewhat in excess of the maximum sewage flow. The sewage will flow alternately into each siphon tank, being controlled by air-lock feeds. A fixed proportion of the total flow might have been utilized, passing it over a circular weir and intercepting the desired proportion.

The arrangement is illustrated diagrammatically, but the distributing channel, the air-lock feeds, the small compression and feed chambers, and the compression domes, starting bells and interconnecting piping recommended by the Pacific Flush-Tank Co. are not shown.

There is a float in each siphon tank, with a counterweight so hung that it sinks into or is withdrawn from a feed box as the float rises or falls. As a siphon tank fills, the float rises, and the counterweight sinking into the feed box displaces the solution, which is thus fed into the sewage in practically exact proportion to the rate of flow at any instant. After this siphon tank is filled, its siphon is vented and the counterweight is withdrawn as the tank empties, while the feed box fills up, ready for the next displacement. In the meantime the sewage is flowing into the other siphon tank and is

being treated with the solution displaced from the other feed box.

Strictly speaking, for exact proportionality of chemical feed to the flow to be treated it is essential that the tension be constant in the suspension line where it is attached to the float in the siphon tank; also that the supply to the feed boxes be shut off just at the overflow level, and that the necessary maximum head on their overflow weirs be infinitely small.

When the area of the float in the siphon tank is large in relation to the area of the displacer in the feed box, the effect of the variation of the tension in the suspension line is small. For example, with a float 20 in. in diameter and a 2-in. displacer, submerging 2 ft., the variation in the submergence of the float in the siphon tank due to this cause is only about ¼ in. Moreover, neglecting the friction of the pulley or shaft, the tension in the suspension line at the float will be constant, if the weight of the suspension line per unit length is equal to half the weight of the solution displaced per unit length of the counterweight. In fact, if it is considered worth while to do so, the effect of the change in the weight of the displacer as it submerges can be eliminated entirely, either by slightly increasing its area from bottom to top, or by a simple compensating device such as a heavy chain with free hanging ends; the chain being linked over a sprocket geared to the shaft which is turned by the movement of the float in the siphon tank.

With a constant-strength solution, the chemical dose can be varied either by using displacers of different areas, or by changing the amplitude of the vertical movement of the same displacer. This can be accomplished by attaching its suspension to different points on a cone pulley keyed to the shaft, which is rotated by the movement of the float in the siphon tank. The dose, in grains per gallon or pounds per million gallons, can be marked on the displacers in the former case and on the cone in the latter case.

This method of chemical feed can be used either with a tipping bucket or with a single siphon, instead of the two siphons, and although the proportional feed is not quite so effective, the compression domes, starting bells, etc., are not required.

Approve Development-Committee Plan of American Society

Prominent Engineers in This and Other Organizations Discuss Phases of Move, and Possibilities of Other Societies Co-operating

Prominent engineers have been asked by "Engineering News-Record" to comment on the resolution of the American Society of Civil Engineers creating a committee on development, as set forth in the issue of June 27, p. 1209. Members of the society were merely asked their opinions on the move. The views of members of other societies were also sought on the suggestion made by this journal that the other national societies form similar committees, all coöperating to lay out a broad program for the engineering profession. Replies are here published from Gano Dunn, Frederic P. Stearns and Fred Lavis, members of the society; and, of the second group, from Philip N. Moore, past president of the American Institute of Mining Engineers, and F. F. Sharpless, member of the institute and past secretary of the Mining and Metallurgical Society of America.—Editor.

Gano Dunn Sees Only Good in the Move—Thinks Other Societies Will Support It

Only good can come from the appointment of the committee on development by the board of direction of the American Society of Civil Engineers on June 18.

The rapid growth of the engineering profession, the tendency for it to consolidate, the eccentricity of its geographical distribution, the leaning toward including more than purely engineering matters among the functions of the national societies, and the augmented public appreciation of the essentialness of the engineer's services to the community, not only now in war but in the new conditions that will succeed it, all call for a fresh taking of the sun and increased gifts and vision in the piloting of the movement that is beginning to express itself. This expression may be observed in many significant happenings throughout the memberships of all kinds of engineering groups in the United States.

The more study professional development receives and the greater the number of points of view that are cultivated and respected, the surer shall we be in the end to mark a progress worthy of the ideals of our profession and of the intelligence that it represents. Failure to study will leave unheeded timely warnings and unseized opportunities that may not soon recur.

The American Society of Civil Engineers is to be congratulated on its opportune lead in this matter, which will probably be supported by other engineering societies both individually and through the Engineering Council.

Frederic P. Stearns Commends Move—Thinks November May Be Too Early for Report

The preamble and resolutions adopted by the board of direction of the American Society of Civil Engineers regarding a committee on development, and your editorial comments thereon as printed in *Engineering News-Record* of June 27, have been read with interest and approval.

There is need, under the changed conditions of the world, for the development of the scope of the work of the society, as set forth in the preamble, and the method of reaching the desired results by means of the committee provided for by the resolutions is to be commended.

In view of the importance of selecting suitable members for this committee, much time will be required by the 22 local associations of members of the society and by its president for selecting the full committee, and further time for selecting from this body the executive

committee. It is therefore not unlikely that Nov. 1, 1918, will be too early a date for an adequate preliminary report, but this does not affect the general merits of the project, as a well digested report presented several months later will meet all requirements.

It is especially important that the committee be carefully selected and that the executive committee be composed of men who will, as you suggest in your editorial, grasp the problem broadly and do much hard, painstaking work.

Fred Lavis Hopes Committee Will Help Us to Correlate Engineering with Business, and Think Internationally

The following very briefly expresses some thoughts I have in regard to the creation of the committee on development of the American Society of Civil Engineers:

The trouble with the American Society of Civil Engineers is that as a society it has been so obsessed with the technicalities of the profession that it has failed to realize the human side of engineering, and, more especially, the fact that engineering is an adjunct of business. With the present development of international business this would be a fatal defect if persisted in.

Even before the war America was developing a considerable interest in the affairs of the world. Our interests in Cuba and the Philippines gave many of our people their first realization that there are vital interests outside of the United States. The construction of the Panama Canal—a link in one of the great trade routes of the world—furthered this, and the present war is bound to make us think internationally and vitally realize many things which formerly we only dimly sensed through reading of them.

It is, therefore, of immense importance that the American Society of Civil Engineers has taken the step it has. Let us hope that the committee will work with a full realization of the spirit of the resolutions which created it and with a broad vision, not only of the function of the society to its members in the United States, but also in its relation to business and in relation to the future development of the United States as an important factor in worldwide work. To carry this out, of course, it will be most desirable that one or more members of the committee be engineers who have had a fairly wide experience outside of the United States, and while many of these are not available now on account of the war, it may be possible to find some who are not so engaged, or enlist the help of others, even though they may not be in the country at this time. Finally, let us hope that such well considered conclusions as the committee may present be not killed by internal politics, as so many previous attempts to get the society out of the rut it is in have been.

Philip N. Moore Thinks Societies Have Scarcely Touched Edge of Great Possible Field of Service

As I am not a member of the American Society of Civil Engineers, it would be improper for me to criticise its past policies or present plans for development, however much I may welcome any move in that direction on the part of so distinguished an organization.

My own views upon a not greatly differing problem in the affairs of the American Institute of Mining Engineers are on record in my address as outgoing president, delivered in February last. The quoted paragraphs in a way cover your question.

"Such a body as the institute has ever before it the two extremes of policy, either one of which, followed too far, leads to disaster. One is centralization with efficiency; the other, wide control with a large number sharing in its problems, mingling in its affairs, and thereby possibly leading to confusion, if not disharmony; and yet, both policies are needed.

"An effective body must have its centralized working board easily assembled, and able to speak with authority; at the same time, if its widely distributed membership, doing the real work of the profession in the mountains, mills and smelters, be not consulted actually, instead of nominally; if these men be not made to realize that they count, that their judgment is desired and has weight, inevitably loyalty lapses and yields place to indifference and criticism.

"The problem of wider or more democratic participation in the affairs of all national engineering societies is one of great difficulty, because, from the nature of things, the majority, especially of the men in their subaltern days, inevitably dwell in isolated communities, where opportunities for personal contacts with their equals, who think along the same lines, are rare. These are the men who are doing the real work of the profession. Those who dwell in the great cities have either passed subaltern days and reached the dignity of being no longer in the service of any one employer; or they are the chiefs of the great technical organizations needed at the nerve centers of the country for frequency of counsel and efficiency of control.

"The time removed from field contacts is apt to measure a certain loss of sympathy with the point of view of the field man. By such detachment he loses the insight of the younger man and tends to consider our common problems from the viewpoint of his neighbor. This is unconsciously done, and absolutely without intent to be inconsiderate. Its improvement constitutes one of the difficult problems of society administration; and yet, without its constant consideration in plan and action, the society loses the warm loyalty of the younger man which is its best asset for the future.

"In the local section the younger men have opportunity to meet their elders, to bring to preferment those whom they esteem, and through them, as representatives, to make an impression upon the consciousness of the main organization. Probably never before have your national officers so fully realized this situation, or so sincerely desired to give it cordial consideration. . . .

"The vision dwells in the minds of many that ultimately these four great societies [the four national societies], lightening the emphasis they place upon their differences, may see the time when, for the solidarity of the profession, for their best interests, as well as for increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation, freedom for individual development may be achieved through divisions along the lines of technical interests, which might either fol-

low the present four grand divisions, or be more minutely subdivided.

"An organization of this sort could and probably would be more strictly professional than any of the four have been heretofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring grave consequence."

In elaboration, further, I may say that I expect the time to come when the directors of the great national societies will be chosen by the local engineering societies dwelling in specified geographical districts. In order to respect the very evident necessity of having a quorum of the board resident contiguous to New York, it would be a simple and feasible matter to use the English system of choosing members of Parliament wherein any district can be represented by the man of its choice, no matter where resident. On this plan, it could be provided that each district, at certain intervals, would be called upon to select a man residing in or near New York as its representative. Such man would naturally be one known to and sympathetic with those naming him, and unlikely to be of a circle hitherto practically self-perpetuating. If to this he added the obligation to pay the traveling expenses of directors, to stated meetings of the board, there would necessarily come about a much wider participation in the decisions of each organization than is now possible.

I firmly believe that these societies have scarcely touched the edge of the great possible field of service to members and community.

If, in addition to this enforced widened system of control, there can be added some propaganda which will make the members realize that membership brings obligations as well as privileges, the possibilities of service will correspondingly increase. Certain it is that there exist wide unrest and dissatisfaction with the conduct of some of these societies in the past; equally certain it is that each step which has brought about wider participation in their affairs, even the result of a contest, has made for good.

F. F. Sharpless Doubts Only the Desirability of Identical Methods for All Societies to Effect Needed Changes

A nonmember of the American Society of Civil Engineers might give views that were quite unbiased but they might be quite as valueless, because of his lack of knowledge of its history and present condition.

One need not, however, be a member of this society to realize that the preamble to the resolutions points to a condition daily becoming more painfully evident to all engineers, namely, that this society and other engineering societies are not functioning so as to be of the greatest benefit to society in general; indeed, they are doing but a small part of that which is their privilege and should be their duty. Individuals within various major engineering societies have seen the light or have seen some light and have tried to guide our activities as societies into more useful channels, but the conservatism of technical organizations has been hard to overcome, and although a large number of our members have felt that there was a call to greater usefulness they have hesitated to assume any initiative.

Your suggestion that the action of the civil engineers be followed by similar action upon the part of the other engineering societies is in principle a most proper suggestion, but I question the advisability of all societies not equally conservative. Some constitutions permit of following identical procedure. All of our societies are broader action and greater usefulness than others; the membership of some societies is permeated with more liberalism than others. Hence, while there is but one goal to be reached, the paths to this point will not all be identical; some will be rougher and some longer than others, and different means may be required to attain the common field of activity.

It is a truism that large committees produce small results. The civil engineers recognize this in turning over their contemplated work to an executive committee. Might it not be economical of time and labor if the other societies, if asked to coöperate with the civil engineers, go no further than appoint small committees who should await the preliminary report of the active committee?

Such small committees could then consider this preliminary report and advise their board of directors how far coöperation was possible or advisable and what contitutional amendments would be required to give each society its maximum usefulness and the entire engineering profession its proper position in the economy of society.

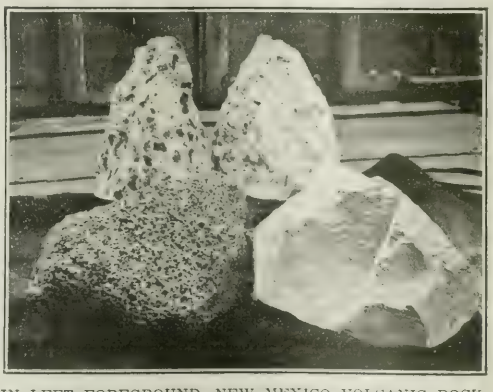
Light Weight Concrete for Ships From Special Aggregate

Volcanic Rock Forms Basis For Concrete of High Strength and Weight Twenty Per Cent Lighter Than Normal

BY JAMES P. NASH

Testing Engineer, University of Texas, Austin, Tex.

TESTS recently made in the laboratory of the engineering division of the bureau of economic geology, University of Texas, show that certain aggregates, notably a volcanic scoria readily available in the Southwest, will give concretes of weights about 120 lb. per cubic foot and in 28 deg. tests compressive strength above 4000 lb. per square inch. Such material would



IN LEFT FOREGROUND, NEW MEXICO VOLCANIC ROCK. RIGHT FOREGROUND, QUARTZITIC SANDSTONE. CONCRETES FROM ROCK IN REAR

have marked and obvious advantages for concrete ship building.

The volcanic scoria used in these tests is from New Mexico, about 35 miles north of Las Cruses. Crushed between ¾ in. and ⅛ in. in size it weighs but 39 lb. per cubic foot loose. The specific gravity of the material being 1.50, it weighs solid 93.4 lb. per cubic foot. The volcanic rock screenings passing the ⅛-in. screen weigh 78 lb. per cubic foot loose. This increase in weight of the screenings over the crushed rock is due to the fact that considerable pore space is lost by the finer crushing. Sandstone used in the tests, though somewhat heavier than the volcanic rock, also gave good results. It came from the property of the Texas Gravel and Sand Co., at Piedmont, Grimes County, Texas. An up-to-date crushing and screening plant able to produce 200 tons of crushed and screened stone per day is in operation, so that no further development is necessary to assure a constant supply for ship construction. From the fact that this material is only 80 miles from the port of Houston, Tex., it is believed that it offers numerous possibilities for the construction of concrete ships.

TABLE I. CHARACTERISTICS OF AGGREGATES USED IN TESTS

Material	Specific Gravity	Weight Lb. per Cu Ft Solid	Weight Lb. per Cu Ft Loose	Absorption, Per Cent	Crushing Str. Lb. per Sq In.	Percentage Retained on: [illegible] In. Screen	[illegible] In. Screen	[illegible] In. Screen	[illegible] In. Screen
Volcanic scoria	1.50	93.4	39	4.2	From 1,500 to 5,000	2	62	94	98
Indurated sandstone	2.20	137.0	61¾	3.4	5,440	0	40	71	100
Limestone....	2.62	164.0	78	1.4	9,860	0		100	
Colorado river gravel	2.59		94½			0	40	70	100

The rock has a specific gravity of 2.20, giving a weight solid of 137 lb. per cubic foot. Crushed so that it will pass the ¾-in. screen and be retained on the ⅛-in. screen, it weighs 61¾ lb. per cubic foot. Screenings passing the ⅛-in. screen with the dust removed weigh 62 lb. per cubic foot. Due to a smaller porosity, the sandstone screenings weigh less than do the screenings produced from the lighter volcanic rock.

The mixing and placing were done by hand, and the same consistency was obtained in every case except where noted in the tables. This was a mushy consistency; that is, when the concrete was tamped with a ⅝-in. rod water would appear on the top of the soft concrete. The specimens were 6 x 12-in. cylinders which were stored 21 days in wet sand, and then in air until tested. Where sand is noted the local Colorado River sand was used. This is a well graded coarse sand of excellent quality for concrete work. The gravel specimens were made from the local Colorado River gravel, except the gravel was graded to conform with the grading of the sandstone. The crushed limestone also approximated the grading of the volcanic rock, so that the results are directly comparable.

It is worthy of note that both the sandstone and the volcanic rock concrete are superior in strength to the gravel and limestone concrete at 28 days. In the case of the volcanic rock and screenings the concrete weighs 14.8 per cent. less, and has 12.5 per cent. more strength than the limestone concrete made at the same time and similar in every way. In like manner, the concrete made with the crushed sandstone and screenings weighs 10 per cent. less than the similar concrete made with gravel and sand and at the same time developed 12.4 per cent. greater strength. The weights for the concrete given in the tables are the weights of the concrete when it is removed from the molds, 24 hours after being poured. With the sandstone concrete the weight at 28 days was approximately the same as the one-day weight, the water absorbed in wet sand being given up when the specimens were stored in air. The volcanic rock concrete, however, averaged about 1 lb. per cubic foot heavier than at one day.

Using the sandstone crushed below the ½-in. screen and screenings of the same material, a concrete has been produced which weighs but 128 lb. per cubic foot. The strength of this concrete has not yet been determined, so the results are not recorded. In fact, the above results are only preliminary to a larger series of tests of this same material, which will include absorption tests and modulus of elasticity determinations.

St. Paul Meters Most of Water Sold

Of 42,250 water connections in St. Paul, Minn., 91.2% are metered. The percentage of receipts from the sale of water is almost exactly the same. During 1917 the average cost per service for maintenance was 10.7c. The daily consumption was 58 gal. per capita, but as 40% of the demand is supplied by individual artesian wells 73 gal. are supplied to each consumer. Gallons per tap are 377 and per meter 281 (domestic 141 and commercial 2290). It cost $34.15 per million gallons for the total maintenance and $66.06 if interest on bonds and sinking funds is added.

TABLE II. RESULTS OF TESTS OF CONCRETE SUITABLE FOR SHIP BUILDING
(Each compressive strength result is the average of from 2 to 4 specimens)

Coarse Aggregate	Fine Aggregate	Proportion	Water Used per Cent by Weight of Mix	Sacks of Cement per Cu. Yd. of Concrete	Weight of Concrete Lb. per Cu Ft	Compressive Strength Lb. per Sq. In. 7 Days	28 Days	Remark
Volcanic rock, [illegible] to [illegible] in	Sand passing [illegible] in. screen	1:1:2	16.4	11.1	124.0		5,100	
Volcanic rock, [illegible] to [illegible] in	Sand passing [illegible] in. screen	1:1:2 10% hydrated lime by weight..	18.4	10.[illegible]	120.8		4,100	More water used in mix than necessary
Volcanic rock, ⅛ to ¾ in.....	Volcanic rock screenings, below [illegible] in	1:1:2	19.8	11.4	11[illegible].7		5,060	
75% volcanic rock, 25% limestone, ⅛ to ¾ in......	Sand passing ¼ in. screen...	1:1:2	15.1	10.9	129.0		4,525	
Crushed limestone, ⅛ to [illegible] in	Sand passing [illegible]	1:1:2	11.3	10.2	140.[illegible]		4,500	
Sandstone, [illegible] to [illegible] in	Sand passing [illegible]	1:1:3	12.8	7.[illegible]7	132.0	1,730	3,560	
Sandstone, ⅛ to ¾ in........	Sand passing ¼ in. sieve ..	1:1:2	15.3	10.4	1[illegible]1.7[illegible]	2,140	4,160	
Sandstone, ⅛ to ¾ in........	Sandstone screenings between [illegible]	1:1:2	1[illegible].3	10.7[illegible]	12[illegible].7[illegible]	2,785	4,990	
Gravel, [illegible] to [illegible] in	Sand passing [illegible]	1:1:2	10.7	[illegible]	143.0	2,770	4,450	
Sandstone, [illegible] to [illegible] in	Sand passing [illegible]	1:1:2	16.7	10.0	130.25	1,505	3,340	Too much water used in mixing
Sandstone [illegible] to [illegible] in	Sand passing [illegible]	1:0[illegible]:2.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Wood-Stave Pipe Built of Local Hemlock in North Carolina

By David R. Shearer
Electrical Engineer, Johnson City, Tenn.

Decision was made in the summer of 1916 by the Boone Fork Lumber Co. to build a small hydro-electric plant in western North Carolina provided the work could be done without delay. The site was a deep and rocky gorge 14 miles from the railroad and almost inaccessible to wagons. The installation contemplated the use of a 30-in. pipe line about 1200 ft. long and designed to work under a head of 20 ft. at the intake and 144 ft. at the water wheel. The dam could be constructed of timber which was easily secured from the pond area and the machinery could be brought in by teams with ropes and tackle where necessary, so that the real problem was the pipe line. Because of the delays in securing pipe on the market and the difficulties of laying, it was decided to construct a continuous wood-stave line and to secure all the material locally, except the bands.


ONE OF THE CONCRETE BLOCK ANCHORAGES

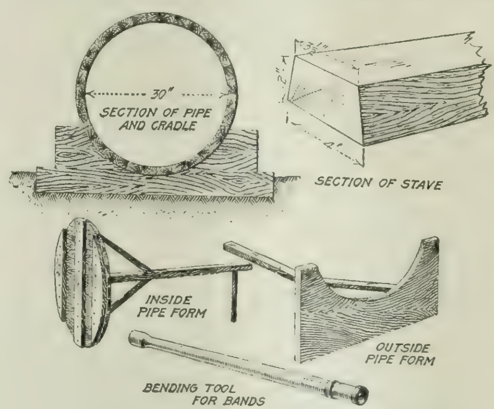
These bands were to be of round steel threaded on both ends, part of them 1 in. and part ¾ in., shipped without bending, to facilitate hauling on wagons. A small portable saw-mill was found and started to cutting 2 x 4-in. hemlock for the staves. The staves were left flat on the outside and inside and the edges bevelled to the proper angle on a small portable planer. The bevel was taken so that the outer edges came in contact before the inner edges, thus leaving a small crevice of about $\frac{1}{32}$ in. on the inside of the finished pipe. This was done with the idea that foreign matter would soon fill these spaces and assist in preventing leaks. By leaving the staves flat the pipe section was polygonal, but as the diameter was 30 in. this variation from a true circle was hardly discernible.

After the staves were cut and bevelled the ends were squared and a saw kerf cut in each end ¾ in. deep, in which was to be driven a 1½ x 4-in. piece of 12-gage sheet steel. As no dry kiln was available, the staves were used almost green, a condition which necessitated frequent tightening of the bands for two or three months after the pipe was placed in service. It would therefore have probably cost less to have erected a small kiln and thoroughly dried all the staves before use.

The bed was excavated for the line and the necessary trestles built, after which cross timbers were placed about 4 ft. apart. These were slightly hollowed where the pipe was to rest, but nothing further was done to them until the pipe had been assembled and banded, when they were ballasted; brace blocks were spiked on them and wedges driven against the pipe. The 1-in. bands were placed at the lower end of the pipe, spaced from 6 to 18 in. c. to c. The ¾-in. bands were spaced from 10 to 24 in. c. to c. At the points of greatest stress in the curves reinforced-concrete anchor blocks were formed around the pipe. These blocks were 8 x 2 ft. on top and were battered 2 in. in 12 inches.

The actual construction of the pipe was done by seven men: four put together the staves and three followed with temporary banding. At first bands were placed about 8 ft. apart, simply to hold the pipe in shape. A circular sliding form 1 in. smaller than the pipe was used to form up the circle on the inside and a sliding cradle held the bottom part of the pipe in place. After a little practice the men were able to lay about 100 ft. of pipe daily in spite of the rough nature of the ground and the difficulty of assembling the rough green staves.

After the entire line was put together the crew was sent over it again to complete the banding. The steel was bent partly on a heavy timber form and partly on the pipe by means of long socket handles which fitted over the ends of the steel rods. Two men would bend a band easily; then the lug was put on and the nuts run up.



CONSTRUCTING PIPE LINE WITH SPECIAL TOOLS

The entire pipe was built and placed in service in less than 60 working days. At first there were many leaks and a few knots blew out, but after it was tightened a few times and small holes were plugged the leakage became much less and now after use the pipe is practically watertight. It is to be noted that at times the pressure surges run up to 20 lb. per square inch on this pipe in spite of the fact that there are two relief valves at the lower end, but the service has been satisfactory from the time it was placed in operation.

The writer had charge of the design and installation of this pipe and plant.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Merriman's Sanitary Engineering

ELEMENTS OF SANITARY ENGINEERING. By Mansfield Merriman, M. Am. Soc. C. E. Fourth edition. Revised with the assistance of Richard M. Merriman, Assoc. M. Am. Soc. C. E. New York: John Wiley & Sons, Inc., London; Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 244; illustrated. $2.

Twenty years have passed since the first edition of this well known college textbook appeared. With the development of the branches of sanitary engineering treated, and the demand for the book, successive editions have increased in size until the present or fourth edition is considerably larger and more comprehensive than the first one.

Opening with a general review of sanitary science which occupies some forty pages, the volume continues with chapters on water and its purification, water-supply systems, sewerage, sewage disposal, and the collection and disposal of refuse and garbage. The last-named chapter includes about four pages each on privies and cesspools and on street cleaning. As the larger part of the first chapter deals with very much the same topics as the remainder of the book, and since the concluding chapter is brief and has a fourth of its space gives to privies and cesspools, it will be seen that the volume is confined almost wholly to water-works and sewerage.

Although the two subjects just mentioned are the most important sanitary topics for general engineering students, yet the conception and practice of public health and sanitation have broadened so much in the past two decades, and there are now so many engineers connected with the local, state and Federal public health services, and responsible for health conditions in camps and industrial plants, that the scope of the next edition of the book might well be considerably enlarged. Thus the authors dismiss heating and ventilation with a few words and a remark that this is work for the architect rather than the engineer, whereas it is essentially engineering and has been so recognized for many years by the existence and activities of the American Society of Heating and Ventilating Engineers. Mosquito control may also be classed as a branch of sanitary engineering. The book barely mentions mosquitoes in connection with yellow fever and malaria, saying of the latter that "*probably* [italics ours] the infection of malaria is propagated by the help of mosquitoes."

Revision in the present edition, the authors state in their preface, includes the correction of all known errors, the substitution of some new problems or exercises for old ones, a new article on the Imhoff tank, a second new article on relatively new or not very common methods of sewage treatment, and new matter in 11 (of 85) other articles, "several of which have been entirely rewritten." These changes and additions are valuable but are insufficient to bridge the gap between the years 1906 and 1918.

Illustrations of deficiencies which, though minor, might easily have been made good are: Stopping with the London general death rate of 20.5 per 1000 for the decade 1881-90 in the field of mortality statistics, when the decrease might have been shown so much more strikingly by later figures; leaving the mention of Worcester, Mass., as the largest chemical precipitation plant in the United States, and ignoring the much larger city of Providence, which built similar works as far back as 1900; citing the Barren Island garbage-reduction works, New York City, as the largest in the country, when these were succeeded by a plant just off Staten Island in 1917; the entire omission of the activated-sludge process of sewage-treatment; and misleading statements under garbage disposal. One of the latter reads: "In large American cities the tendency has been to have a special plant for garbage cremation in which no other refuse is burned, but in the smaller cities the three classes (garbage, street sweepings and rubbish) are often burned in the same furnace." The reverse would be more nearly correct but, as a rule, large American cities reduce rather than burn garbage, and very few cities of any size attempt to burn street sweepings.

Considerable space has been given to a few of many minor omissions and commissions because they illustrate the difficulty or impossibility of bringing an old book up to date and making it worthy of being called a new edition by a mere cutting of plates here and there and the insertion of a few new pages. The book is worthy of thoroughgoing revision and considerable expansion. It is strongest in strictly engineering and hydraulic matters and weakest in dealing with present-day conceptions of public health and sanitation and in statistical and other illustrative matter inserted in the earlier editions but now out of date.

Finally, when another revision is made, it might be well to reconsider the statements on p. 12 and 13 to the effect that not health but disease is to be considered the normal state of man.

British Industrial Housing and Welfare

WELFARE AND HOUSING: A Practical Record of War-Time Management. By J. E. Hutton, Manager of Labor and Catering Department of Vickers Ltd., Member of the Food Investigation Committee of the Ministry of Munitions. London and New York: Longmans, Green & Co. Cloth; 5 x 8 in.; pp. 192; 12 halftones and two folding plates. $1.50 net.

Based on the author's experience in housing, feeding and looking after the general welfare of a hundred thousand workers employed by a single industrial concern in the stress of war time, this small volume promises to be of great value to anyone concerned with similar problems, whether officially or as a student. Welfare supervision, temporary and permanent housing, catering, canteens, food values, motor transit, hospitals and medical services, works police, the woman worker's viewpoint (contributed by a woman) are considered in succession, and there is a sane and sympathetic chapter on industrial unrest. Appendixes deal with government regulations as to fitness certificates for workers, sanitary accommodations, washing conveniences, ambulance, first aid and minor injuries' services and provision and

protection of drinking water. Various forms are given as well as equipment specifications, menus, dieting values, and cost figures. The book should appeal to many in this country who suddenly find themselves confronted with the problems of meeting the needs of present-day war workers, in factory, shop, camp and shipbuilding plants.

Legal Bars to Municipal Activities

AMERICAN CITY PROGRESS AND THE LAW—By Howard Lee McBain, Dorman B. Eaton Professor of Municipal Science and Administration in Columbia University. New York: Lemcke & Buechner. Cloth; 6 x 8 in.; pp. 260. $1.50.

Absence of state authorization of municipal activities on the one hand and constitutional prohibitions on the other have often barred municipal projects. In the readable volume before us the author examines the "more important rules of law that are involved in some of the forward-looking movements in American cities."

The main topics considered are home rule, the breaking down of the rule of strict construction of municipal powers, extension of the police power as illustrated by smoke and billboard ordinances, building heights regulation, zoning and excess condemnation as elements of city planning, municipal ownership of public utilities, control over living costs, municipal recreation and the promotion of commerce and industry by such means as the development of water power, advertising the city, and financial aid to private enterprises.

The book will repay reading by those who wish an up-to-date presentation of the subject indicated by its title. The reader would have been helped by a concluding chapter of a generally summary character, and also by more comprehensive summaries than are now given at the close of some of the chapters.

Theory of Landscape Design

AN INTRODUCTION TO THE STUDY OF LANDSCAPE DESIGN—By Henry Vincent Hubbard, Assistant Professor of Landscape Architecture, Harvard University; Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University. New York: The MacMillan Co. Cloth; 9 x 12 in.; pp. 406; illustrated. $6.

Earlier books on landscape architecture have passed hastily over the basic principles of design, or have taken them up piecemeal in connection with the practice of the art. This one outlines the theory on which the successful practice of the art depends. It is written primarily for the designer, and secondarily for those who wish to increase their power of appreciation of landscape and landscape design.

After a short introduction and a chapter on out-and-out theory, such topics as taste, ideals and the historic styles are taken up, with a seeming excess of abstract philosophical terms. There are then separate chapters on landscape characters, effects and composition which are less abstract than the earlier ones. The treatment then becomes still more concrete, with chapters on natural forms (ground, rock, water, as elements in design), on planting and on such structural elements as buildings, sculpture, fountains, cascades, gates, fences, roads and paths. The body of the book ends with a long chapter on types of design according to uses, including gardens, estates, land subdivisions, parks and reservations. An appendix deals with professional practice, and with procedure in design. There is a sufficiently full selected bibliography. A useful detailed index is provided.

Remarkably well chosen and handsomely presented illustrations—which really illustrate—add much to the value and interest of the volume. All the illustrations in the text, and the plates accompanying the text as well, are reproduced from pen-and-ink drawings, which always harmonize with type matter better than do half tones. The very handsome half-tone plates are grouped at the end of the volume, thus giving not only a more pleasing effect than if scattered through the text, but also facilitating reference, since the plates of both classes are so numerous and so often mentioned in the letter press as to make it impossible to place many of them opposite the text references.

The one serious drawback to the use of the volume, aside from its bulk, is the great length of the type lines, which severely try the best of eyes. In the case of such a handsome-appearing book, one hesitates to urge that a double-column page, narrower margins and smaller type would have been more serviceable to the reader, but such is the plain truth. Even with smaller type the book could be read much more easily if printed in two columns, besides which smaller type and narrower margins would have made a less bulky volume. Artistically, the book might be pronounced almost perfect, but not if the highest art—at least in the useful arts—is to fit form to function, as the elder Olmsted declared. The chief function of the printed page is to convey information quickly and easily. An overlong type measure, like the one in this volume, makes reading laborious. Mawson's "Civic Art," reviewed in these columns June 13, 1912, is a worse sinner in length of type measure by nearly two inches, besides having a less pleasing page and being a more bulky volume. Authors and publishers of books on landscape architecture and town planning might well put more restraint on their strong tendency to yield to the artistic impulse in book format. Otherwise they are liable to sacrifice convenience to appearance, thus violating one of the fundamental principles which they are trying to inculcate.

It would be a mistake to dismiss so valuable a work with even minor adverse criticism on the form of presentation. The volume is a notable addition to the literature of landscape architecture. It marks a distinct advance in the working data of an art which, most happily, is rapidly growing in theory, in practice and in public appreciation in America.

Americanization Practically Considered

AMERICANIZATION: A Discussion of Present Conditions, with Recommendations for the Teaching of Non-Americans; A Report Made by Charles H. Paull to the Solvay Process Company, Syracuse, N. Y.: Free on Application to the Company Named. Paper; 6 x 8 in.; pp. 37.

Americanization is a term which has come into wide use within the past two years to convey in one attention-compelling and inspiring word an idea of the increasingly widespread efforts which are being made to convert foreigners into worthy citizens or fit subjects of citizenship. These efforts are not new and some of them are prompted by not entirely unmixed motives, but they have been broadened, deepened, humanized and accelerated by the many new conditions and problems created or brought into prominence by the world war.

Among the most earnest and effective students and promoters of Americanization are a fast growing num-

ber of captains and lieutenants of industry. Proof of this is afforded by the interesting and valuable report noted above. The report is based on visits to industries and educational agencies in Massachusetts, Rhode Island, New York, Pennsylvania, Ohio and Michigan, and on suggestions from "experts in labor and education." Deductions from the survey, instead of the data gathered, are presented in readable form. Less than three pages is devoted to a series of 19 "recommendations for a school of non-Americans connected with the Solvay Process Company."

The report should interest a large percentage of the readers of this journal, both because of its practical relation to various engineering and manufacturing industries and because of its humanitarian and patriotic appeal. It may be had for the asking.

Unique Irrigation System Described

An extensive irrigation system in which all the water is pumped from wells, collected in redwood and in concrete pipe, passed through a concrete-lined canal, repumped, passed through a reinforced-concrete canal, and finally distributed through riveted steel pipe, is described in an irrigation ditch edition of the Lindsay (Cal.) *Gazette* of June 7. This unique system was built by the Lindsay-Strathmore Irrigation District, of which Stephen E. Kieffer, San Francisco, is chief engineer. E. C. Eaton, Lindsay, Cal., who was resident engineer for the work, is now superintendent of the system.

The Deepest Well in the World

Under the title, "The Deepest Well in the World and the Next Deepest in America," Dr. Israel C. White, state geologist of West Virginia (Morgantown, W. Va.) has described (1) a well 7386 ft. deep put down by the Hope Natural Gas Co., eight miles from Clarksburg, W. Va., and (2) a well 7248 ft. deep owned by the People's Natural Gas Co., and situated five miles from McDonald, Penn. The paper, which has been printed as an illustrated pamphlet of 22 pp., was presented by Dr. White before the Natural Gas Association of America last May. The second of the two wells described is said to be the third deepest well in the world.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

CHEMICAL AND BIOLOGICAL SURVEY OF THE WATERS OF ILLINOIS: Report for 1916—Edward Bartow, Director. Paper; 6 x 9 in.; pp. 190; illustrated.

In addition to an account of the routine work of the year, this report contains considerable data on Illinois water-supply and a number of University of Illinois theses on allied subjects. Among the theses is one by F. W. Mohlman on "The Activated-Sludge Method of Sewage Treatment." Other theses deal with bacterial purification of sewage, the effect of gashouse waste on the biochemical oxidation of sewage, and radioactivity of Illinois waters. A separate paper by W. R. Gelston gives operating results derived from the workings of the new water-purification plant at Quincy, Ill.

CITY MANAGERS' ASSOCIATION: Fourth Yearbook; Proceedings of the Society, Nov. 19-21, 1917. Achievement Reports—Auburn, Me.: The Secretary of the Association. Paper, 6 x 9 in.; pp. 126; illustrated.

Besides the proceedings of the 1917 convention this pamphlet contains portraits of more than fifty city managers, notes on "achievements" under the city manager plan, and a list of city-manager cities up to May 15, 1918, giving population, date in effect, name of manager, date of appointment and salary.

COMMISSION OF CONSERVATION, CANADA: Report of the Ninth Annual Meeting at Ottawa, Nov. 27-28, 1917—Ottawa, Canada: The Commission. Paper; 6 x 10 in.; pp. 257; illustrated.

CONCRETE ENGINEERS' HANDBOOK: Data for the Design and Construction of Plain and Reinforced Concrete Structures—By George A. Hool, S. B., Professor of Structural Engineering, The University of Wisconsin, and Nathan C. Johnson, M. M. E., Consulting Concrete Engineer, New York City; assisted by S. C. Hollister, B. S., Research Engineer, Corrugated Bar Co.; with Chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. New York: McGraw-Hill Book Co., Inc., London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 860; illustrated. $5.

CONSERVATION COMMISSION, STATE OF NEW YORK: Fifth Annual Report, 1915—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 517; illustrated.

Water-power and storage, gaging station records, decisions on water-supply applications, public lands and forests are the chief subjects reviewed in this belated report.

THE FINANCING OF PUBLIC SERVICE CORPORATIONS—By Milton B. Ignatius, LL.M. of the New York Bar, Assistant to General Valuation Counsel, New York Central Lines. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 456. $5.

This book covers a subject of which engineers generally know all too little, and the author appears to know his subject. "Capital Stocks," "Funded Debt" and "Capitalization," the three principal parts of the book, each of which is subdivided into a number of chapters, give an idea of the scope of the volume.

THE FUNDAMENTALS OF MECHANICAL DRAWING—By Richard Shelton Kirby, C. E., Assistant Professor of Drawing and Descriptive Geometry in the Sheffield Scientific School of Yale University. New York: John Wiley & Sons, Inc. London. Chapman & Hall, Ltd. Cloth; 10 x 7 in.; pp. 83; illustrated. $1.50.

Intended for first-year college work. Several hundred "drill problems in the elements are provided."

GROUND WATER FOR IRRIGATION IN LODGEPOLE VALLEY, WYOMING AND NEBRASKA—By Oscar E. Meinzer. Washington, D. C.; U. S. Geological Survey. Paper; 6 x 9 in.; pp. 69; illustrated.

HEATING AND VENTILATION—By John R. Allen, Dean of the Department of Engineering and Architecture, University of Minnesota; M. Am. Soc. M. E., and J. H. Walker, Superintendent of Central Heating, The Detroit Edison Company. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 268; illustrated, $3.

PETROLEUM, ASPHALT AND NATURAL GAS: Bulletin No 14—Kansas City, Mo.; Kansas City Testing Laboratory. Leather; 5 x 8 in.; pp. 232; illustrated. $2.

A handbook designed for "anyone interested in the production, refining, selling, uses and technology" of the materials named in the title.

SCOPE AND APPLICATION OF THE NATIONAL ELECTRICAL SAFETY CODE—Washington, D. C.; Bureau of Standards. Paper; 7 x 10 in.; pp. 84.

SOUTHERN PINE IN RAILROAD CONSTRUCTION— By Thornton A. Green, Special Representative, Southern Pine Association at Washington, D. C.: Address the Author as Above. Paper; 6 x 9 in.; pp. 34.

Preliminary result of a study undertaken to find "how the substitution of steel, concrete, etc., for wood could be checked and how the Southern pine orders by the railroads could be increased." Devoted chiefly to efforts made to increase use of Southern pine in freight cars and to specifications and dimensions for such material. There is also a brief section on laminated construction for barges. Further studies "will include timbers for trestles and general work, including material for immense car repairs that will include large orders for sills." The report was presented to the New Orleans meeting of the Southern Pine Association, May 2.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1917 – Washington, D. C.; Superintendent of Documents. Cloth; 6 x 9 in.; pp 787; 10c

SURVEY OF NORTHERN AND NORTHWESTERN LAKES; April, 1918—Detroit, Mich.: U. S. Lake Survey Office. Paper; 8 x 10 in.; pp. 513; illustrated

TEST OF A FLAT SLAB FLOOR OF THE WESTERN NEWSPAPER UNION BUILDING—By Arthur N. Talbot, Professor of Municipal and Sanitary Engineering and in Charge of Theoretical and Applied Mechanics, and Harrison F. Gonnerman, Research Associate in Theoretical and Applied Mechanics. Urbana, Ill.: University of Illinois. Paper; 6 x 9 in.; pp. 52; illustrated. 20c.

WATER-SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY: Surface Water-Supply of the United States, 1916—Nathan C. Grover, chief hydraulic engineer. Paper; 6 x 9 in. At prices named below, from Superintendent of Documents, Washington, D. C. No. 431: Part I. North Atlantic Slope Drainage Basins. C. C. Covert, C. H. Pierce, and G. C Stevens, district engineers. Prepared in coöperation with the States of Maine, Vermont, Massachusetts and New York Pp. 171. 15c.

No. 437: Part VII. Lower Mississippi River Basin. Robert Follansbee, district engineer. Pp. 47; illustrated. 10c.

No. 426: Southern California Floods of January, 1916, H. D. McGlashan and F. C. Ebert. Prepared in coöperation with the State of California. Pp. 78; illustrated. 15c

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Heavy Motor Trucks and the Highways

Sir—The editorial in *Engineering News-Record* of June 13, entitled "Sound Development of Highway Transportation," calls renewed attention to a matter, the economic and financial importance of which has been but partially recognized and appreciated by engineers, and scarcely at all by the public

The necessity that has arisen during the war for the employment of mechanical power trucks on the highways for military and commercial purposes has brought more prominently to our attention the whole subject of the use of such trucks on our roads, and should serve to impress upon our minds the importance of a thorough and prompt study of the whole subject. The enormous increase in the use of power trucks that war conditions have brought about, and the large amount of capital that has been and is being invested in their manufacture, will place the truck interests, at the end of the war, in a position of power and influence that may be difficult to control, if control shall be found necessary. The fundamental question that must be decided sooner or later will continue to be, "Shall the use of heavy power trucks on the highways be prohibited, or shall the highways be so constructed as safely to permit their general use?"

By the term "heavy power trucks," as used in this letter, I refer to trucks of a rated load capacity of more than four tons.

Our experience has now clearly shown that even our best present highways are quickly destroyed by the excessive wheel loads and high speed of these trucks, and an answer to this question ought to be found without delay. If it can be conclusively shown by satisfactory evidence that the use of these trucks on the highways is, in normal times, necessary for the accommodation and promotion of the commercial and industrial interests of the country at large, and therefore beneficial to all classes of the people to an extent that will justify the enormous expenditure required, there can be but one answer. If, on the other hand, it cannot be shown conclusively that such an expenditure will yield a reasonable profit on the investment, or if it appears that provision for the use of heavy trucks will benefit a comparatively small class at the expense of the great mass of the taxpayers who must pay for the building of our public roads, a different answer is warranted. There is undoubtedly much to be said on both sides of the question. It needs careful, scientific and economic study and investigation, which so far it has not received. The arguments presented have been mostly those of special interests, the manufacturers and salesmen of trucks, and the often ill considered views of the good roads enthusiasts. The arguments on the other side have not been fully and properly presented to the public. Particularly, the enormous cost of building highways of the character that will be necessary to withstand the traffic of heavy power trucks has not been fully realized. Such a truck, with a rated capacity of 7½ tons and its normal load, imposes a rear wheel pressure of from 16,000 to 22,000 lb. upon the road surface, compared with, say, 2000 lb. by the ordinary two-horse wagon. The wheels of the truck are also of less diameter than those of the wagon. While the solid rubber tires of the truck serve o spread the concentrated load over a larger area, and are less severe in abrading the road surface than steel tires, the unit pressure on the surface is still in excess, and the load to be carried by the foundation and subfoundation is very much greater. The higher speed of the power vehicle is also an important factor in its effect upon the road surface and foundation. I have spoken of a 7½-ton truck, but it is reasonably certain that much heavier ones will be used. If power transportation on the highways proves economical at all, the economy will obviously be increased with the load capacity of the vehicle (at least up to a certain limit), and there will be an insistent demand that the use of 10- or 12- ton trucks be permitted. In fact, many such are in use today. The arguments that have led to the constant increase in the weight and capacity of railroad cars and ships would doubtless be equally patent in the case of power trucks.

To provide a highway capable of carrying such loads without rapid deterioration would call for a roadway surface approximating that of our best city pavements, and a concrete foundation from 50 to 100% stronger and more rigid than is now found adequate for city streets.

Such a roadway 20 feet wide (and no less width would be sufficient) with its incidental items would cost at pre-war prices not less than $40,000 per mile. This does not include the reduction of gradients now considered satisfactory, which the truck interests might with good reason demand.

There are said to be more than 2,000,000 miles of public roads in the United States, of which some 235,000 miles were reported as "improved" at the end of 1914. If we assume that 8% of the whole would have to be built or rebuilt, as main or secondary roads, in order to carry out a scheme of general heavy truck use, at an average cost of $25,000 per mile, the total first cost would be $4,000,000,000, or about $40 per capita for the whole population of the country.

Now, I do not believe that the people at large who must be taxed for the cost after the war, when the country will be more or less impoverished, understand that the construction or reconstruction of our highway system, to fit it for the use of heavy power trucks, would involve anything like so great an expenditure, and there is every reason to believe that when they fully realize what it involves they will be unalterably opposed to any such scheme.

The assertion, often made, that only a very few of our main highways would have to be so improved is unsound. To serve satisfactorily the purpose of transportation, distributing and delivering their freight, the trucks must have free range. They would have frequent occasion to use the secondary and local roads, and these eventually must be designed and built with such

use in view, though not necessarily of a strength and quality equal to those of the main lines.

Arguing from the present congested condition, due to the war, of rail and water transportation, it is asserted that these agencies have broken down and can no longer furnish the facilities that our expanding business demands. Such an assertion is at least premature. It will hardly be denied that under normal conditions it is *possible* for the railroads and waterways to enlarge and extend their capacity and facilities so as to meet fully any probable demands. Their past history furnishes ample evidence that with encouragement and fair treatment they will gladly do so; their own interests impel them to do so. Business sanity should lead the country to a careful consideration of what may be done in this direction, before launching upon a scheme to spend billions of dollars for what, at best, may prove a doubtful substitute.

For it is reasonably certain that even with perfect highways and the possible improvements and economies in the construction and operation of trucks that may be expected, the trucks will never be able to compete in ton-mile cost with the railroads for hauls of any considerable distance. They will have obvious advantages for short hauls, where terminal and delivery expenses cut a considerable figure in the total cost, and where very prompt handling is important, but for this kind of service a lighter class of trucks, not exceeding three or at the most four tons capacity, will doubtless prove most economical.

If, however, it shall eventually be found that the steam railroads and the waterways are inadequate, and the highways must be resorted to, it may be worth while to consider whether the construction of enormously expensive roadways is the best solution of the problem.

One possible substitute would be the construction, along the sides of the roadways,, of light industrial railroads for the use of commercial vehicles. Most of our highways are now—or could be, readily and cheaply—graded to such width as to permit the building of a single track on each side of the roadway proper. The cost of such a single track, ample for the use of trucks up to 15-ton capacity, would probably not exceed in normal times after the war $10,000 per mile, or $20,000 per mile for the two tracks.

Assuming that the roadway for ordinary business or pleasure travel could be built for $12,000 per mile, the total first cost would still be less than that of a roadway adequate for the trucks. The truck wheels could be constructed with steel treads and flanges placed on the inner sides of the rubber tires, of such radius that they would not interfere with the operation of the trucks upon ordinary roadways, and portable switches or turnoffs could be carried, enabling the trucks to leave the rails and take to cross or diverging roads or streets where necessary. Many of these details that cannot be dealt with in a letter like this would have to be worked out carefully, but from some study of such a scheme I believe it to be practicable. Aside from first cost, there are many arguments in favor of the plan, a few of which may be briefly mentioned:

1. The roadway would be less congested and left free for its normal traffic.

2. The tractive resistance of the trucks on steel rails would be much less than on the best roadway surface, thus economizing the power to be expended.

3. The trucks could safely operate at a higher speed than on the roadway, for the reason that they would not be obstructed or delayed by the roadway travel.

4. The cost of maintaining the roadway would be reduced and its life greatly prolonged.

5. With the trucks removed from the roadway the danger of accidents to those using it should be materially reduced.

It is not unlikely, if the truck traffic promises to be anything like as large as its advocates predict it will be in the future, that private corporations might undertake to build and maintain the tracks, on the basis of a ton-mile tariff charge sufficient to make the investment profitable, while fair and reasonable to the patrons. The saving of power, the higher speed attainable and the freedom from roadway accidents would help to compensate for such charges, if they did not compensate wholly for them.

In any event it would be just and proper that the interests specially benefited by the construction and maintenance of such railroads should, directly or indirectly, bear a large share of the cost.

Whether the foregoing brief arguments and conclusions shall be deemed sound or unsound, the main purpose of the writer will be attained if this letter helps to call attention to the very great importance of the questions involved and the urgent need that they shall be discussed from an engineering and economic standpoint.

New York City. S. WHINERY.

Equal Payments to Liquidate a Debt With Interest

Sir—The method of determining the amount of equal payments to liquidate a debt with interest given in your issue of May 2, p. 871, is in error. It is based on the payment of interest on the amount paid and not, as it should be, on the amount remaining unpaid.

A proper formula for this method of payment can be deduced as follows, using the same nomenclature as in the article cited: P = principal; $p_1, p_2, p_3, \ldots p_n$, portion of principal paid with each payment; a, amount of each payment; r, interest rate for the fixed period.

The first payment will be $a = p_1 + Pr$. Each principal payment will increase by the interest on the previous payment, so that $p_2 = p_1 + p_1r$, $p_3 = p_2 + p_2r$, etc., or $p_2 = p_1(1 + r)$, $p_3 = p_2(1 + r)$, etc.

Then $p_2 = p_1(1 + r)$, $p_3 = p_1(1 + r)^2$, $p_4 = p_1(1 + r)^3$, $\ldots$ $p_n = p_1(1 + r)^{n-1}$, and

$P = p_1 + p_1[(1 + r) + (1 + r)^2 + (1 + r)^3 \ldots + (1 + r)^{n-1}$

Summing this series, we have

$$P = p_1 + p_1 \frac{(1 + r)^n - (1 + r)}{(1 + r) - 1}$$

From this p_1 can be found and $a = p_1 + Pr$ gives the value of a.

The value of a in the example given is $668.32, which gives the correct returns when actually figured by tentative payments.

L. B. MERRIAM, Civil Engineer.

West Palm Beach, Fla.

Sir—There are two rules in common use for computing partial payments, both of which may be found in

any grammar-school or business arithmetic. First there is the "merchants rule," which provides that the borrower pay interest on the principal from the date of the note until maturity, and that he be allowed interest at the same rate on all installments from the time of payment until the maturity of the note. Nothing could be more fair or just than this, each party paying at the same rate for what he gets from the other, interest being figured simple or compounded, according to agreement. The "United States rule" assumes that the interest on the entire unpaid principal becomes due at the end of each period of payment, and provides that it be first deducted from the amount of the payment, the remainder of the payment, if any, being deducted from the principal. This rule is identical with the merchants rule with the interest compounded. The United States rule is, therefore, superfluous and the merchants rule, proper form of interest being assumed (simple or compounded) correctly and completely covers all partial-payment problems.

It is interesting to analyze Mr. Shepard's development to discover the premises upon which his formula is based, the premises not being stated in the discussion. It is assumed that the reader has the original article before him. The equation

$$A = p_1 + p_1 r + p_2 + 2p_2 r + p_3 + 3p_3 r + \;.\;.\;.\; p_n$$

indicates simple interest, and the statement that the equal installments are represented by $p_1(1 + r)$, $p_2(1 + 2r)$, $p_3(1 + 3r)$, etc., is equivalent to the assumption that at the end of each period interest is due and must be paid on that part of the principal which is to be paid at that time, the interest on the remaining unpaid principal being carried over. Such a plan of payment would be unusual, and, from the writer's point of view, uncalled for. The result is some kind of a compromise between simple and compound interest.

Applying the merchants rule as given above to the example cited by the author, assuming that he intended to use simple interest, the results are as follows:

Simple interest on the principal for 29 periods at 0.5% per period = \$18,000 × 0.005 × 29 =	\$ 2,610
Principal	18,000
Amount	\$20,610

The amount of an installment of \$1 per period paid at the end of each of 29 equal periods, with simple interest at 0.5% per period $= \frac{1}{2}(1.14 + 1.00)29 =$ \$31.03.

The installment required to liquidate the debt with equal payments is \$20,610 ÷ 31.03 = \$664.196. The total payment required to liquidate the debt is 29 × \$664.196 = \$19,261.684, the net interest payment being \$1261.68. It will be noticed that the total payment required by this simple and universally used rule is less than by the proposed calculus method.

If interest is compounded at the end of each period, using the same rule, and taking formulas for compound interest from any handbook the amount of \$18,000 at 0.5% per period for 29 periods $= 18{,}000\ (1 + 0.005)^{29}$ = \$20,801.25. The amount of an installment of \$1 per period paid at the end of each of 29 equal periods, with compound interest at 0.5% per period, is $[(1 + 0.005)^{29} - 1] \div 0.005 =$ \$31.125.

The installment required to liquidate the debt with 29 equal payments is \$20,801.25 ÷ 31,125 = \$668.31. The total payment will be \$19,380.99, and the net interest, \$1380.99, as against \$1261.68 for simple interest. Ordinarily, the amount and the principal of an installment of \$1 can be taken directly from interest tables, without the use of formulas, but the writer has no table for interest at 0.5%.

It can be positively stated that economy in the payment of interest cannot be effected by inventing new methods of computation. In the present case, where the debt is to be repaid by equal installments, the amount of each installment is definitely fixed as soon as the rate and the plan of interest are agreed upon, and any correct method of computation will give the same result. It is possible, of course, to agree to some arrangement, that suggested by Mr. Shepard, for example, which will give a result intermediate between simple and compound interest, but the logic or necessity of such an arrangement is not apparent. JULIAN HINDS,

Assistant Engineer, U. S. Reclamation Service.
Denver.

[Other correspondents have offered similar solutions of Mr. Shepard's problem.—Editor.]

Use Nearby Aggregate for Concrete

Sir— While New England faces a serious coal shortage because of lack of transportation facilities, one sees a reinforced-concrete bridge under construction, the specifications of which call for trap rock for the aggregate.

This material must be transported by rail 50 or 60 miles and carload after carload (coal cars) is being unloaded for use in the bridge construction. Within an eighth of a mile of the bridge location is a ledge of as fine material for use as aggregate as ever was blasted out of the earth's crust. The use of this material would have saved the coal cars and transportation for the sorely pressed people of New England, besides saving the transportation expense and the cost of extra handling to the state.

The engineer under whose direction the specifications were drawn might have used the advantage of his position to further the cause of conservation by a practical and very public example.

A. A. YOUNG.

Jewett City, Conn.

Experiments Prove Trench Fever Spread by Lice

Scientific proof that trench fever is a germ disease, transmitted by trench lice as hosts, is given in a cablegram from General Pershing to Secretary Baker, published recently. Sixty-six noncombatants whose names and addresses are given in the cablegram, volunteered for the necessary tests, which were conducted by the Army Medical Corps. Some of these men were inoculated with blood from trench fever victims and others were subjected to bites from lice taken from trench fever cases. A large percentage of the men in both cases contracted the disease. For control purposes, a third group of men were subjected to bites from lice taken from healthy men. The results were negative.

HINTS FOR THE CONTRACTOR

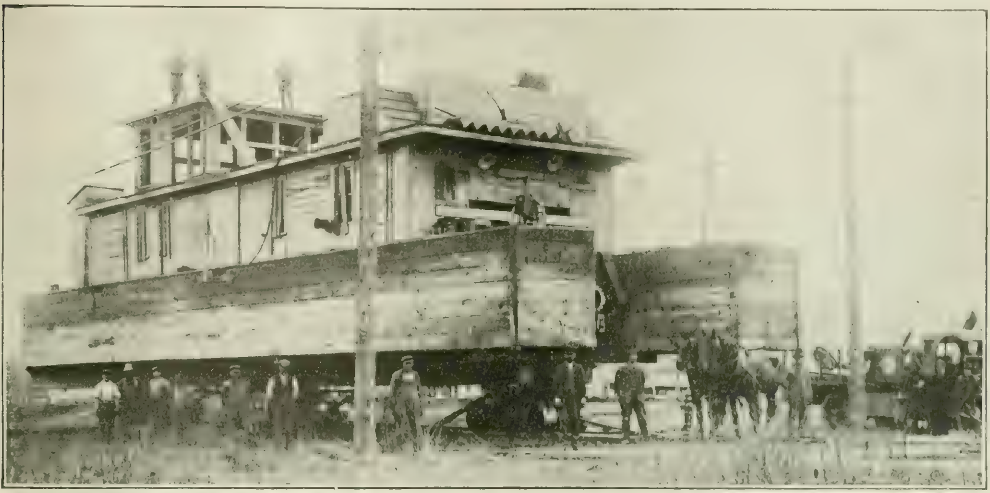
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Move 180-Ton Dredge 4½ Miles Through City Streets

OVERLAND transport of a large hydraulic dredge had to be resorted to this spring at Minneapolis, in order to save the time and money incident to dismantling and rebuilding. The Northern Dredge and Dock Co. had just completed a four-year contract for the Minneapolis Park Board, at Lake Nokomis, with an electric hydraulic dredge which it wished to use on a new contract at South St. Paul on the Mississippi River. There is no water communication between the two sites, and the company was ready to go to almost any length rather than dismantle the dredge, on account of the difficulties in getting the necessary timber, a great deal of which must be sawed specially, and in getting the timber transported after it was sawed. A special permit was obtained from the City of Minneapolis to move the dredge overland through the outlying streets, a distance of 4½ miles, and launch it in the Mississippi River from special ways at the city levee.

The dredge is 80 ft. long, 24 ft. wide and 28 ft. high. The steelwork, consisting of the A-frame gantries, spud hoist and ladder frame, was removed, reducing the weight to about 180 tons. The dredge was mounted on three trucks of eight wheels, each 30 in. in diameter and with 18-in. tires, and was moved on a track of 6 x 6 in. maple timbers with the ordinary house mover's windlass and team. The timber tracks were used over and over again, but in general lasted only about three days. The dredge was moved and launched in 38 days, the cost being about $10,000, which also covered the moving of the dismantled portions and the balance of the equipment, such as pontoons, pipe, rubber connections, etc. The machinery, motors, pumps, etc., were not removed.

In moving the dredge through the streets of Minneapolis five street car tracks and the main line of the Chicago, Milwaukee & St. Paul Ry. had to be crossed; the latter carries 72 passenger trains a day, in addition to freight trains and switching service.



THREE EIGHT-WHEEL TRUCKS CARRY 180-TON DREDGE THROUGH MINNEAPOLIS STREETS

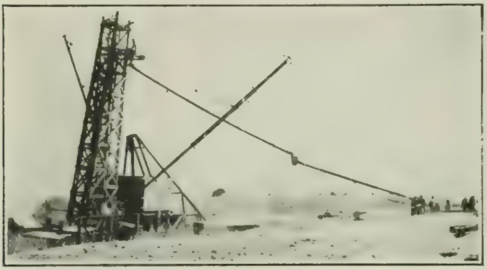
Cement Bags Tobogganed Down Roller Chutes

BAGS of cement at the concrete mixing plant for the new quartermaster's depot at Chicago are delivered 25 ft. from the conveyor head to the storage bin by board toboggans riding on roller chutes. All carrying of bags on the working floor is eliminated by this arrangement. The head of the belt conveyor which brings the bags from the car or the cement house stands about 2 ft. above the floor level and is 25 ft. from the bin top, which is covered with a grid of gas pipe. One end of the roller chute rests on the pipe grid and the other end is blocked up under the conveyor head. As the bags come up over the conveyor head they drop one by one onto 10 x 20-in. boards which a workman places on the roller chute one after another. The momentum of the bag as it shoots over the belt head sends the board tobogganing down the roller chute to land on the grid top of the cement bin. Here a workman cuts the bag tie and retrieves the board toboggan.

The grid top consists of 1-in. gas pipes laid one way across and 3 in. apart. The bags are untied where they fall and are left to drain out, eliminating nearly all emptying labor except a final shaking. The roller chute is made in 6- and 10-ft. sections of two 4 x ⅜-in. steel sides held 12 in. apart by steel rollers set like the rungs of a ladder and 6 in. apart. The rollers are 4 in. in diameter and 12 in. long and are journaled on ⅜-in. bolts through the sidepieces. The contractors for the work are the E. W. Sproul Co., Chicago, with C. W. Sproul as superintendent.

Floating Concrete Plant Builds Highway on Crown of River Levee

A FLOATING concrete plant, operating from the Sacramento River, Cal., is being used in constructing a road on Grand Island. The concrete is delivered to the subgrade through a counterbalanced swivel chute which is supported by a tower and boom. The plant,



POURING PAVEMENT SLAB FROM FLOATING PLANT

shown in the photograph, consists of a mixing barge, a derrick barge, a sand barge and a cement barge, all bound together with cables and moving along the bank as the work progresses. Materials are delivered to the construction plant by means of barges on the river.

Without rail transportation for materials and on a roadbed of deep sand, the construction problems were somewhat unusual. It was decided that the road, on the island itself, should be built on the levee, which averages 15 to 18 ft. above the adjacent tilled area and about 25 ft. above low water elevation in the river. For this location, it was found expedient to construct the pavement with the equipment mentioned above.

Before commencing the work, care was taken to see that the levee conformed to all requirements of the reclamation districts and the California Reclamation Board. A crown width of 25 ft., and slopes of three on one, for the river side, and two on one, for the water side, were approved. The elevation of the levee crown was established by the engineers of the State Reclamation Board, with a view to safety in times of extreme high water.

Having shaped up the subgrade, which consists entirely of sand, it has been found that the best method of compacting it is to soak it with water on the day previous to laying the concrete, until the water penetrates 12 to 18 in. into the sand where it meets the moisture from below. The surface is again watered heavily just ahead of the concrete crew. Under these conditions the sand subgrade will support the weight of a man almost without indentation. The large amount of water in the sand also prevents an excessive absorption of water from the concrete during the first few hours of setting.

The mixing barge, for pouring this pavement, contains a steam engine-driven hoist, winding drums and a 1-yd. mixer, bunkers for rock and sand with a combined capacity of 100 tons, cement platform and water pumps and water storage. The full capacity of the outfit was rated at 200 cu.yd. per day, which would give about 800 lin.ft. of road, but to a recent date the best day's work had been about 544 lin.ft. One of the difficulties was that the mixer had a tendency to slop over with a full charge. On this account the charge was reduced to a four-sack batch containing about 22 cu.ft., and this cut down the output.

Sand is delivered by barge from a point on the river about 15 miles north of the work, where suitable materials were found in the river bed. Tests on 1 : 2½ briquets, which were made with the sand developed over 2500 lb. per square inch in a 28-day period. The concrete mixer delivers the 1 : 2½ : 5 mix to a skip which is elevated to the top of an 80-ft. tower erected on the barge, and there dumps into a chute which delivers the concrete to the roadbed by gravity. The templet used to spread and tamp the concrete is shown in operation in the photograph. The upper section of the chute is supported and swung to position by a boom on the barge. The lower section of the chute is supported on a counterbalanced steel truss; which is attached to the upper chute by means of a swivel joint. By the use of this swivel connection, an operating radius, covering 60 ft. of road, is afforded from one position of the barge. With this arrangement, concrete can be delivered directly from the barge to the pavement along its entire length.

The work was started at the upstream end, and as it progresses the group of barges is eased downstream as required. The derrick barge is constantly unloading

DELIVERING, SPREADING AND TAMPING CONCRETE

sand and rock from delivery barges to the bunkers on the mixing barge. Cement in slings is lifted by the same derrick to the cement platform.

The highway alignment is made up of a series of very gradual curves, superelevation being provided on the sharper ones. Specifications require the concrete surface to be finished by hand with steel floats, which give practically a sidewalk finish. Two 2 x 8-in. redwood

header boards are left permanently in place at the edges of the concrete, secured by stakes and anchored to the concrete by 20-penny nails driven through from the outside.

The contract for the first section of the highway, 13.25 miles in length, was awarded to the Healy-Tibbitts Construction Co., San Francisco, at a price of $7.95 per cubic yard under terms whereby the county furnishes the cement. The pavement is 16 ft. in width and 5 in. thick. The expense of moving camp is small, as a tug and motor boat are required in connection with the work. Laborers are housed on a camp barge.

General supervision of the work rests with the Sacramento County Highway Commission, of which R. M. Morton is chief engineer. W. H. Stearns is resident engineer on the work and W. J. Graves is superintendent for the contractor.

Rock Channeler Cuts Starting Groove for Sheet Piling

A STARTING groove cut by a rock channeler permitted steel sheet piling to be sunk through hardpan overlying a sand bed, at the Junction Dam, Wellston. Mich. The purpose of the sheeting was to cut off flow of water through the sand. It was found in several places to be impossible to drive the steel piles through the hardpan by ordinary methods. Here a rock channeler was employed to cut on the line of the sheeting a groove some 10 ft. deep in which to start the piles. An ordinary quarry channeler was used. It was fitted with a longer cutter with a flat bit about 4 in. wide at the cutting edge, but otherwise the machine and the method of operation were the same as for rock channeling. The dam was built for the Consumers' Power Co., by the Fargo Engineering Co., Jackson, Mich.

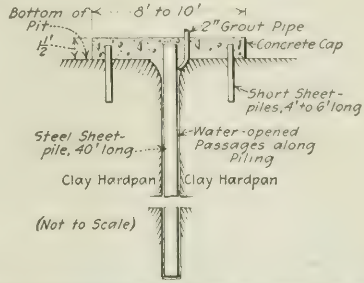
Combination Air and Water Pressure Grouting Machine Effective in Fine Sand

PRELIMINARY control and finally complete checking of artesian water rising along a line of steel sheeting at the Junction Dam, Michigan, were accomplished by a concrete cap and subsequent grout injection. Fine sand, ordinarily so difficult to penetrate with grout, was cemented by a special machine using alternately air and water pressure. Drill tests showed the sand to be well consolidated, and the result is attributed to the combined pneumatic and hydraulic method of injection.

Junction Dam is founded on a compact clay hardpan penetrated from below in places by sand strata and pockets. The sheeting consisted of steel piles driven to a depth of about 40 ft. below normal river surface to form a water stop. In driving this piling under the power house and spillway an artesian flow of water was encountered where sand strata were penetrated. The flow was considerable in volume and under some pressure, and needed to be shut off so as not to hinder construction operations and finally, of course, to seal the dam structures.

To control the flow the line of sheeting was capped with concrete anchored, as shown by the sketch, by short lengths of sheet piles set into the hardpan. While the concrete was setting the water flow was turned through pipes which were closed after the concrete had attained reasonable strength. Grout was finally injected through these pipes to close the passages opened by water along the sheeting and to consolidate the sand pockets.

Chief interest in the grouting operations lies in the machine used and the procedure of building down successive cemented strata. In the fine sand it was necessary to place the holes as close together as 3 or 4 ft. To prevent blowing out in an upward direction the



GROUT BEHIND SHEET PILE STOPS ARTESIAN WATER

grouting was worked from the top of the sand stratum downward. After saturating perhaps 1 ft. of sand with grout it was allowed to harden for a day or two. Then the cemented layer was drilled through, where necessary, and the grouting resumed. These processes were repeated until there was a seal 2 or 3 ft. thick.

The grouting machine used was designed by S. G. Hulse, construction engineer, Bedford, Penn. It differs from the ordinary tank grouting machine principally by the introduction of water pressure as well as air pressure, both controlled by valves so that varying proportions of each can be used, and so that air can be first used to expand the voids and hold them open while the grout is forced to place by water pressure. This combination of air and water injection proved remarkably effective in consolidating sand.

As has been proved frequently, the difficulty of grouting sand, especially if it contains water under pressure, is that such voids as exist are minute and the grout, on account of friction, will penetrate only a short distance from the pipe end. On this work, by using the air first, the small voids were seemingly collected by the packing of the sand into a smaller number of larger voids into which the water pressure was able to drive the cement particles. Air pressure to inject the grout was not tried, and it may be that it would serve as well as water pressure, but on this work, for some reason, the water seemed to be especially effective.

Another principal advantage found in the grouter here described was a device to prevent the balling up of more or less dried cement, which is a common trouble in grouting. This device consists of a central diaphragm horizontally across the tank. This diaphragm is perforated with numerous ¾-in. holes fitted with short brass tubes. The mixing action of this diaphragm prevents the formation of cement balls.

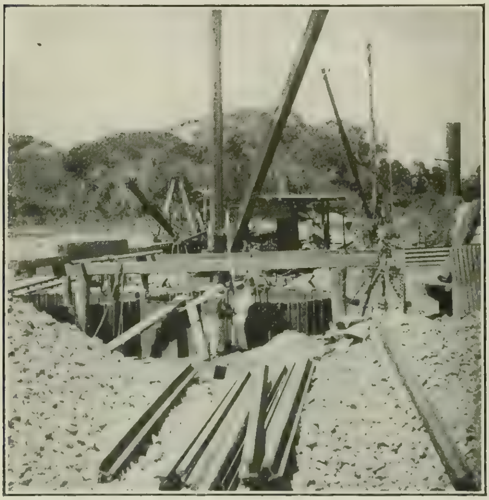
Referring to the grouting machine, the engineers for the Junction Dam state that no trouble was experienced

in keeping the machine clean, if it was washed out promptly, with water under pressure, when work was stopped for the day. The two machines used were both built for this work.

Hoops Made of Old Steel Rails Brace Circular Steel Cofferdams

By W. T. Penney
Guatemala City, Guatemala, C. A

INTERIOR hoops, made of old steel rails, were used to brace the cylindrical foundation cofferdams of the Lenta River Bridge on the International Railway Co.'s line in Guatemala, built under the writers direction as contractor. Each foundation consisted of two circular units, 15 ft. in diameter, filled with concrete, placed directly against the 7-in. steel sheet piling. The piles were driven to 48 ft. below the bed of the river. One of the foundations, driven to grade, is shown in the illustration.



STEEL SHEET PILE CYLINDERS DRIVEN TO GRADE.

The piling was in lengths of 30 and 20 ft., each pile formed of a 30 and a 20-ft. length, placed end to end. In driving, these lengths were reversed alternately in order to break the joint. Driving proceeded until the piles had reached a depth of 48 ft. below the bed of the river, penetrating the soft conglomerate rock. The piles, though light, stood the driving with steam hammers through the sand and gravel very well.

After the cylinders were driven, they were excavated with ¾-yd. orange-peel dredges, working in the water. On account of the lightness of the pile sections, internal bracing, made in the shape of hoops, was used, Bracing of any other type would have interfered with the dredges making the excavation. The hoops were made on the ground of rail sections, being bent to the proper shape and placed 5 ft. apart vertically as the excavation proceeded. When the hoops were being placed it was necessary to unwater the cylinders, one 6-in. pulsometer pump being sufficient to handle the water. The first hoop was suspended with a ¾-in. rod from the top of the cylinder and lower ones were suspended from one another in the same manner. After they were placed they were wedged lightly with the cylinders. Excavation proceeded to within 5 ft. of the end of the sheet piling, at which point concreting commenced.

The excavation having been made, the cylinder bottom was sealed with about 5 ft. of concrete and left overnight to harden. The concrete for sealing the bottoms was lowered into the water by especially constructed bottom dump baskets, and when it had hardened sufficiently the water was pumped out. As the concreting proceeded the internal hoop bracing was removed, the hoops being used in other cylinders; bracing enough for two cylinders was sufficient for the entire work. The sand for the concrete was taken from the interior of the cylinders, but the crushed rock was brought from a quarry nine miles from the bridge, no gravel being found in the river bed and very little in the cylinders.

Bridge Abutment Unwatered by Siphon

IN THE reconstruction of an abutment of a bridge at Lilio, Laguna Province, P. I., a long siphon made up of old artesian well drive-pipe was improvised to unwater the leaking cofferdam, according to information received from W. C. West, acting chief constructing engineer of the Bureau of Public Works of the Philippines. The river is a mountain stream with a rapid fall, and carrying a considerable flow. Its bed is composed of boulders and sand with very little gravel, and the percolation under the sand-clay cofferdam was such that a large gang of bailers had to work for hours every morning before any excavation could be made. No pumps had been provided, because the footings were to be carried only a short way below the river bed and water trouble was not anticipated.

The siphon was made up of an old 4-in. pipe which happened to be in the neighborhood. Its extreme length permitted the extension of the lower end downstream to an outlet below the level of the bottom of the abutment excavation. The 9-ft. upper leg was formed by heating and bending a length of the pipe. The siphon was started by lifting the upper leg and filling it with water by means of buckets, the outlet having meanwhile been closed by an improvised valve. The contrivance worked perfectly, unwatering the excavation in short order. By adjusting the foot-valve to limit the flow to the volume of the seepage, the water was kept easily within the sump into which the upper leg of the siphon was led.

An Effective "No Smoking" Notice

In a wooden shipyard of the Northwest, where 3000 men are working on rush schedule, it is important to impress on them the danger of breaking the rule which absolutely prohibits smoking. This is acomplished by a sign placed just inside the workmen's entrance, which reads, in large flaming letters: FIRE in this plant may put every man out of work. Help the management protect your job. NO SMOKING!

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Ask Rail Administration to Reconsider Rates

Highway Societies Request that Freight Increase on Road Materials Do Not Exceed 25%

Following an informal conference in Washington on July 10, the executive committees of the American Association of State Highway Officials and of the Highway Industries Association adopted a petition, which was presented by the committees to the Railroad Administration the following day, asking that order No. 28, which placed flat-ton freight rate increases on cement, brick, stone, sand and gravel, be modified so that a straight increase not exceeding 25% would apply. The petition presented reads as follows:

"The executive committee of the American Association of State Highway Officials and the executive committee of the Highway Industries Association, representing respectively all the state highway departments and National Association of Sand and Gravel Producers, National Slag Association, National Crushed Stone Association, Portland Cement Association, National Paving Brick Manufacturers' Association, National Association of Asphalt Block Manufacturers, in conference, represents:

"1. That the flat-ton rates presented by the Director General's order No. 28 imposes upon certain commodities—to wit, cement, brick, stone, sand and gravel, and other road materials—an undue and unjust proportion of the increased transportation cost;

"2. That said order imposes unequal, unjust and inequitable freight charges upon all materials used for highway construction, and unless modified and reformed so as to make said rates both equal and just will interfere with further road improvement throughout the entire country;

"3. That it is an obligation of the Government to distribute the transportation tax so that it will bear equitably on commodities and localities;

"4. That if a straight increase of 25% in commodities generally be fair it is unjust to select certain commodities and impose upon them increases ranging from 50 to 500 per cent;

"Wherefore, supplementing petitions already presented, we pray the Director General of Railroads that General Order No. 28 be modified so as to apply a straight increase of not exceeding 25% on road-building material.

"We further pray that the carriers under the Director General's control be authorized to refund on shipments moving subsequent to June 24, 1918, all charges collected in excess of 25 % above the previously existing rates."

In addition to this resolution, the committees urged relief for contractors who had entered into contracts for work prior to the promulgation of the recent freight advance orders, calling attention to resolutions adopted by the Highway Industries Association and previously presented to the railroad administration.

On receiving the petition, the representative of the Director General of Railroads advised the committees that the portion of the appeal asking relief for contractors could not be considered, and that there could be no distinction between contractors holding contracts executed prior to the promulgation of the increases and those holding contracts executed later. If any relief is secured it must be for a reduction in the rate itself or through state, county or municipal authorities. Decision on the main petition has not yet been rendered.

Joint Highway Convention Arranged for October

Arrangements have been made by the American Association of State Highway Officials and the Highway Industries Association under which the two organizations will hold a highway convention in the week beginning Oct. 6. The highway officials will hold their own meetings in the early part of the week and will then join with the Highway Industries Association in joint sessions for the discussion of papers and the highway situation generally.

Chicago is under consideration as the place of meeting, but announcement as to the place will be made later.

St. Louis Wants Bids for Garbage Disposal by Reduction

Bids for garbage disposal by reduction will be received Aug. 6 by the Board of Public Service of St. Louis. The city will collect the garbage and deliver it to two loading stations provided by the contractor. The plant must have a capacity of 400 tons a day and be located not nearer than a half mile to the city limits. The present contract will expire Sept. 1, 1920. The garbage of St. Louis is now disposed of by reduction in a plant owned by the Sanitary Reduction Co., whose contract expires Sept. 1. About 200 tons a day are now handled. The new bids will be on a tonnage basis. The United States Food Administration has urged that the proposals be for reduction rather than hog feeding, since a reduction plant is already in existence and glycerine, grease and tankage are so much needed.

Student Training Corps Plans Complete

Combined Military and Intellectual Instruction Open to Young Men Not Under 18

Details of the plan prepared by the War Department to offer to able-bodied college students over the age of 18 the opportunity to enlist in the military forces of the United States and to obtain training in the colleges which will prepare them for the more exacting forms of military service have now been completed. The plan was briefly described in *Engineering News-Record* of May 23, p. 1017.

The plan is an attempt to mobilize and develop the brain power of the young men of the country for those services which demand special training. Its object is to prevent the premature enlistment for active service of those men who could by extending the period of their college training multiply manifold their value to the country. If, however, the need arises for the services of these men in the fighting line, the terms of their enlistment are such that they can be called by the President on a day's notice. For the present it will be the policy of the Government to keep them in training until their draft age is reached.

War Department's Announcement

Commenting on the importance of special training, the War Department, in a recent announcement, says:

"This is a war in which soldiers are not only marksmen, but also engineers, chemists, physicists, geologists, doctors, and specialists in many other lines. Scientific training is indispensable. Engineering skill is needed by the officers who direct every important military operation and who control our lines of transport and communication. In the same way chemical and physical knowledge are in constant demand at the front as well as behind the lines, while the task of saving the lives and restoring the health of hundreds of thousands of wounded calls for the services of regiments of military physicians. The scientific training which prepares a man to fulfill one of these highly specialized duties and the more liberal training which helps to develop the qualities of leadership needed by the officer or administrator are essential elements of military efficiency."

For the purpose of developing men who shall have this combination of military and intellectual training the new corps has been created—to be called the Students' Army Training Corps. Voluntary enlistment in this corps is open to all able-bodied students in the in-

stitutions of collegiate grade who are not under 18 years of age. Students under 18 cannot be legally enlisted, but they may enroll and thus receive military training until they reach the age when they can legally enlist.

Training units will be organized in accordance with the needs of the army and the character of the institution. Most of them will be infantry units, though some schools will have heavy artillery and light artillery courses. There may be one or more cavalry units. Schools of medicine and engineering, to a limited number, will have specialized technical units.

Those Enrolled to Be Equipped by War Department

The boy who enlists in the Students' Army Training Corps will be a member of the army of the United States. He will be provided by the War Department with uniform and equipment, but will be on furlough status and will not receive pay. He will undergo regular military training as a part of his course during the college year, will attend a six weeks' camp for rigid and intensive military instruction with a private's pay, and will be subject to the call of the President for active service at any time, should the exigencies of the military situation demand it. The policy of the Government, however, will be to keep members of the corps in college until their draft age is reached, and the War Department will have the power to order such men to continue in college even after their draft age is reached whenever their work is such that the needs of the service—e.g., for doctors, engineers, chemists and the like—are such as to make that course advisable.

The Students' Army Training Corps will be administered by the committee on education and special training of the War Department, which will function as a section of the training and instruction branch of the war plans division of the General Staff. Competent officers and noncommissioned officers will be assigned to the various institutions to carry on the work of military instruction. To supplement the officers assigned by the War Department three special summer training camps are being held to train a limited number of picked students and members to assist in the work of military instruction.

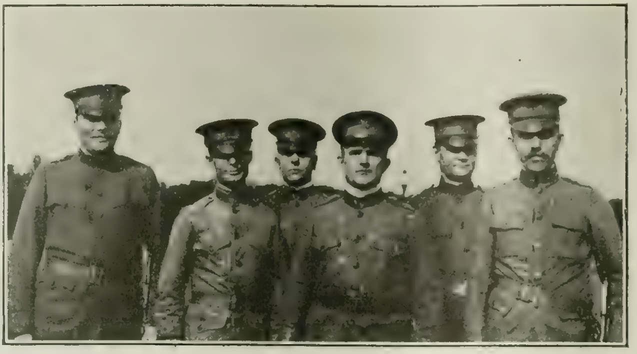
These camps will be held at Plattsburg, N. Y., Fort Sheridan, Ill., and Presidio, Cal., for sixty days, beginning July 18.

Concluding the statement already referred to, the War Department says:

"The importance of this plan for combined military and collegiate training, if we are to meet in the future the urgent needs of the army for highly trained men, is so great that the War Department earnestly requests the colleges, councils of defense and other patriotic societies to coöperate in bringing it to the attention of the young men of the country and in urging them to do their part to make it a success."

Construction Division Engineers Reviewed by Their Chief

Concluding their drill for the season, the officers of the construction division of the War Department were reviewed July 11 by their chief, Brig. Gen. R. C. Marshall, Jr. Approximately 150 men, ranging in rank from lieutenant to major, were in line. As was to be expected from a group of men of such intelligence, the officers displayed remarkable proficiency in drill work and showed to advantage at the review. Those in the reviewing body were, in addition to General Marshall, Cols. Peter Junkersfeld, F. M. Gunby, J. N. Wilcutt, Evan Shelby, J. H. Alexander and Lieut. Col. Philander Betts. All of them except Col. Betts are shown in an accompanying picture taken just before the review.



OFFICERS OF CONSTRUCTION DIVISION, WAR DEPARTMENT

This picture was taken just before the review last week. From left to right the officers are: Colonels J. H. Alexander, F. M. Gunby, J. N. Wilcutt; Brig. Gen. R. C. Marshall, Jr.; Colonels Evan Shelby, Peter Junkersfeld.

Coroner's Jury Blames City For Fatal Collapse

Alleging contributory negligence on the part of both the builder and of the city building department, the coroner's jury looking into the collapse of the building under reconstruction at Sioux City, Iowa, on June 30, in which 38 persons were killed, has made some very radical recommendations as to the future conduct of the city's building department. As noted briefly in *Engineering News-Record* of July 4, p. 56, the building, occupied by markets and stores, collapsed in the middle of the day when a large number of customers were inside, and subsequently caught fire, with the fatal result indicated. The structures were very old and, according to the coroner's report, had brick walls in a state of disintegration, both the brick and the mortar being in very weak condition. The repairing consisted in cutting floor joists, lowering floors and attempted underpinning.

The coroner's jury found that the building inspection department made only a casual examination of the work, demanded no plans or specifications, and took the word of the contractor as to its safety. The jury has, therefore, recommended that fixing the responsibility for the deaths be undertaken by a grand jury and that "the council of the city revise its building ordinance at once in such a way as to provide for a rigid inspection of all buildings by thoroughly competent, technically educated and experienced inspectors, and revise its present methods of building inspection."

The city had a change of administration last January, and it is freely charged in the newspapers that the city building department was made the plaything of politics.

Fast Freight Service Opened On New York Barge Canal

Through freight service with all the commercial machinery common to railway freight service has been initiated by the United States railroad administration on the New York State Barge Canal, the operation of which the Government took over some months ago. A triweekly fast freight carload and less-than-carload service has gone into effect between New York and Buffalo, serving Albany, Troy, Amsterdam, Little Falls, Utica, Rome, Syracuse, Rochester, Lockport, Tonawanda, Niagara Falls and Buffalo. Ten deck-loading power freighters and two covered barges were acquired to form the nucleus of a new fleet. As the traffic develops and the demand for additional equipment arises, the service will be extended to other points and additional vessels acquired. Freight agents have been appointed and will be located at each of the above-named ports.

Uniform bills of lading, naming all the conditions and liabilities accepted by rail lines, will be issued and freight will be accepted subject to the rules and regulations relative to ratings, packings, etc., that are prescribed by current classification. Tariffs have been issued naming class and commodity rates between all points to be served. The rates, as noted in these columns some weeks ago, are the old railroad rates,

which are about 25% less than the present railroad rates. Tariffs will also be issued naming joint rates with connecting carriers, both water and rail. For the present the new boat line will operate only between Albany and Buffalo, transfer being made at Albany to the Hudson River Line.

As a part of the new freight service the Government has had built a 50-ft. spur at Troy, which connects the tracks of the Boston & Maine R.R. with the warehouse and dock of the barge canal at that point. This is the first actual track connection between railroad and canal, and will permit the ready transfer of freight between these two carriers. The railroad administration is also building trestles at Ithaca on Lake Cayuga and Watkins on Lake Seneca, which can be used in loading barges with coal from the accessible fields.

Federal Government Takes Over New Jersey Canals

Another canal system has been added to the inland waterways now operated by the Federal Government. Under date of July 10 the Director General of Railroads issued an order, effective July 15, making G. A. Tomlinson, now general manager of the New York canal section of the United States railroad administration, general manager of New York and New Jersey canals. The effect of the order is that Mr. Tomlinson, in addition to operating the New York State Barge Canal, will operate for the Director General upon the Delaware and Raritan Canal and connecting waters such equipment as the United States railroad administration now has in its possession and control engaged in such operation and such additional equipment as may be assigned for that purpose. He receives the same powers of administration on the Delaware and Raritan Canal as he already has on the New York State Barge Canal.

The Delaware and Raritan Canal connects the Delaware and Raritan Rivers, is 44 miles long and has a navigable feeder, 22 miles additional. Up to the time the United States Government took over the railroads it was leased to the Pennsylvania R.R. and was little used. It is now intended to make it a working waterway between New York and Philadelphia, with a daily freight service, and as soon as possible proper equipment will be purchased and installed to that end.

Bids for Laying 72-In. Steel Water Pipe Wanted

Jersey City wishes bids until July 27 for laying the 34,590 ft. of riveted steel pipe between its Boonton reservoir and Watchung tunnel, noted in *Engineering News-Record* of July 11, p. 102. M. I. Fagen is director and C. A. Van Keuren is chief engineer of streets and public improvements. Clyde Potts, 30 Church St., New York City, is consulting engineer for the work.

Form United States Housing Corporation

Organization Similar to Fleet Corporation Created to Take Care of the Housing Operations

Following the precedent established by the United States Shipping Board in founding the Emergency Fleet Corporation, the United States Housing Corporation has been created to take over the functions now being performed by the bureau of industrial housing and transportation of the Department of Labor. A charter was taken out under the laws of the State of New York and the articles of incorporation provide for the issuance of 1000 shares of stock without par value. The executive officers of the corporation are, President, Otto M. Eidlitz; vice president, Joseph D. Leland; treasurer, George G. Box; secretary, Bert L. Fenner. These four, in conjunction with A. B. Kerr, John W. Alvord and William E. Shannon, serve as directors. The stock is held on behalf of the Government and the Secretary of Labor, who is credited with 998 shares, Mr. Eidlitz and Mr. Box having one share each. All of these men have been connected with the bureau of industrial housing and transportation of the Department of Labor.

The urgent deficiency bills just passed carry an appropriation of $60,000,000 for housing. This is the money which was authorized in a previous bill, $10,000,000 of which is to be used in the City of Washington, but the appropriation was not carried in the first act. In a later bill $40,000,000 more was appropriated, making a total of $100,000,000 to be expended by the Housing Corporation.

Scope of War Department's Education Committee Enlarged

When the committee on education and special training of the War Department was authorized last February its purpose was designated as that of "organizing and coördinating all of the educational resources of the country with relation to the needs of the Army." Under its authorization the committee has organized the training courses for mechanics, and is now forming the students' army training corps (details of which will be found on page 149 of this issue.

On June 28 the order creating the committee was amended, defining more particularly its scope. While its function originally defined covered theoretically all educational work of the War Department, actually there were instructional amendments of the orders; changes have been made in the draft regulations bringing the enlisted reserve corps under the committee. The amended order reads as follows:

"The Committee on Education and Special Training shall hereafter function as a section of the training and instruction branch, war plans division of the General Staff. Its functions shall be: To study the needs of the various branches of the service for skilled men and technicians; to administer a system of special training in colleges, schools and industrial plants; to represent the War Department in its relations with the educational institutions of the country; to supervise and administer military training in all colleges and civil institutions; to supervise and administer the furlough or enlistment in the enlisted reserve corps of technical students and teachers, in accordance with the provisions of Section 151 of the selective service regulations. The committee will be given such additional assistance, commissioned and civilian, and such additional office space, as may be necessary for the proper execution of its duties. The advisory civilian board appointed by the Secretary of War composed of representatives of educational institutions will continue to be associated with the committee."

Recommend Garbage Utilization in San Francisco

Garbage utilization at San Francisco has been recommended by a committee of five city officials, including E. P. Jones, assistant city engineer and Dr. William C. Hassler, health officer. The committee advises that householders be required to separate garbage from other city refuse; that the disposal of the material thus separated be by contract; and that bids for the work be invited. The plan of the committee appears to contemplate a single contract for disposal, under which the contractor would utilize the garbage by reduction or by feeding to hogs and would very likely burn the refuse, or at least the noncommercial portion of it, at the new incinerator, owned by the city. The committee advises that hotels and restaurants be permitted to continue to dispose of their garbage privately, but one member of the committee dissents from this proposition on the apparent ground that the city should get the benefit of the value of the hotel and restaurant garbage.

Drainage Contractors Appeal for Relief from Increased Costs

The Levee and Drainage Contractors' Association has issued an appeal for the relief of drainage contractors throughout the country, either through an increase in prices on pre-war contracts or entire suspension of all work being done at a loss and which was entered into before the present conditions of extremely high prices and shortage of both labor and materials. At the same time the association states that it is not the desire of its members to make any profit on pre-war contracts, but that it is desired only to obtain an increase sufficient to equal the added cost of completing work undertaken previous to present conditions.

In speaking of retained percentage ranging from 10 to 20% on contracts until they are entirely completed, the association states that this practice forces the contractor constantly to seek additional funds with which to carry on his work, and as the banks have restricted their lines of credit, especially to drainage contractors, on account of the dangerous conditions confronting them, it is almost impossible for contractors to borrow additional funds with which to complete work. It is pointed out that while the retained percentage in some instances is a statutory requirement, it can be offset by allowing advances on material and supplies which must be accumulated far in advance of their needs to enable contractors to continue the work, since present conditions will not permit definite assurance of shipments by producers.

Niagara Power Insufficient for War Needs

Both Water and Steam Sources Being Increased and Available Power Allotted by Government

War industries centering around Niagara Falls and Buffalo and extending into western New York are using all the available power there and are forcing increases both in the hydro-electric and steam-power plants. A recent report to the Secretary of War by Gen. C. Keller and Robert J. Bulkley, who have been supervising the supply of electrical power in western New York for the Government, gives the details of the allotting of power to various companies, mainly on the basis of the essential nature of the industries.

The two American hydro-electric plants at Niagara Falls were taken over by the Government in December, 1917, and their power distributed under Federal order to essential industries. One of the plants, during the past winter, devoted 74% of its power to direct war industries and 12% to transportation; of the remaining 14% only 2% went to really nonessential interests. The other company had 97% in direct war industry. In some cases power users deprived of power changed their product to one essential to the war and received power.

Regarding shortage in this district the report says:

"Under war conditions the power supply falls short of the demand by about 200,000 hp. This estimate is not based on new industries coming into the district, but is determined as the amount of power which could be absorbed by the industries now operating, were such a supply available. A large part of this amount would be absorbed without the addition of new industrial equipment by the users.

"Some of this shortage will be relieved next Fall by the proposed enlargements of the steam plants of the Buffalo General Electric Co. and the Niagara, Lockport and Ontario Power Co. These two companies are now making additions to their plants aggregating 62,000 hp. By means of a further development by the American hydro-electric power companies at Niagara Falls their existing supply of power, amounting to about 250,000 hp. will be increased by about 160,000 hp."

Work has already been started on the 66,000-hp. addition to the Hydraulic Power Co., on the American side of the Falls. Two 33,000-hp. units are to be installed at present, and in future, if permission for use of more water can be had, this will be increased to ten such units, making a total capacity, with the present units, of 450,000 horsepower.

In Canada the Ontario Power Co., now under control of the Hydro-Electric Commission of Canada, is being increased 50,000 hp., the increase to be available before the beginning of 1919. The Chippawa development of the Commission is well under way though its completion is two years in the future This plant is to have four 50,000-hp. units now and may have 100,000-hp. units, the largest ever attempted.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The Pacific Highway Association of North America elected the following officers at the recent meeting in Maryhill, Wash.: President, Samuel Hill; executive officer, J. C. Potter, Portland; senior vice-president for Washington, E. A. Stuart, Seattle; for Oregon, Simon Benson, Portland; for California, Mrs. A. B. Spreckles, San Francisco, and F. W. Jackson, San Diego; for British Columbia, A. E. Todd, Victoria, and F. R. MacD. Russell, Vancouver; for Alaska, Falcon Joslyn, Fairbanks; for Yukon Territory, Alfred Thompson, Dawson; for Arizona, Dr. J. A. Ketcherside, Yuma.

The Michigan State Good Roads Association will hold its convention Sept. 2-4 at Detroit in conjunction with the state fair. A road school will be conducted the first day by F. F. Rogers, state highway commissioner, for the 2200 county and township road commissioners. The second day will be exhibit day, and papers will be presented on the use of machinery and materials. National speakers and foreign army engineers will be on the third day's program, while it is hoped to stage road building exhibits on a stretch of road in the fair grounds the fourth day. In the interest of a full exhibit of machinery, priority arrangements have been made with the Government to transport goods within the state one way free of charge. Willard M. Bryant, Kalamazoo, is field secretary of the association.

The Engineers' Club of San Francisco heard a talk on "Italy and the War," by Lieut. Bruno Roselli of the Italian Army, at its meeting on July 9. Lieutenant Roselli spent two years at the front.

The Engineers' Club of Columbus, Ohio, on June 28 discussed the future water supply of the city. Prof. E. F. Coddington, chairman of a committee on civic activities, presented the results of his investigations in graphic form. A committee on Americanization was appointed to coöperate with the Chamber of Commerce.

The Houston, Tex., Engineers' Club was addressed by E. E. Sands, city engineer of Houston, at the meeting of July 11. Mr. Sands spoke at length on "The Relation of the Engineer to the Public."

The Chicago Engineers' Club was addressed July 11 by William H. Blood, Jr., of Stone & Webster, on "The Construction of the Hog Island Shipyard," Mr. Blood addressed the weekly noonday meeting of the Chicago Association of Commerce on the same subject July 10.

The Washington State Association of County Engineers will hold its 14th annual convention in Seattle on July 24, 25 and 26, at the same time as the 12th annual convention of the Washington State Association of County Commissioners. There will be joint sessions of the two organizations as well as separate meetings.

The Detroit Engineering Society will hold its next meeting Aug. 10 It will consist of an inspection trip to the Ecorse plant of the Great Lakes Engineering Works, engaged in shipbuilding work for the Emergency Fleet Corporation. The arrangements for the trip are being made by George B. Turnbull of the executive committee of the society and a list of all members expecting to be present will be submitted to the Emergency Fleet Corporation officials for approval.

The Rochester, N. Y. Engineering Society held a special meeting July 8, at which an appeal for members to serve the Rochester district of the ordnance office production division of the War Department was made through Alfred M. Mosscrop, production manager of the local ordnance division. Sergeant Major Charles L. Haslett, British Royal Flying Corps, gave an il-

lustrated talk on "Aërial Photography." The illustrations showed the arrangements of trenches and the effect of high explosives. Sergeant Major Haslett is now an instructor at the United States School of Aërial Photography at Kodak Park, Rochester.

Personal Notes

J. Harold Rapp and Bernard Summer, Pittsburgh, have formed the firm of Rapp & Summer, structural engineers, with offices in the Fulton Building.

E. A. Hadley, chief engineer of the Missouri Pacific R.R., has been appointed engineering assistant to the Federal director of the Southwestern region, with headquarters at St. Louis.

H. R. Carpenter, assistant chief engineer of the Missouri Pacific R.R., has been appointed chief engineer of all the lines reporting to Federal Manager A. Robertson.

Professor Horace R. Thayer of the department of structural engineering, Carnegie Institute of Technology, Pittsburgh, has been elected as the first president of the newly organized Authors' Club of Pittsburgh.

E. F. Mitchell, chief engineer of the Texas & Pacific Ry., has been appointed chief engineer of that line and the other lines under the jurisdiction of Federal Manager J. L. Lancaster.

J. H. O'Neill, general superintendent of the Great Northern Ry. lines west of Troy, Mont., has been appointed terminal manager in charge of all terminals between and including Everett and South Tacoma, Wash.

Howard Elliott, who left the presidency of the Northern Pacific Ry. in 1913 to become president of the New York, New Haven & Hartford R.R., has returned to the Northern Pacific as president. He succeeds J. M. Hannaford, who resigned to become Federal manager.

J. M. Weir, chief engineer of the Kansas City Southern Ry., has been made chief engineer of that line and all others under the jurisdiction of Federal Manager J. A. Edson.

E. B. Temple, who has been assistant chief engineer of the Pennsylvania R.R. since 1906, has been appointed engineering assistant to C. H. Markham, regional director of the Allegheny region, United States railroad administration. Mr. Temple was graduated from Swarthmore College in 1891, and entered the service of the Pennsylvania R.R. the same year as rodman.

J. M. R. Fairbairn, assistant chief engineer of the Canadian Pacific Ry., who has been appointed chief engineer, as mentioned in *Engineering News-Record* of last week, p. 104, was born in Peterborough, Ont., in 1873. He was graduated from the University of Toronto in 1893. Following brief private practice in British Columbia, Mr. Fairbairn entered the engineering department of the Canadian Pacific Ry. as a draftsman at Winnipeg, where he served for two years. Later he was resident engineer at Place Viger, Montreal, assistant engineer at Toronto, assistant engineer maintenance of way at Montreal, and division engineer at Toronto. In February, 1911, he became assistant chief engineer.

J. M. R. FAIRBAIRN

W. A. James, engineer of construction of the Canadian Pacific Ry., has been made assistant chief engineer, with office at Winnipeg, succeeding J. M. R. Fairbairn. Mr. James has been with the Canadian Pacific Ry. since 1898, successively as assistant engineer, locating engineer, division engineer and engineer of construction.

W. F. Turner has been appointed division engineer of the Southern Pacific Co. at Ogden, Utah, succeeding Otis Weeks, who has entered other Government service.

H. S. Shorey, formerly assistant county engineer of Grays Harbor County, Washington, has been appointed county engineer to fill the vacancy created by the death of George D. Robertson.

J. L. Thayer, deputy county engineer of Lincoln County, Washington, has resigned to become associated with F. W. Anderson Mortgage & Investment Co. of Spokane. Mr. Thayer has served two terms as county engineer of Lincoln County, and has been deputy in the office for the past three and a half years.

H. R. Pratt, recently chief engineer of the Western Maryland Ry., has been appointed engineer maintenance of way, with headquarters at Hagerstown, Md.

R. N. Begien, general manager of the Baltimore & Ohio R.R., and before that chief engineer, has been appointed operating assistant to the Federal manager.

R. D. McKeon, acting assistant division engineer of the Pennsylvania R.R., Western Lines, has been appointed division engineer at Fort Wayne, Ind., succeeding Guy Scott, who has entered military service.

Frederic A. Delano, mentioned in *Engineering News-Record* of July 4, p. 60, as having tendered his resignation as a member of the Federal Reserve Board, to accept a commission in the Corps of Engineers, has received a commission as major.

Horace H. Esselstyn has left his work at Hog Island as resident engineer for the Emergency Fleet Corporation of the United States Shipping Board to become commissioner of public works of the City of Detroit. Mr. Esselstyn succeeds George H. Fenkell, who resigned to become civil engineer for the Water Works Bureau, as mentioned in *Engineering News-Record* of May 16, p. 977.

I. A. Cottingham, special engineer of the Texas lines of the Southern Pacific Co., has been appointed chief engineer of the Texas lines, with office at Houston.

V. K. Hendricks, assistant chief engineer of the St. Louis-San Francisco Ry., has been made chief engineer of all the territory of L. Kramer, Federal manager.

Virgil G. Marani, consulting engineer and head of the information and promotion department of the United States Gypsum Co., has become chief engineer for the Gypsum Industries Association. Mr. Marani was graduated from the civil engineering department of Toronto University in 1893, and in the following year was engaged with Mann & White on canal work in Buffalo. Later he became sanitary engineer for Cleveland and from 1896 to 1906 was construction engineer for the Cleveland Gas, Light & Coke Co., after which he entered private practice, remaining until 1910, when he became building commissioner

for Cleveland, in which work he specialized in the matter of building codes. For the past five years he has been consulting engineer for the United States Gypsum Co., specializing in gypsum products.

F. MERRITT, chief engineer of the Gulf, Colorado & Santa Fe Ry., has been appointed chief engineer of that line and all the others under the jurisdiction of J. S. Pyeatt, Federal manager.

ALEXANDER BRESTH, formerly of the Massachusetts State Department of Health, has been commissioned as second lieutenant in the sanitary corps of the National Army.

RICHARD L. O'DONNELL, assistant general manager of the Pennsylvania R.R. since August, 1917, and previously general superintendent of the Western Pennsylvania division, has been appointed general manager, with headquarters at Philadelphia, succeeding Elisha Lee, appointed Federal manager. Mr. O'Donnell entered the service of the Pennsylvania R.R. in 1883 as a rodman, and was successively assistant engineer in the principal assistant engineer's office, assistant supervisor, supervisor of Altoona yards, assistant division engineer and division superintendent. In 1903 Mr. O'Donnell was appointed general superintendent of the Buffalo and Allegheny Valley division, and in 1911 general superintendent of the Western Pennsylvania division, from which position he was promoted to assistant general manager in August last year.

C. S. KRICK, general superintendent of the New Jersey Division of the Pennsylvania R.R., has been appointed assistant general manager, with headquarters at Philadelphia, succeeding Richard L. O'Donnell, who has become general manager, as mentioned immediately above. Mr. Krick entered the engineering department of the Pennsylvania R.R. in 1887, and worked up in the usual way, serving successively as rodman, instrument man, assistant supervisor, supervisor, assistant engineer and principal assistant engineer, from which position he was transferred in 1907 to the superintendency of the New York Terminal division, which was combined with the Hudson division to form the Manhattan division. In May, 1916, he was appointed general superintendent of the New Jersey Division.

ROBERT V. MASSEY, general superintendent of the Eastern Pennsylvania division of the Pennsylvania R.R., has been appointed general superintendent of the New Jersey division, succeeding C. S. Krick, who becomes assistant general manager, as mentioned in these columns. Mr. Massey entered the engineering department of the Pennsylvania R.R. in 1892, and after successive promotions he became division engineer of the Schuylkill division in 1907. He was later appointed division engineer of the New York division, and in 1914 was made superintendent of the Manhattan division.

N. W. SMITH, superintendent of the Middle division of the Pennsylvania R.R., has been promoted to be general superintendent of the Eastern Pennsylvania division, with headquarters at Altoona, succeeding Robert V. Massey, transferred to the New Jersey division, as mentioned in these columns. Mr. Smith entered railroad service with the Philadelphia & Erie in 1893, serving successively as assistant supervisor, supervisor and principal assistant engineer. In 1907 he became division engineer of the Middle division, and was appointed superintendent of the Central division in 1910. Subsequently he was transferred to the Middle division.

GUY G. HARVEY has resigned as county engineer of Lincoln County, Washington, to become construction engineer for the board of commissioners. He will continue to have charge of the work coming under the jurisdiction of the county engineer, and the vacancy will not be filled until after the fall election.

M. C. BYERS, recently assistant to the president of the Western Maryland Ry., has been made general manager of that road, the Cumberland Valley R.R. and the Cumberland & Pennsylvania R.R., with headquarters at Hagerstown, Md. Mr. Byers was chief engineer of the St. Louis-San Francisco Ry. from 1909 to 1913.

CAPT. A. F. PILLSBURY, district officer of the United States Shipping Board at San Francisco, has been appointed general manager of the San Francisco district, with full control of all Emergency Fleet Corporation shipbuilding operations in that district The new appointment, made by Charles M. Schwab while in San Francisco, carries with it authority to apportion steel to the various shipyards.

W. H. WELLS, chief engineer of construction of the Southern Ry., has been made consulting engineer of construction of the Carolina, Clinchfield & Ohio Ry. and affiliated lines.

E. M. DURHAM, JR., assistant chief engineer of construction of the Southern Ry., has been appointed chief engineer of construction Mr. Durham, who was graduated from Lehigh University in 1896, has been with the Southern Ry. since 1900, with the exception of a short period, beginning in 1914, when he was special engineer in charge of valuation of the Atlanta, Birmingham & Atlantic R.R. With the Southern Ry. he was successively assistant engineer, resident engineer, principal assistant engineer and assistant chief engineer of construction.

WILLIS RANNEY, of Bartlett & Ranney, consulting engineers, San Antonio, Tex., is in Spain as superintendent of construction for the Ebro Irrigation & Power Co., Camarasa, Province of Lerida. He is installing a hydro-electric development consisting of a dam 314 ft. high, a power canal and tunnel, 30 x 47 ft., and a 100,000-hp. power house. Mr. Ranney was in charge of the design and construction of the Eagle's Nest irrigation project in New Mexico, described in *Engineering News-Record* of Dec. 6, 1917, p. 1066. Neil Hansen, his superintendent and construction engineer on the work, was left to complete the project.

R. C. WHITE, division superintendent of the Missouri Pacific R.R. at Wynne, Ark., has been appointed assistant chief engineer with headquarters at St. Louis, succeeding H. R. Carpenter, promoted as noted elsewhere. Mr. White has been with the Missouri Pacific continuously since leaving West Point in 1905, with the exception of four months last year when he was chief engineer under the constructing quartermaster in charge of the construction of the Army cantonment at Camp Pike, Arkansas. With the Missouri Pacific up to 1914, he was successively assistant in the engineer corps, assistant engineer and roadmaster, division engineer and general roadmaster. In 1914 he was made engineer maintenance of way at Little Rock, and in January, 1917, he was made division superintendent.

E. T. BOWER has been appointed assistant engineer maintenance-of-way for the Alaska Engineering Commission. He succeeds E. O. Archibald, resigned.

OBITUARY

CALVIN H. ALLEN, at one time president of the Western New York and Pennsylvania R.R., died June 14 at his home in New York City, in his 91st year. Mr. Allen entered railway service in the engineering department of the New York and Erie Railroad in 1849 and rose in the railroad world through the engineering department. At the time he was first vice-president of the New York & Philadelphia R.R. he was elected to the presidency of the Western New York and Pennsylvania road, at the same time assuming direction of a number of subsidiary companies, prominent among which was the Detroit, St. Clair River R.R. Mr. Allen retired in 1901.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Rationing of Coal Includes Factories and Homes

Aim to Balance Deficiency of Production by Saving Through Campaign of Education

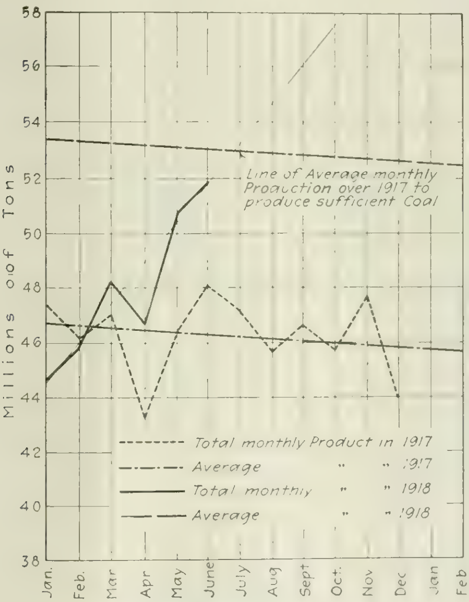
There will be no discrimination in favor of domestic consumers of coal at the expense of the industries in the rationing of coal by the United States fuel administration. Domestic orders will be censored to preclude hoarding, at the expense of existing supplies, and to insure economical consumption. Although the factories will be denied the use of coal in domestic sizes, domestic users will be forced to study methods to conserve their supply in order that the 20,000,000-ton saving that is the aim of the educational campaign now in progress to reach all of the 250,000 industrial power plants in the United States shall not be nullified.

The National Coal Association, composed of the bituminous operators, has taken action looking to the utmost output and asserts that it is doing everything to assure a maximum supply and to overcome the serious labor and other shortages. The results of its efforts are indicated in the marked upward slope of the average production line in the accompanying diagram. As indicated, production has mounted steadily and all previous records have been broken, but the diagram shows that extraordinary production must be continued to maintain this slope until the ordinates below the upper broken line will be balanced by those above. Latest records already indicate a flattening of this line and to offset this flattening the stringent rules of the fuel administration have been promulgated. Even as it is, the administration warns the country that a more or less serious shortage is inevitable, and urges consumers to look for and heed all future notices and regulations as well as to put into immediate practice those already issued.

Every possible saving is being put into effect. An order is in preparation, by the fuel administration, which is to take the place of the so-called "lightless night" order of Nov. 13, 1917, which was suspended on account of the daylight saving law, and the general conservation program of the Administration.

It appears that in every city and town of the country from which statistics have been gathered electricity is being greatly wasted in light for advertising, store illumination and other purposes. Radical reductions will be ordered in the quanity of coal consumed for the purposes specified. The order will provide closer restrictions in the New England states, New York, Pennsylvania, New Jersey, Delaware, District of Columbia and Maryland, than in other states where the transportation of coal is not so acute a problem.

The fuel administration has compiled a preference list in which all consumers of coal except domestic have been recorded under the following classifications: Railroads; army and navy, together with other departments of the Federal Government; State and county departments and institutions; public utilities; retail dealers; manufacturing plants on the War Industries. Board's preference list; manufacturing plants not on the War Industries Board's preference list



SOFT COAL PRODUCTION 1917-18

Building Interests Organize for War Service

Form National Federation Under Lead of United States Chamber of Commerce

Representatives of more than 100 national and regional organizations and individual firms engaged in building work and allied industries were called together at Atlantic City July 15-16 by the United States Chamber of Commerce. The National Federation of Building Industries, for the object of helping the Government, was formed.

The convention, after the opening address of Harry A. Wheeler, president of the United States Chamber of Commerce, organized by creating a war service board on which national associations will have three representatives each and a regional association one representative. This board will meet four times a year, the first meeting to be the first Monday in November, 1918. It will elect an executive committee of nine, which will transact the business of the federation, elect a president and appoint an assistant to the president. This assistant is to be a paid officer who will maintain offices at Washington, and be the point of contact between the Government and the federation, and also between the members and the executive board.

It was provided that the articles of association may be amended by a two-thirds vote of the war service committee, and the intention of later forming a permanent organization to represent the building industries after the war was expressed at the convention.

The convention was organized with Allan Walker as chairman, and a temporary executive committee, consisting of J. R. Wiggins, Philadelphia; J. H. Kane, Birmingham; A. M. Maddock, New York City; Charles Gomphertz, San Francisco; J. A. Kling, Cleveland; W. L. Clause, Pittsburgh; W. S. Dickey, Kansas City, and Rudolph P. Miller, New York City, with B. F. Affleck, president of the Portland Cement Association, as president, elected to serve until November.

Manufacturers of products used in building and construction work, and of construction equipment, were well represented, while the Engineering Council, the American Society of Electrical Engineers, a number of chapters of the American Institute of Architects, the National Association of Builders' Exchanges and several contractors' associations sent delegates.

The convention was addressed by Senator Calder, New York, and by Louis A. Post, assistant secretary of labor.

Store-Door Freight Deliveries to Be Inaugurated

Railroad Administration Expects to Increase Terminal Capacity 50 Per Cent by New Order

Store-door deliveries for freight in the Borough of Manhattan, New York City, have been ordered by the railroad administration. The district covered by this order of Director General McAdoo, is that south of 59th St., and all railroad freight delivered at piers and yards in this district will be affected. It is expected that the system will increase the amount of freight that the railroads can handle from 30 to 50 per cent. The action was taken after an extensive investigation of conditions by a committee composed of the Hon. James S. Harlan of the Interstate Commerce Commission, the Hon. Travis H. Whitney of the New York Public Service Commission, and the Hon. W. E. Donges, of the New Jersey Public Utilities Commission. A comprehensive report of their findings was submitted to the Director General of Railroads by Commissioner Harlan, a brief summary of which follows:

The congestion of railroad terminal facilities, during the past year, was partly due to the destruction of shipping by submarines and inadequate railroad facilities, but a great proportion of this congestion was caused by the conditions of delivery in New York and the antiquated methods followed. The conditions in lower New York are peculiar. There are very few team tracks where trucks can back up to the car door and receive goods for delivery.

Freight Stored on Piers

Much of the freight, whether it is in carload lots or less, must therefore be unloaded at piers and stored until claimed by the consignee. Moreover, the owner is allowed 48 hours after receiving notice to claim the freight, which time, due to slow notification, is often extended to three days. It is also found that a large portion of the trucks delivering these goods carry only partial loads, often only one box. This leads to congestion at the terminals, trucks having to stand in some cases as long as 60 hours waiting for their loads. The freight itself is unloaded in haphazard manner, so that it is difficult for the truck driver to locate his consignment of freight, and a recent count showed 100 drays, at 7 a.m. waiting at one pier for loads.

Under the new plan, notice will not be given to consignees until the goods are delivered at his store door; the fact that he has ordered the goods being considered sufficient evidence that he is ready to receive them. The freight will be unloaded and distributed in various locations at the terminals, according to the delivery zones into which the drayage district will be divided. Only trucks registered for this work will be allowed at the piers, and instead of being partially loaded, will receive full loads for the delivery zone to which they are going.

The organization for carrying out this system will consist of a drayage director, who will have general supervision and control of the trucking of freight from the pier or freight station, after it has been unloaded. He will be assisted by drayage supervisors, one at each pier, who will direct the unloading of inbound freight. All trucks must be registered by the drayage director, who will establish such rules and regulations as will facilitate the prompt removal of freight. If freight is not accepted by the consignee, the drayage director has power to store it in public warehouses at the owner's expense.

Number of Women Increasing in All English Trades

There are at present 4,538,000 women and girls in the classified trades in England that are under the jurisdiction of the British Board of Trade. Counting all the women employed in all work throughout the United Kingdom this number will be increased to 5,000,000, whereas before the war it amounted to but 2,000,000.

They are still being recruited to the extent of 15,000 a week, and at present are employed in all the trades that were formerly occupied exclusively by men. Munitions workers number more than 800,000, chemical and engineering establishments more than 200,000, and thousands of women work as mechanics and other hands in machine shops outside these two classifications.

End-Dump Body and Hand-Operated Hoist for Small Trucks

An end-dump body and hand-operated hoist for motor trucks is shown in the accompanying illustration. The hoist mechanism is operated entirely by hand, being a departure from hydraulic and power connected devices.

The bodies are made in various sizes, and are furnished as a unit with the hoist, ready to clamp on to the chassis of any truck. It is said that this combination is particularly adapted to the trucks of smaller size in handling all kinds of loose material such as coal, stone, gravel, etc.

When the hoist is operated by one man a load of one ton can be dumped in about 30 seconds; two tons, in 45 seconds; three tons, in 1¼ minutes; four tons, in 1¾ minutes; five tons, in 2½ minutes. This combination of body and hoist has been produced by the Archer Iron Works, Chicago.

HAND-OPERATED HOIST AND END-DUMP BODY

Business Notes

Robert F. Atkins, formerly Eastern credit manager, Universal Portland Cement Co., has been appointed credit manager of the Emergency Fleet Corporation. E. M. Johnson, formerly assistant credit manager of the Universal Co., at Chicago, succeeds Mr. Atkins at Pittsburgh, and A. J. Joyce of the Chicago office is the successor of Mr. Johnson.

The Arthur McMullen Co., general contractors, 149 Broadway, New York City, announces the opening of a Philadelphia office at 1309 Finance Building, under the direction of George B. Palmer, vice-president.

The Pittsburgh Testing Laboratory announces its recent removal from its temporary quarters, in the B. F. Jones Law Building, to its new office and laboratory buildings at 612 Grant Street, Pittsburgh. The new laboratories will be larger and better equipped than they were in the old quarters.

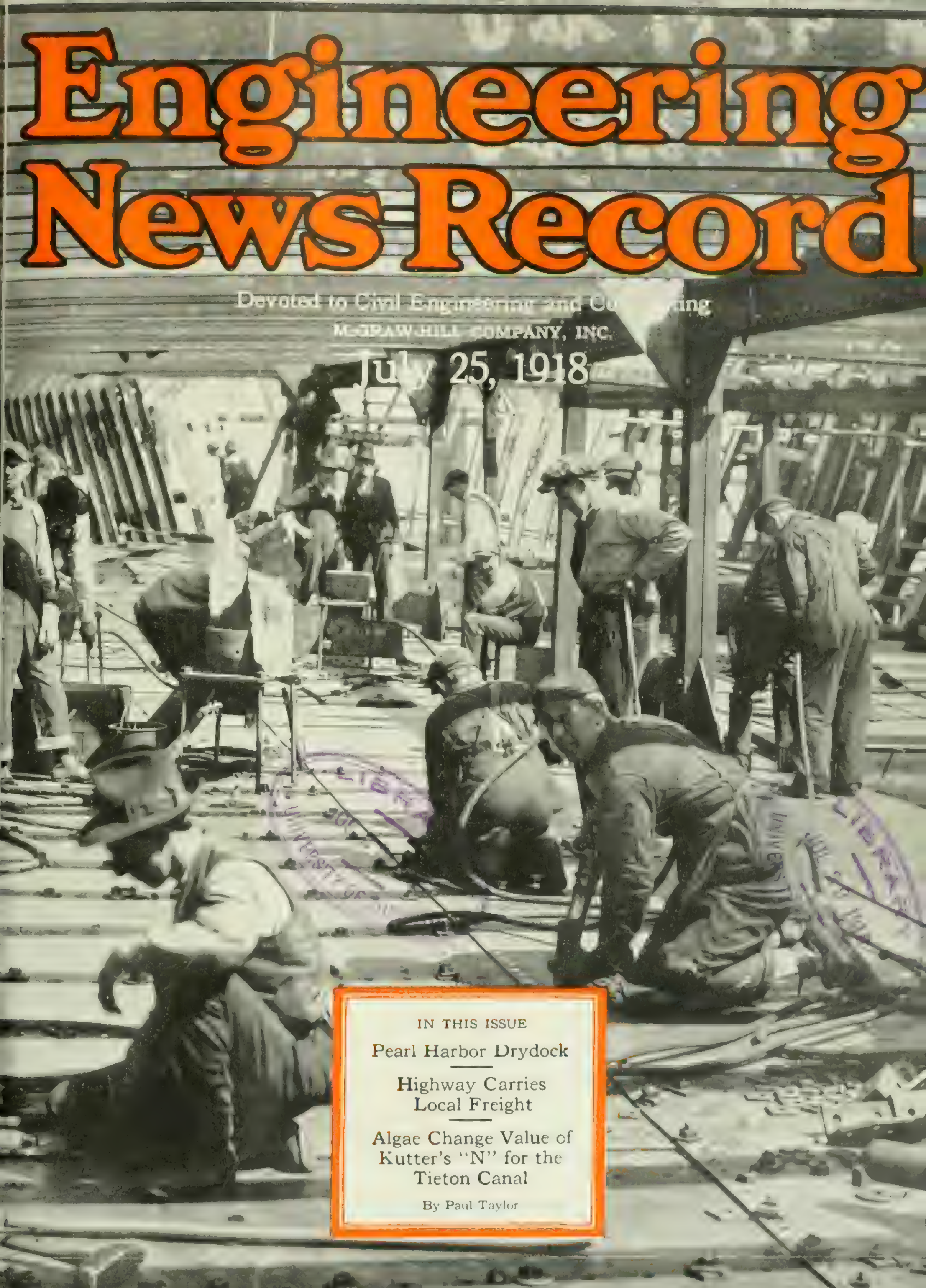
Trade Publications

"Monitor Sash and Operator," is the subject of Section 2, first edition, of "Fenestra Steel Windows," issued by the Detroit Steel Products Company, Detroit, Mich. It contains data, diagrams and information regarding that portion of their output.

"Pine and Patriotism" is the subject of a paper-covered book of 268 pp., embodying the official report of the third annual meeting of the subscribers to the Southern Pine Assn. Besides the financial statement it contains reports from officials in every field of operation covered by the association.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
July 25, 1918



IN THIS ISSUE

Engineering Methods Enable Skinner & Eddy Steel Shipyard at Seattle to Make Remarkable Records


Kreolite Lug Wood Blocks
"The Paving that's Saving"
There's no destructive push from these blocks –Look at curb alignment!
This picture was taken several years after the laying of the Kreolite Lug Wood Block Pavement on Jefferson Ave., Toledo, Ohio. The blistering sun of summer and the frosts of winter have both worked their will on this pavement.
Sunshine, rain, snow and ice have alternately contracted and expanded it. Yet the **perfect alignment of the curb** shows how effectively the **lugs** on the blocks absorbed all expansion—eliminated side-push—and preserved a smooth, even pavement surface And, not only that, but the lugs provide just enough space between the blocks to afford horses perfect foothold.
"The Lug makes a good block better."
50% of orders received in 1917 were repeat orders.
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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

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The Building Industries at Atlantic City

THERE was reported in the news column of this journal last week a convention of the building industries, called by the United States Chamber of Commerce to organize for the service of the Government. At it manufacturers of every kind of material that enters into construction work were ably represented. The makers of construction equipment were there. The master builders were represented both sectionally and nationally. But the professional men—the engineer and the architect—were conspicuous by the absence of every national society, save the electrical engineers and a member of the Engineering Council, who also represented other interests. And the general contractors—the men who build our railroads, our bridges, our industrial and manufacturing facilities, our highways, our municipal works—forming a group as important as the manufacturers, were represented by a few men who managed to seat themselves on beds and chairs in a single room of the hotel when they came together to discuss what part it was possible for them to take in this movement. Perhaps the Chamber of Commerce is not to blame. It was stated that every organization of which it could find a record was invited. And the few contractors who attended agreed that they themselves were to blame. They lack a representative, aggressive, national organization.

Research Into Society Aims

WHAT is the object of an engineering society? We recently recorded the starting by the American Society of Civil Engineers of a systematic inquiry into its objects, aims, and proper field of work. We also noted the appeal of Morris Cooke to the American Society of Mechanical Engineers that that society should more definitely, in its official code of ethics, affirm its duty to the public. Later Gen. William H. Bixby in his presidential address before the American Society for Testing Materials declared that engineering societies today have no longer the same objects to serve that were important when they were originally formed. Other interests have become much more important. He sums it up by saying that the importance of an engineering society today is to be judged by what it does for the general public, not by what is does for its members. Of course, the work done by any society in aiding its members to become more competent engineers, and in the establishment of standards and the improvement of practice is a service of great value to the public. The point worth emphasizing, however, is that this public service viewpoint should be kept in mind. As General Bixby pointed out, if an organization is merely looking after the pleasure and welfare of its own members, it should call itself a club, rather than a society or institute.

Water-Works Shutdowns and Sleepy Officials

RECENT shutdowns of two water-works plants indicate that the officials of some cities of the country need to bestir themselves to guard against accidents which may have dire results. In one case a city was without water for a day because lack of a proper valve system made it necessary to shut off power at the pumping plant to repair a broken fire hydrant, and the pumping plant failed to operate when an attempt was made to put it in service again. A wide-awake chamber of commerce committee made an investigation following this accident and pointed out the need of the addition of new valves and proper maintenance of those in existence—some of the latter being so corroded that they could not be operated. In the second city the pumping plant was stopped, it is stated, as the result of failure of the city government to advance wages of employees. Some of the operators appear to have refused to work, and one of those on duty is said to have quit because he was "fatigued" after running the plant continuously for sixteen hours. Although such action may well have been quite unexpected, the wide-awake city official is prepared for just such contingencies.

Politics and Garbage in New York City

OVERWEIGHT should not be given by those unfamiliar with New York City conditions to allegations that the reduction works which treat the garbage of the metropolis are so great a nuisance that they must either be closed or else, if their byproducts are wartime essentials, taken over by the Federal Government. Staten Islanders condemned the plant as a nuisance before it was built. The controversy over it has been, and apparently still is, mixed in politics. Whatever else happens the plant should not be shut down until competent disinterested engineers declare that it cannot be operated with reasonable freedom from nuisance. As to its being taken over by the Federal authorities, no evidence has yet been made public which proves that this or any other garbage-reduction works should pass into Federal operation.

Housing Problems Need the Engineer

SOMEONE, having in mind the potency of executive direction and the general need for brains, has recently made the cogent remark that an organization chart is not an organization. It is no less true that a chart fails often to represent the relative importance of the various men and powers it so neatly delimits. This is the case in both of the Government housing departments, where formal organization reduces to less than secondary rank the engineering branches which are spending nearly half of the money and which have today large influence on the programs of design and construction. Fortunately both departments have in their engineering heads men of great competence and strong personality. Both are gradually impressing upon their associates the responsibility that must fall to the engineering divisions.

Industrial housing is not new in this country, but it has been developed as a sociological rather than an engineering problem. Most groups of workmen's homes have risen little higher than the ordinary real-estate development, where engineering has consisted in laying out lines and grades and connecting the houses to the usual public utilities. The sociological problems have been studied by an earnest group of men who see quite clearly the social side of housing, who realize the needs for clean and healthy living conditions, who have a fair appreciation of real-estate economics, but who fail utterly to understand that the laying out and building of a town to house 5000 persons is an engineering problem of the first magnitude.

Next to the social reformers, the architect has been an important figure in the housing of the past. He adds to a possible understanding of the social side of the question a knowledge of the construction of the individual house, but as appreciating the economics of quantity production or the importance of the public-utilities design and construction, the architect is by experience and training little better fitted than is the social expert.

These two types of men have had large influence in Washington. Working behind the scenes and on full stage, they organized the housing operations of the Government with little initial consideration of the engineering necessities or recognition of the engineer's part in the work. In intentions if not in actual practice he was placed as an employee somewhere between the head bookkeeper and the chief clerk. There was no particular animus in this action; these men simply did not see in a housing development an engineering problem that could not be solved by subordinate employees. It is not necessary to outline the progress of the education that has taken place. The engineer is now an important figure in administrative conferences, his advice on economic questions is sought and the consideration of design and construction set up by his investigations play a large part in the selection of site and the type of development.

This better appreciation of the importance of the engineer in Government housing work should obtain also in the greater public and private developments that are sure to come. But the engineer must be awake, as many of them now are, to the fundamental social problems involved in the building of industrial communities. Only in this respect is the profession less well prepared than the two groups who are strenuously trying to control all future housing development.

All idealists are intolerant. Those who have made the matter of industrial housing a thorough study in the past few years are for the most part idealists, and they see in any criticism of their fine purposes the devil's hand of commercialism. This insinuation the engineer must fight. He will give ground to no one in fighting for the best of living conditions, but working as he is with the very skeleton and body of the city, he has a practicality of purpose which the more theoretical and specialized of his associates do not possess. Once the principles of good housing are accepted, the possibility of carrying through any development, not backed by the unlimited funds of a war-driven government, must depend on the engineer. It is he who must bring any scheme within the realms of economic possibility. Just now we are apt to forget profit and loss in the demands of the times, but these times will not always be with us. Relative costs of different sources of water supply and of different types of sewer and road construction, the choice between new utility construction on cheap land and existing utility use on expensive land, and, most important of all, the economies resulting from quantity production of houses—all are problems that only the engineer with construction experience can solve.

Opportunity for service to industry lies in the furtherence of this idea—the engineer's function in housing. Individually and collectively engineers should keep it in mind.

Confidence and Contractors

WAR conditions have made us realize more fully than ever that construction work cannot be carried on efficiently without confidence and coöperation between the contracting parties. On public work especially both the difficulty met in completing important highway and municipal work, requiring in one state the passage of three laws for relief; and the impossibility of obtaining reasonable tenders, which has forced the Federal Government to put all construction on a percentage basis, have convinced most of us that the fixed-price contract is open to improvement. While fixing the price to be paid, and attempting through specifications to fix the quality and time of delivery of the work, the old type of contract throws all the risk on the party least able to carry it, tempts the skimping of work to increase profits, furnishes a cause of disagreement, which is never wholly avoided, and retards the development of high skill in the working forces by making it profitable, at least for the time being, to hold down wages without regard to ultimate efficiency. Moreover, this method does not make the contractor's future depend sufficiently on his ability and reputation, leaving the field open to those who are undesirable and without experience. Its most serious defect, however, is that whereas the working force, the contractor and the engineer (representing the owner) should coöperate to produce the structure with the greatest economy, the fixed-price agreement assumes that the contractor will not produce the result with economy, sets the engineer to watch him, and

makes it profitable on the individual job to skimp the work and hold pay below the level at which greatest efficiency would be realized.

Neither is the cost-plus contract better than the fixed-price agreement in important respects. True, it throws the unforseen risks on the owner, who logically should carry them, and removes temptation to slight work or hold wages below the point of efficiency. It has many other advantages which make its choice for war work a wise one. But under it, it is still more necessary to maintain a duplicate organization—one to do the work, a second to watch the first lest it waste the owner's money. Manifestly such practice is due to a lack of confidence in the contractor, and prevents close coöperation between his forces and the engineer

Is there, then, any method of handling construction work which avoids these difficulties? The answer is found on page 118 of the last issue in an article which describes the workings of a system which is in common use abroad, and which has been most successful where employed on private work in this country. Mr. Fitch's article on page 125 suggests some detailed methods by which this system might be applied to public highway contracts, and a letter to the editor on page 191 shows how they are actually being applied to state bridge work.

There is no difference between the contract forms used in this and the cost-plus system, other than the penalty and bonus method of determining the fee. But there is a wide difference in the method of handling work and of selecting contractors. The contractor is assumed to be competent to produce the best results for the lowest cost, and is left entirely free to do so. Failure through incompetence or dishonesty is visited by his elimination from the business. Public works departments would keep performance records, as private owners are learning to do, and use them in common to select contractors with reputations for efficiency. The inexperienced and incompetent would be barred from tendering. No one could take work without having had adequate experience as a member or responsible employee of an established organization. In a short time such a contracting fraternity would be built up that any member could be depended on to devote his best efforts to any work he undertook. The rate of compensation would be proportioned to each one's ability and reputation, and would not be subject to risks. More efficient organizations would be built up, for it would be profitable to raise wages as long as the value of the work increased proportionately. The contractor's interest in doing the best work at the lowest cost would be so strong that a large "supervising" force to see that he did it would be a waste of money.

To put such a system into effect requires much more than the willingness of contractors. For some years they have worked to establish the system with private owners, and with indifferent success, when the volume of private work is considered. It is the owners and engineers who must travel the greatest distance to reach this goal; and of all owners, public agencies have farthest to travel. Graft and the suspicion of graft must be eliminated by swift and complete annihilation of the guilty parties. Laws and customs must be changed to extend unqualified confidence to the contractor as it is now extended to the engineer.

But the goal is not impossible. War has brought it much nearer; in fact, it is within reach, if we will undertake the necessary educational work, stand with a united front on the ground that the change is to the benefit of the public, whether as individual employers of contractors' services, or as public agencies of the community itself.

New York Must Not Interfere With Hudson River Bridge Projects

NEW York State has no authority to interfere with the construction of the proposed Castleton bridge over the Hudson River below Albany. This is the decision of the Supreme Court of New York, as reported in the news section of this journal recently, based on the grounds explained in these columns some weeks ago, that the Federal authority over navigable water is paramount, and may not be interfered with by any State.

The court reviews the history of the Castleton bridge project and shows that the Legislature of New York in 1913 passed an act authorizing the construction of the bridge with a span of 300 ft. When the railway company submitted its plans to the Federal Government (as it was of course obliged to do, the Hudson being a navigable river) the War Department engineers ordered the span increased to 600 ft. Authority for the construction of the bridge was also granted by a special act of Congress. The New York authorities then attempted to interfere, and the Legislature of 1917 passed an act which repealed the act of 1913 (under which, by the way, the railway company had already spent more than $350,000) and ordered that the proposed bridge if built must cross the river by a single span of about 1000 ft. This year the Legislature sought to clinch its control by enacting a law which makes the approval of the State engineer and the State superintendent of public works requisite to any railway bridge across the Hudson River, and requiring any such bridge to have but a single span.

Judge Chester, who writes the decision, shows clearly the specious nature of the State's claim that it has a right to add its restrictions on such work to those which the Federal Government might impose. The Federal authority rests not merely on its control over navigable waters, but on the fact that Congress has the paramount right to regulate interstate commerce over highways, railways and bridges as well. The interstate character of the proposed bridge, which New York State's attorneys attempted to deny, Judge Chester evidences by quoting from Secretary Baker's opinion, in which he said, "The connection between New England and the West necessitates bridging the Hudson, and the proposed bridge will be of great value to the country in facilitating the handling of freight to and from New York City."

The decision is, of course, subject to appeal to the higher State courts if the New York authorities see fit to spend time in that way, but there is small chance that any courts will undertake to reverse a decision so well fortified; and in any event, the ultimate authority lies with the Federal courts, who would probably make short work of such a belated attempt to limit the Federal authority.

Seattle Shipbuilders Overcome Pioneer Difficulties and Set New Speed Records

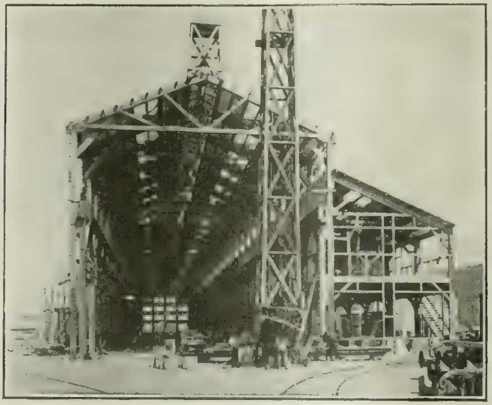
Inadequate Plant Does High-Speed Work—Persistent Expediting of Material—Labor Problems Solved—Large Punch Shop Does All Plate Work—Two New Machines Used

By Claude A. Osier
Seattle, Washington

NOT much more than two years ago the shipbuilding plant of the Skinner & Eddy Corporation occupied an acre of ground on barren tide-flats. Today it is in the heart of Seattle's shipbuilding and ship industry district, and covers a ground area of 25 acres; indeed, with the recent acquisition of the Seattle Construction & Dry Dock Co. a total of 55 acres is included in the corporation's shipbuilding plant. In the intervening period the name of Skinner & Eddy has become familiar to the entire industrial world. The company has set the pace for shipbuilding in the United States. It has created new records for speed in ship construction and launching while expanding, building and rebuilding a plant which was originally designed to construct two ships for the company's own use.

What the remarkable performances of the corporation mean as human achievements can be more fully appreciated when it is understood that the plant is inefficiently laid out and inadequately equipped, and that practically none of the employees who have contributed their share in making the records were shipyard mechanics prior to their connection with the plant. They were green hands, who have been trained in the art of shipbuilding at the Skinner & Eddy yard.

In the rapid growth of the shipbuilding industry in the Northwest under the emergency conditions of the past two years the demand for men far exceeded the supply. To overcome this difficulty the company trained men for the various kinds of work involved. The result of this method of developing workers is that within the



ORIGINAL BUILDING OF SKINNER & EDDY PLANT, AND PARTS OF THE PLANT OF TODAY

past eight months the riveting strength has been increased from 80 gangs of riveters to 320 gangs.

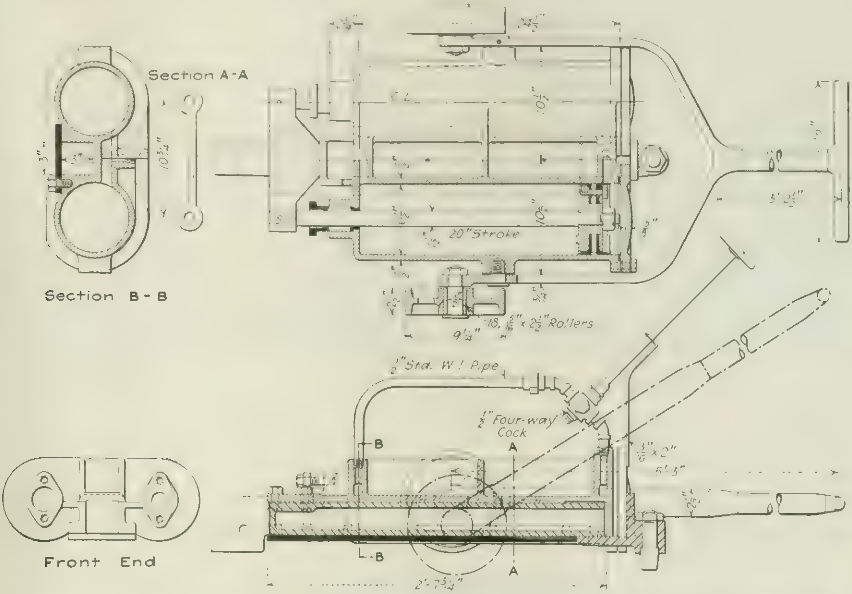
That the plant is by no means a model in its layout and equipment follows naturally from the manner of its growth. As the demand for space increased more and more, the yard frontier was gradually pushed east and north, by literally lifting up fences and setting them back, a few yards at a time. At one point a new though temporary building was erected, at another an additional story was tacked on—all in a frantic effort to make the plant keep pace with the ever-increasing shipbuilding program. As new property was acquired, old buildings thereon were remodeled and used for whatever department was in most need of additional space, often regardless of whether the new location bore a proper relation to that of other departments or not. All this had to be done, and still must be done, without in the slightest degree slowing up the ambitious shipbuilding program outlined. The main idea is to build ships, and build them at the highest possible rate of speed

The success of the yard cannot be ascribed to its plant layout or equipment, or to new methods of ship construction; it must be attributed to the owners' recognition of the absolute need for ships and their determination to allow no obstacle, however large, to impede progress. When a keel is laid a date is set for the launching of the completed vessel, and it then becomes the ambition of each individual engaged in work on that ship not only to meet the date set but to cut the time down a day or two. This must be done, however, without interfering with work on other ships under construction at the plant, and without taking men off those vessels. The aim is not for individual records but for the greatest output of ships in the shortest possible time.

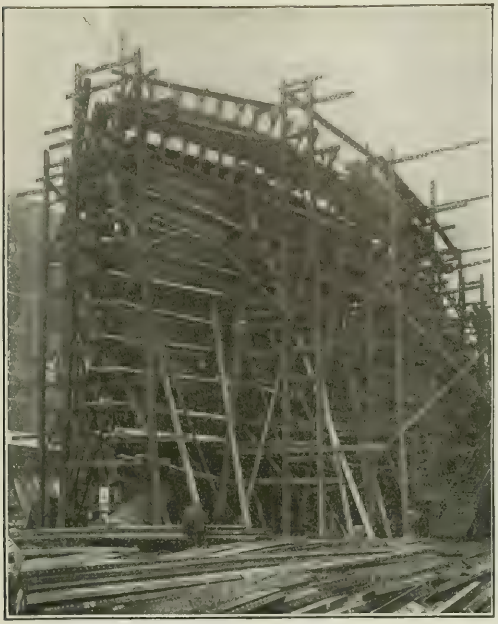
Since breaking ground for the plant, on Feb. 14, 1916, the company has constructed and delivered 26 steel ships—three 10,000-ton oil tankers, one 7800-ton and twenty-two 8800-ton cargo vessels, a total dead-weight tonnage of 231,400. The first keel was laid May 2, 1916, and the first completed ship delivered Sept. 21 of that year.

During the first year's activities the best time made for completion and delivery of a vessel was 162 working days. This time has gradually been cut down until today the average time for building, launching and completing a ship is 75 working days. The outstanding record of the company was made on the "West Lianga," which was built and launched in 55 working days, and was completely outfitted and equipped and turned over to the United States Shipping Board in 67 working days. This record feat in steel ship construction can be better appreciated when it is realized that in pre-war ship construction from seven months to a year was usually consumed before a vessel of this size was even launched. The last four ships built by the company have been constructed, from laying of keel to launching, in 55, 57, 56 and 55 working days, respectively, which proves conclusively that the record of the "West Lianga" was not a spasmodic effort to break records, but is an actual possibility for a regular pace.

Perhaps one of the strongest factors in the plant's success is the foresight demonstrated by the company in arranging for an uninterrupted flow of material to the plant. Never since the plant has been engaged in the construction of ships have the working forces been held up for want of materials. Shipments of steel, necessary equipment and apparatus from Eastern manufacturing centers to the warehouses and storage spaces of the company have been continuous. Before a ship had been sold or a contract signed, the company had placed orders for materials for 40 steel ships. It now has



PNEUMATIC FRAME BENDER DESIGNED AT SHIPYARD REDUCES LABOR AND SAVES TIME




STEAMER "WEST LIANGA," BUILT IN SIXTY-SEVEN DAYS—VIEW AT LAUNCHING AND TWELVE DAYS BEFORE

contracts with Eastern manufacturers for steel and equipment covering its activities for the next two years.

The company maintains a steel department whose duty it is to follow every plate and bar of steel from the time the order sheet is written out until the actual material is laid in the racks in the yard. Every piece of steel rolled for the company is traced day by day, and through representatives at the mills the sequence of production is maintained as required in the construction of the vessel.

Unprecedented steps have been taken to make certain that equipment would not be delayed. For instance, when lack of transportation facilities recently threatened serious delay in delivery of equipment and materials the company purchased 300 freight cars for its own use. Again, to facilitate quick delivery of one of the record-built ships the corporation secured special-train delivery of turbines from an Eastern concern, by fast freight. In another instance, to overcome a shortage in auxiliary equipment for another record vessel, a freight train carrying pumps en route from an Eastern factory was halted at a point in transit and certain portions of the pump were transferred to express shipment, thereby expediting delivery of the vessel to the Shipping Board.

As a result of the showing made in the rapid production of ships, and the requirement of the Government for the largest possible tonnage in the least possible time, arrangements were made in April for the lease of the Seattle Construction & Dry Dock Co. plant, operated by the Todd Shipyards Corporation, and placing it under the management of the Skinner & Eddy Corporation. On June 1 the latter took possession of the property, and without appreciable interruption put into operation the system existing at the original plant.

In the first Skinner & Eddy plant, now known as Plant No. 1, the hull material moves from the layout shop, where it is marked from the mold-loft templets, by small flat-cars to the punch shop. This latter has outgrown itself four times, necessitating each time the building of an addition to keep its equipment under cover. When the most recent additions were made the only site available for the new tools was a hundred yards away from the parent building.

The punch shop is in a sense the heart of the shipbuilding plant, as upon its capacity to fabricate the steel depends the speed of erection; enough bolters-up and riveters can be worked upon the ships and assembling floors to handle the plates and bars as fast as they can be delivered from the punches. This shop is served by monorail trolley hoists, which distribute the material to the various machines and assist the punch cranes in handling it while it is worked. The entire plant has six trolleys, two bridge cranes and eight locomotive cranes. Five industrial locomotives and six storage tractors transport steel and equipment from the various storage yards and warehouses to the shipbuilding berths.

Besides punching, the shell plates require scarfing at the corners where joints intersect. The engineering department of the company designed and developed a portable scarfing machine which can be clamped to the edge of the plate by means of setscrews and cuts a truly machined scarf of the desired width and length in about 15 minutes.

Frame bars which require bending to suit the form of the ship are heated in oil-fired furnaces and bent on the usual cast-iron bending slabs before they go to the punch shop. Here the bending is not done by the ordinary hand procedure of squeezing the bar against the

form with a crescent-shaped "crowder" handled by half a dozen men. Instead, the bending is quickly and neatly accomplished by a small portable double-cylinder pneumatic ram operated by one man. (See drawing.) This machine, designed at the plant, has produced a 40% increase in the output of the bending slabs.

From the punch shop, flat-cars carry the fabricated material to positions under the ship-erection cableways. All hull material is handled to place in the ship by cableway. As now used, there are two cableways over each berth or ship. The masts carrying the cables are about 100 ft. high and 486 ft. apart. Power is furnished by double-drum friction-drive winches operated by 25-hp. direct-current motors. The load line is two-part, of ⅝-in. plow steel, and has a hoisting speed of about 75 ft. per minute with normal load of 4000 lb. The transmission cable is continuous, passes over an elevator sheave, and has a normal travel speed of 300 ft. per minute. These cableways can handle about 75 tons of material per day, and if used to the utmost capacity would take care of the entire material of one vessel in about fifty days; each hull involves about 3600 tons of steel. Electric bells are used as a means of communication between the signal man on the slip and the winch man at the head of the slip.

The aërial system, while not original in shipbuilding work, was first applied by the general manager of works, David Rodgers, on submarines, and was later adopted by him for ship construction in the Skinner & Eddy plant.

Realizing that air supply in a shipbuilding plant is intimately related to the speed and efficiency of hull erection, the corporation has taken every precaution to insure sufficient and continuous air supply. There are two power houses, of which No. 1, situated at the head of the fitting-out wharves and to the north of the building slips, is the main compressor plant; this serves also as distribution point for all electric lights and power feeders to various departments. It runs 24 hours per day, the load varying from full capacity during day shift to approximately 3000 cu.ft. per minute demand on the midnight shift. Power house No. 2, at the south side of the yard, is used only during the day shift, when the maximum demand occurs. The main station contains seven units of total capacity of 10,350 cu.ft. free air per minute; this equipment will soon be more than doubled by adding five compressors, totaling 14,310 cu.ft. capacity. The other station contains four units, totaling 5700 cu.ft. capacity. Each compressor has a receiving tank of 315 cu.ft. capacity, except in the case of the largest duplex compressors, which are provided with two receivers. These are supplemented by the capacity of lines in the distribution system, which has about 1500 ft. of 12-in. main supplying 6-in. branch lines to the slips and fitting out wharves. The air is delivered to the mains at about 105 lb., and reaches the tools with a drop of from one to five pounds

PLATE SCARFING DONE BY HOME-MADE PORTABLE MACHINE

Plant No. 2, which has an equipment of about 7300 cu.ft. capacity, is not adequately provided as to receivers or distribution system, and considerable pulsation and friction loss occur. The deficiency is being remedied as rapidly as possible. Arrangements of piping are being made so that all power houses can be cut in on the same lines. With contemplated additions the plants will have a combined capacity of about 37,500 cu.ft. of free air per minute. This will provide one or two large units in reserve in case of failure of another set.

During the first year the plant was in operation the machine shop occupied a space of 40 x 100 ft. Outgrowing its quarters, it was then moved to an old building formerly used by a structural steel concern. To meet the multiplied demand this department is about to move to a new shop building, the only modern one in the plant. The new structure is 100 x 250 ft., with a balcony in each wing, giving a total of 40,000 sq.ft. of floor space. Two overhead cranes of 30 and 10 tons capacity will handle the work.

Continuous with the machine shop building and forming a part of the same structure is the foundry, 125 x 250 ft., which is equipped with two cupolas, having a combined capacity of 30 tons per day. The company operates a smaller (15-ton) foundry outside of the plant.

Other departments are the pipe shop, copper shop, galvanizing plant and sheet metal shop (all under the direction of one superintendent), electrical shop, joiner and carpenter shop, pattern shop, blacksmith shop, fit-

ting and riggers' shops, and installation department. Workmen from the latter get onto the ship as soon as the tank tops are laid, and begin installing the pumps and other machinery. This work proceeds so that on the day of the launching the machinery spaces are practically finished, except for the engines and boilers themselves, which, owing to their size, cannot conveniently be placed in position while the vessel is on the stocks.

On each hull there is employed total power equipment of 700 hp., and the working force includes 48 riveters, 30 chippers, 50 holders-on and 70 drillers. The combined plants employ 12,500 men, to be increased to 13,500 shortly.

The plant contains three fitting-out slips with a total frontage of 3000 ft. There is one pair of sheer legs of 50 tons lifting capacity, standing 110 ft. above the wharf level, and in addition there are numerous locomotive cranes running along the face of the dock for use in installing the smaller parts of the ship equipment.

At various points in the yard steel bars and plates and other material are stored in racks, all being handled by means of locomotive cranes. Ten spurs enter the plant from main railroad lines and the yard is interlaced with a system of tracks for the locomotive cranes In all, there are about five miles of standard-gage tracks in the yard.

Vessels at present under construction by the company are of what is generally known as the three island type —a well-decked vessel with poop, bridge and forecastle houses disconnected. Contracts have been signed by the company to construct several shelter or flush deck ships for the Emergency Fleet Corporation.

Each of the two plants has five ways. At present Plant No. 1 is launching vessels at the rate of two per month, or approximately 18,000 tons shipping capacity. With the improvement and rearrangement of Plant No 2 the corporation will be able to launch one 8800-ton steel vessel each week.

Working Organization of the Plant

A remarkable working organization has been built up, with a trained man at the head of each department, acting under the direction of David Rodgers, general manager of works. Mr. Rodgers has been able to inspire an unshakable feeling of confidence among the superintendents and foremen and men. He does not direct the activities of the plant from his office, but is constantly on the job, advising, suggesting, directing. He is the absolute construction head of the corporation, and the owners of the plant never question an order that he gives or a plan that he contemplates carrying out.

To encourage the superintendents and foremen, and to show them that their efforts are appreciated, the corporation gives them bonuses when a vessel is launched; this is in lieu of overtime. The employees are given double time for overtime, but the foremen work early and late without being recompensed according to the union scale. The corporation has maintained the best relations with its employees, and work has never been delayed by labor troubles. The spirit of harmony and coöperation is a prime reason why the plant turns out ships at a record-breaking pace. When all other Seattle shipyards were tied up by strikes about a year ago, this one continued building ships.

Once a day, usually after 5 p.m., the various superintendents and foremen congregate for discussion of the day's work. Actual production of that day is outlined and the following day's activities are planned. The General Manager of Works attends these meetings, checks up the progress of the work, makes suggestions, and gives orders. At noon each day, officials of the company, including both President Skinner and Vice-President Eddy, meet with the various department heads at luncheon at the plant's restaurant. Here plans are laid for the succeeding 24 hours' work, and the various difficulties arising are freely discussed. These noon luncheons and discussions obviate the necessity of long private conferences and telephone conversations. They also bring the heads of the various departments and the officials of the corporation more closely together, assuring unity of action.

The following men direct the affairs of the corporation: D. E. Skinner, president; J. W. Eddy, first vice-president; J. G. Eddy, treasurer; H. G. Seaborn, second vice-president; Victor K. Elfendahl, assistant to president; David Rodgers, general manager of works; C. N. McCallum, chief engineer; James Barclay, naval architect; M. H. Keil, consulting naval architect.

Crops Thrive Under Imhoff-Tank Sludge Tests at Dallas

Fertilized Cotton and Corn Twice as High as That Unfertilized—Soil Lightened and Evaporation Lessened—Farmers Interested

By Charles Saville
Director of Sanitation, Dallas, Tex.

APPLICATION of Imhoff-tank sewage sludge to crops at Dallas, Tex., promises to give good results. The sludge from the Dallas Imhoff tanks, as it flows out of the sludge chambers, has the appearance of heavy black molasses. It has a very slight, and quite unobjectionable, odor of burnt rubber or coal tar, noticeable only at a distance of a few feet. After drying for about a week on the drying beds, the sludge is easily spadable, and is removed in small cars to the dump, which is located a few hundred feet away on the low land bordering the river. This dump has been in use for over a year now, and there never has been any disagreeable odor around it. Weeds do not grow on the dump, but some tomato plants have developed. The sludge has a low water content, and it is light and easy to handle.

Last summer a small amount of the sludge was removed by a few farmers to be used for fertilizer, with excellent results. Early in the present year it was decided by the city sewer commissioner to make a practical test of the fertilizing value of the sludge, and several acres of ground adjacent to the Imhoff tanks were set aside for this purpose. The soil was rather poor, being a sandy loam, which hardens easily under the action of the sun during the long, dry summers. The land was divided into four sections, and planted with peanuts, black-eyed peas, corn and cotton. Half of each section, amounting to one acre, was thoroughly fertilized with about 85 cu.yd. of the dry sludge, which was plowed in and harrowed before the planting.

In this connection, it is interesting to note that Imhoff-tank sludge, on account of its friable and porous characteristics, is especially adaptable for mixing with hard soil, as it not only helps to fertilize the crops, but at the same time keeps the top soil porous and thus prevents evaporation. This is particularly important in hot, dry climates.

The Dallas sludge-utilization "farm" was visited by the writer several weeks after the cotton and corn had been planted. Well-defined lines could be seen separating the sections which had been fertilized with the Imhoff-tank sludge from those which had not been so fertilized. Only slight differences were noticed in the areas devoted to peanuts and black-eyed peas, which had been only recently planted, but the fertilized cotton and corn showed up very much better than that which had not been fertilized. The fertilized corn was not only twice as high as the unfertilized corn, but it had a much greener and more healthy appearance.

The farm superintendent says that the surface soil in the sections which have been fertilized does not pack and crack under the action of the sun nearly as badly as the soil in the unfertilized sections. Next year the superintendent is going to do his fertilizing early in the winter, plowing the sludge well into the soil and cultivating it two or three times before planting. He thinks this will further improve the present excellent results.

Farmers owning land in the vicinity of the sewage-treatment plant are watching the experiment with much interest, and it is expected that next year there will be a decided increase in the amount of sludge taken by them for use on their own farms.

Two points of advantage of Imhoff-tank sludge over the sludge from plain settling tanks are that it does not attract flies so readily, nor is it considered so dangerous from the standpoint of containing possible disease germs.

The writer hopes to make a further report on this matter later in the summer after the crops have been harvested. He takes the liberty of suggesting that similar reports be submitted to *Engineering News-Record* by observers at Atlanta, Ga., and other places where the result of experience with Imhoff-tank sludge utilization is available.

The Immediate Needs of the Railroads

Temporary Storage Tracks Must Be Built, New Locomotives and Cars Rushed to Completion and Present Equipment Repaired Beyond Last Year's Standards if Record Congestion Is To Be Avoided Next Winter

By Former General Manager

Unless vigorous action is taken in the next three months to remedy certain defects in our steam railroad system, the worst traffic congestion ever known will occur next winter. The demands for transportation will be the greatest ever experienced, and while the Government has done much excellent work in its reorganization of the railroads, this reorganization has practically monopolized the first six months of the year and set the roads back that long at a time when it was doubly important that their development programs proceed. The most urgent needs are for rolling stock—which calls for both the completion of all new locomotives and cars possible and the repair to a higher state of efficiency than prevailed last year of existing locomotives—and for large temporary storage yards in the vicinity of traffic centers, to keep surplus traffic off the main lines. To fill these needs there must be adopted a constructive program for obtaining the labor and materials required in the face of unprecedented demand for both for other purposes.

The capacity of our railways in normal times to handle adequately the fall and winter traffic, such as products of agriculture, the ordinary supply of fuel, the winter stocks of merchandise and the countless other commodities, has been taxed for years to the limit and far beyond, resulting in congestion, delays, loss of money and suffering, even loss of life. The normal traffic is now augmented by the added traffic necessitated by the war and its activities. It is safe to assume, therefore, that the demands for transportation which will be made upon the important arteries of commerce will be from 30 to 40% greater during the season fast approaching than the heavy traffic of last winter, the difficulties encountered in the handling of which are so well known that repetition is unnecessary. And this traffic due to war activities, such as the movement of troops and their equipment, supplies for the Army at home and abroad and for the allied governments, the materials for the building of ships, construction of docks, wharves, Army and Naval bases, all demands prompt and expeditious handling.

It is a well-known fact that during the past year the facilities of transportation have not been materially increased, and a careful survey will reveal the astonishing fact that, taking depreciation into account, the actual capacity for "moving the traffic" is not as great as it was a year ago. The railways were taken over by the Government on Jan. 1. The past seven months have been devoted almost wholly to reorganization of the operating staffs of railways under Federal control, and the result of such reorganization has been toward a centralization of extensive mileages, the result of which may be to multiply the difficulties, rather than expedite the prompt execution of plans under former methods of operation. The difficulties of organization have been further complicated by a rearrangement of staff whereby many men long in the service in official capacities have either had their authority removed entirely, new men being placed in their positions, or their authority so curtailed as to preclude the prompt, decisive action so necessary in transportation.

There has been some good work accomplished during the past six months in the unification of railway facilities. The word coördination has, however, been worked

beyond its "limit of elasticity" in many instances. As an illustration, the railway lines entering Jersey City are so radically different one from the other in the character of their traffic that a common use of their terminal facilities has its limitations. One road may be a heavy coal carrier, another a heavy carrier of merchandise, another a heavy carrier of grain. Each road has its distinctive character of terminals to meet its peculiar traffic needs. The absurdity of attempting to use the terminals of a coal road to handle merchandise or grain, or vice versa, is at once apparent, and serious errors have been made in attempting to unify and use in common, facilities that do not "fit the traffic."

The amalgamation of extensive territories of lines under one directing and authoritative head has reduced the necessary element of supervision, which is the most important element in successful transportation, and to this extent, at least, the efficiency of the transportation has been weakened. This error, if it proves to be such, will be evident during the approaching season. It would have been far wiser to add to the supervision and authority of limited territories than to take from it, as every one experienced in transportation knows is an axiom. The rules applicable to commercial concerns, including Governmental departments, do not apply to railway administration when the activities are scattered and the need of constant and wide-spread supervision is a requirement of successful operation.

Budgets Delayed

On all well-regulated lines of transportation in the past the practice has been to prepare a budget, have same approved and the work all planned and under way covering all improvements, additions and betterments and extensive repairs on the first day of January. This important matter has of necessity been delayed considerably, due to the transfer from private to corporate or Federal control of operations, and it is most unfortunate that almost six months of valuable time has been lost, when time was the most important element in providing the needs of transportation so vital in carrying on the war activities. The result necessarily must be that the added facilities authorized and provided for this year will scarcely be completed to add much to the sum total of facilities to meet the increased demands for transportation.

Its terminal facilities are the heart of a transportation system. If the terminals are inadequate to handle the traffic currently, then congestion follows, traffic is set off between terminals, the arteries become clogged and the system fails to perform its functions properly. There is scarcely a dense traffic line which cannot currently handle its traffic between terminals, and a considerable increase, if only the terminals are kept open; and the verdict of every experienced transportation official will be that the terminal facilities of nearly all, if not all, the dense traffic lines will fix the ultimate limit of handling the enormous traffic of next season.

Thus far this year little has been done to meet this deficiency. Much can be done during the next three months if the matter is wisely and vigorously handled by experienced operating men. The one thing most needed is large temporary storage yards, where little or no grading is necessary, in the immediate vicinity of large traffic centers, where surplus traffic can be stored and kept out of working yards and off the main lines, where it congests and interferes with the current movement of live traffic. Such facilities can be provided in limited time and with minimum expense, and removed when the war is over.

Locomotives and Cars, New and Old

Next in the order of importance to handle the maximum of traffic is adequate and well-maintained locomotive equipment. Owing to the necessity for furnishing locomotives for war purposes to our allies, the orders for American roads last year were canceled or deliveries delayed, or in some instances where orders were filled the locomotives were diverted to other roads than the owning lines. The orders for new locomotives for the current year have been seriously delayed owing to changes in design, delays in approving budgets and other causes. This will make only a portion available to handle this season's traffic.

One of the most serious questions confronting the railways at the present time is the condition of the power now in use. During the past winter locomotives were run beyond their economical limit of efficiency, because of the shortage and inefficiency of labor, the lack of materials and the heavy traffic, which demanded the use of power not adequately maintained. Lack of shop labor due to higher paid wages in other industries has made it impossible to restore the condition of locomotives and equipment to their necessary standard, the result being that on most lines of heavy traffic the power will go into the heavy season's work less efficient than it was a year ago. A large part of the new equipment will have to make good the deficiency.

The imperative need, therefore, for the next three months is a maximum output by locomotive works of new engines, and an intensive plan of repairs to such locomotives as can be repaired and placed in good condition. In order to accomplish this latter result, a drastic and constructive plan must be adopted to furnish the necessary labor and material; otherwise the penalty will be engine failures far beyond last year's enormous total, and resultant congestion of traffic.

An adequate supply of freight cars is the next item in importance necessary to handle the maximum traffic. The same observations made above regarding the locomotive equipment apply equally to freight-car equipment. The traffic demands for coal and box cars will greatly exceed the supply, and can be met only in part by the turning out by manufacturers of every possible car of these classes, and by the repair by the railway companies of equipment in use, all of which demands prompt and constructive action similar to that needed in the locomotive department. Freight-car equipment has not been fully maintained during the past year. The inspection requirements in the interchange of cars have been modified and considerably reduced, which will result in defective cars, this in turn cause accidents, all of which has its effect upon the ultimate traffic capacity and efficiency.

The maintenance-of-way department has, with the maintenance-of-equipment department, been subjected to the same abnormal conditions, and this condition is reflected in reduced maintenance of track and struc-

tures. No general constructive policy as to labor has yet been adopted. On many important lines it has been possible to obtain but a small fraction of the necessary labor to maintain adequately the track, bridges, buildings and other structures. The allotments for rail, ties, ballast and timber, so vital for proper maintenance, are not being fulfilled, owing to difficulty in securing labor and material, caused mainly by the higher prices paid by other industries. This is a lamentable condition, and must be met promptly and vigorously if the properties are to be maintained in condition to permit maximum traffic to be handled.

Delay in approving budgets and providing means of carrying out important works has already had its effect, and no time should be lost in adopting a constructive policy in this matter.

The matter of fuel on many railway lines reached a critical stage during the past winter. It was impossible to secure an adequate stock of storage fuel, as in former years, and the grade of fuel supplied was inferior. This caused serious delays to traffic, through engine failures, and in some instances led to suspension of traffic. Railways must have fuel to perform their function properly, and an adequate plan must be made to assure a full supply of good fuel to meet the transportation needs.

Depletion of forces in the rank and file on railways has had a depreciating effect on the efficiency of transportation. The turnover or changes in staff have resulted in the employment in nearly all departments of new men with no previous railway experience. Considerable unrest has prevailed and will continue until the important question of wages, hours of service and working conditions are settled. Discipline cannot be maintained up to the necessary standard under present conditions, and the sooner some constructive and well-defined policy with regard to the men engaged in railway service is adopted the greater will be the results obtained in transportation.

This feeling of unrest among railway employees has extended to some extent to the officials, as in some cases men, after spending a lifetime to reach a position based on merit and faithful service, are suddenly cut off and must necessarily seek other lines of employment. In this manner the railway service is losing a valuable asset which it will require years to recover. The railway service needs these experienced men now more than ever to fill the ranks of the younger men who have been called to the colors.

It has been a tremendous task to change the operations of some 250,000 miles of railway from private to Federal control, and much excellent work has been done, with resultant benefit to the public; but a constructive policy should be outlined and adopted to meet the great emergencies that are now facing the transportation industry, than which there is none more important in the great cause. The salient and outstanding feature which demands immediate and vigorous action should be segregated from the less important, and all energy concentrated on the elements upon which success depends.

Problems of Designing the Reinforced-Concrete Ship

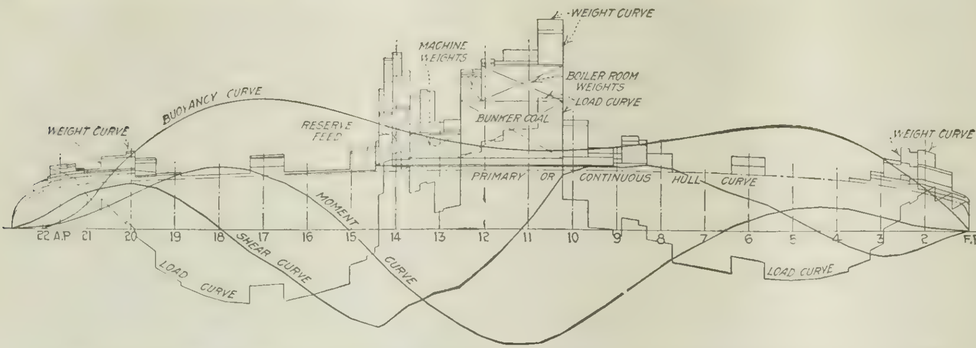
How They Have Been Met By the Emergency Fleet Corporation Told By Messrs. Wig and Hollister In Paper Before American Concrete Institute

CONCRETE ship design has been made the subject of a most thorough investigation by the concrete ship department of the Emergency Fleet Corporation, preparatory to the letting of the contracts for the 42 Government vessels now under way. A résumé of the fundamentals of such design and a statement as to the standards governing the design of the Government ships were given by Rudolph J. Wig, chief engineer, and S. C. Hollister, engineer of design, of the department, in a paper read before the American Concrete Institute in June. The section of the paper devoted to construction problems was abstracted in this journal, July 11, p. 93; the main parts of the design sections are given below. The article may be understood better if read in connection with a study of the details of the 3500-ton ship described in *Engineering News-Record* of July 4, p. 17.

The first consideration that arises in the development of design of a concrete vessel is its form or lines. Many have advanced the belief that concrete ships should be formed with extremely simple lines; with square knuckles and bilges, and with surfaces curved in only one direction. The reason they offer for this is the resulting simplicity in form work. Others believe that this same argument would apply to the bending of plates in a steel vessel, and that the concrete vessel is not alone in presenting this problem. Furthermore, they assert that there is no reason to believe that after a type of form is decided upon the vessels should be more difficult to build on long easy curves than with flat surfaces. The steamship "Faith," which is the first large concrete vessel, has these extremely simplified lines. The vessels at present under construction by the Government have faired lines with surfaces curved in more than one direction. The behavior of vessels of these two types of form will probably give considerable information for future design. It is well known to naval architects that simplified lines are not a hindrance to speed, but rather, if properly designed, may give very favorable results.

The proportions of the concrete vessel are somewhat different from those of the steel vessel. Where the side walls are heavy, the effect is to slow down the period of roll because of the inertia of the sides about a longitudinal axis. This in turn would seem to permit the use of a greater metacentric height than is common in a steel vessel designed for the same service.

The weight of the concrete vessel is in excess of the weight of a steel vessel of equal carrying capacity, and necessitates a careful consideration of the arrangement to gain a maximum strength with a minimum volume of material. It may be that some future designs will develop to a high degree a system of framework and gen-



MOMENT AND SHEAR DIAGRAM OF GOVERNMENT 3500-TON CONCRETE SHIP, UNDER STANDARD SAGGING CONDITIONS AND LIGHT LOAD

eral arrangement which will more nearly suit the nature of the material than the common type of steel arrangements when made up in concrete. Concrete is capable of higher compressive stresses than tensile stresses, and this reason would seem to make desirable an arrangement which employs to the greatest extent the compressive strength of the concrete.

Computations for stability of concrete vessels do not differ from those made for steel vessels. Developments up to the present time have not introduced any new considerations in the determination of the vessel's stable quality.

Vibration and Twisting Will Be Taken Care Of

There are a number of peculiar actions in the life of a ship which have caused considerable discussion among shipbuilders and ship operators in general. One of these is the effect upon concrete of the vibration of the engines. It has been thought by many that the vibration would slowly disintegrate the concrete. Those familiar with concrete construction on land may well realize that this is not in general true, and that there are many fine examples of concrete structures subject to considerable vibration without any apparent deterioration. It has been found, from the concrete vessels at present afloat on both sides of the Atlantic, that the concrete ship exhibits less vibration as a structure than wood or steel vessels.

It is planned to carry out extensive investigations on the completed concrete ship to determine as nearly as possible the points of greatest stress. Pressure recording instruments will be placed at different points on the ship to record the hydrostatic pressure exerted upon the vessel. This work is being carried on under the direction of Prof. F. R. McMillan, formerly of the University of Minnesota. Recording strain gages will likewise be placed at critical points to measure the deformations in the material. Some of these will be placed upon the members of the transverse frames, while others will be placed on the side wall to measure the deformation in the shell reinforcement. Measurements will also be taken upon the longitudinal steel in the deck and bottom. Attempts will be made to measure every possible torsional strain occurring in the vessel. There are several places in the vessel where there is a congestion of stress. One of these points is at the corner of hatch openings. Another point is the gunwale at either end of the shell, forming the side of the bridge erection.

One problem of seaworthiness of the concrete vessel is the resistance it may offer to pounding and panting. The first term is one applied to the action of a boat whose forward or after end has been raised out of the water and then smashes down onto the surface with a tremendous impact. The second term applies more generally to the flexible action of a steel vessel and describes the diaphragm action of the plating as the external hydrostatic pressure alternately increases and decreases. Just what the resistance of the concrete shell will be to such a sea condition remains to be seen. It is only logical to suppose, however, that the concrete shell will not be so apparently flexible as the steel shell and that, therefore, panting will not be apparent. Similarly, it would seem that a considerable reliability may be placed upon the strength of the concrete frame under impact, in the light of our present knowledge of structural action in general.

Machinery Location Important

The speed of a reinforced-concrete ship has thus far been assumed to be the same as a steel ship having the same outer form and dimensions. The only experience which we have at present with the surface friction of a concrete vessel or of concrete in water has been obtained from flow of water through pipes and conduits. It is common to assume that in the cases of pipes and sewers the surface of concrete presents a smoothness equal at least to the surface of steel. It is quite likely that with proper care in the surface of forms in which concrete vessels are cast the outer surface may be materially smoother than the surface of a steel vessel.

The machinery arrangement has an important bearing on the design of a concrete ship. Naval architects are familiar with the fact that very often with the engines aft in a cargo ship the hogging moment is larger than with them amidships. This may not be true with an oil tanker if the oil compartments are grouped amidships to neutralize the hogging effect of the engines aft. It is more desirable to have a larger hogging moment than a sagging moment, because such an arrangement will reduce the likelihood of cracking below the waterline. The location of the machinery, therefore, has a large bearing on the design of the strength of the ship

because of its influence on the disposition of the cargo.

In every phase of the design of the concrete ship, the principle of continuity cannot be overemphasized. The path of stress should be as direct as possible, and there is ample evidence that sudden change of section of the member carrying the stress results in failure of varying magnitude. The transfer of stresses around openings in the deck must require far more attention than would similar ones in the floor of a building. The design of the connection of either end of any deck erection likewise requires the greatest care.

The type of vessel more suitable to concrete would seem to be a vessel which has the greatest possible continuity in its deck line. This statement would offer criticism of the commonly called "three-island type." It would seem likewise to favor the adoption, at least at present, of the flush-deck type as far as possible. The chief difficulty with the three-island type is the provision of longitudinal expansion in the bridge deck and in the sides of the vessel between the bridge and main decks.

Longitudinal Strength First Computed

A section of the original paper is devoted to a description of the standard naval architectural method of determining the longitudinal bending moment and shears under different conditions of loading and wave length. It then continues as follows:

The bending moment which is found as a maximum at a point in the midship section is considered to act over 40% of the middle body instead of acting as the exact form of the bending moment curve for hogging and sagging would indicate. The steel is carried forward fore and aft of the midship section to provide for this moment.

Having now the attacking bending moment and shears, it is necessary to compute the properties of the cross-sections at the points of maximum moment and maximum shear. Properties of the section which are important are the position of the neutral axes, the moments of inertia in hogging and sagging, the arms of the resisting couples commonly known as *jd*. It is common to neglect tension in the concrete in making these computations. The location of the neutral axes may readily be determined by tabular computations and at the same time the moments of inertia about the base line may be determined and later transformed to the neutral axes. In a similar manner the values of *jd* may be determined.

Section modulus may now be computed and the fiber stresses at any point in the cross-section determined from the common formula V/bjd. It is very instructive to construct a curve of shear displacement for the total cross-section of the vessel. Such a curve will point out the fact that the shear in the side walls of a vessel is very nearly constant between decks or between the bilge and the next deck above.

The flexural stresses in the gunwales and in the bilges are greater when the vessel is listed than when it is righted, and must be computed. The difference in stress between the listed and righted positions shows an increase of from 10 to 20% for the listed position over the righted position, depending upon the form of cross-section.

The department requires a concrete having an ultimate strength of 4000 lb. per square inch in 28 days. With this as a basis, the adopted unit stress in outer fiber of 1500 lb. per square inch is 37½% of the ultimate. A bond of 200 lb. per square inch is allowed on reinforcement deformed to provide a positive mechanical bond. The tensile unit stress in steel is 12,000 lb. per square inch in places where the formation of cracks would lead to seepage, and is 16,000 and 20,000 lb. per square inch in places not exposed to the water, the highest value being used in the intermediate transverse bulkheads.

Placing of Longitudinal Steel

There has been considerable discussion concerning the ability of longitudinal steel in the deck and bottom which lies approximately on the center line to develop stress during flexure of the vessel. In ordinary practice the nearest analogy we have to the action of this steel is that action which occurs in the ribbed floors in which the ribs are 30 or more thicknesses of the slab apart. The slab in such a ribbed floor is in compression when there is flexure in the ribs and the unit compression stress is higher immediately over the ribs than midway between the ribs and parallel thereto. The same action occurs in an I-section in flexure when the leg of the outstanding flange is 30 or 40 times its thickness. In both cases, and more frequently in the latter, perhaps, curling results on the transverse section near the end. To what extent this action may be found in a reinforced-concrete vessel has yet to be determined. Undoubtedly, if the stress is smaller near the inboard than near the outboard, the stress outboard must be higher than that originally intended, in order to develop the total tensile resultant necessary to maintain the resisting couple. Now, if it were possible to determine the stress in the deck or in the bottom of the vessel's center line and also the stress in the deck or in the bottom near the outer wall, it would then be possible to compute the longitudinal shear stress between the center line of the vessel and the outer wall. Even though this stress on the center line may be zero, the longitudinal shear in the deck and in the bottom near the side wall would not be as large as it would be in the side wall near the dock and in the bottom, respectively.

There are many difficulties which are met with in the distribution of the longitudinal steel in the cross-section of the vessel. It seems reasonable to suppose that the most effective position for the longitudinal steel would be as near the sides as possible; or, in the case of vessels with longitudinal bulkheads, as near the sides and the bulkheads as possible. This merely groups the steel close to the members which take the shear.

Shear Values Used Higher than Usual

The maximum shears acting upon the vessel occur at approximately the quarter points of its length. Both for hogging and sagging it will be found that at a point near amidships the shear will become zero. As the vessel passes from hogging to sagging it will be found that the shear may not be zero at the center of the length of the ship as given by these two cases, but may be in some instances two-thirds as much as the maximum shear. It would seem consistent practice to

carry the scheme for the shear reinforcement continuous between the quarter points.

Two systems of reinforcements may be employed, one in which the reinforcement runs diagonally and another in which the reinforcement runs vertically and horizontally. There are many practical considerations which require study before the choice may be made between these two systems of reinforcement. These considerations will be pointed out in considerable detail in the discussion to follow concerning types of framing.

The shearing unit stress which is used in the design must, if possible, be much higher than that used in building practice, in order to obtain a vessel of economic weight. Early designs made by the department were based upon the unit shearing stress of 300 lb. per square inch. A later design was raised to 400 lb. per square inch and the department is at present engaged on a design of an oil tanker of 7500 tons dead-weight capacity, using approximately 500 lb. per square inch in shear.

The department has conducted some tests at the Bureau of Standards laboratory at Pittsburgh under the direction of Prof. W. A. Slater of the University of Illinois. Although these tests do not by any means cover the field of ship construction, they do justify the use of the shearing values above mentioned, provided that the proper value be assigned to the unit stress in the steel in a tensile direction. For instance, if when designing with a unit shear stress of 500 lb. per square inch the vertical shear bars are obliged to carry all the shear at 10,000 lb. per square inch in tension, the combination will be worked at a factor of safety of approximately 2.5. From the tests at hand it seems reasonable to limit the tensile stress in vertical bars to 10,000 lb. per square inch. It is possible with these unit stresses to use the formulas proposed by the Joint Committee for the design of members in shear.

The design is usually made to meet the shearing stresses in the sides, and if the shearing reinforcement is carried around the bilge and gunwale into the bottom and the deck, it would be expected that the shearing stresses in the bottom and in the deck were amply provided for. This is the practice at present in use by the department.

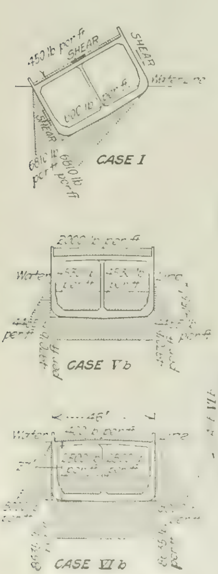
Cracking will occur in the use of shearing values and steel stresses mentioned above if these stresses are developed. These cracks, however, are incipient and are not calculated to admit water even under considerable head. This is being investigated to determine approximately the size of crack above which seepage may be expected. It is believed, however, that such cracks will not interfere with the range of unit stresses mentioned above.

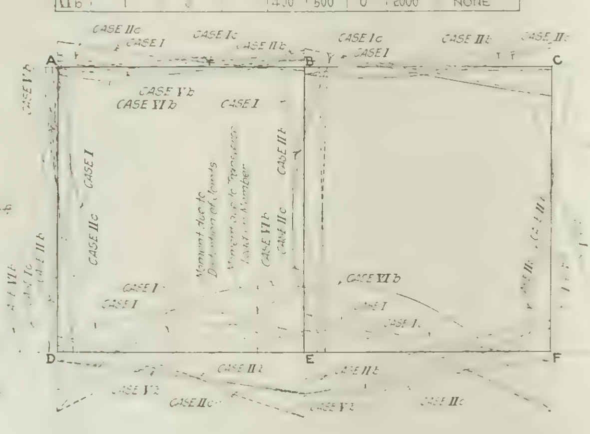
The transverse strength of a vessel is usually supplied in wood and steel by ribs or frames. The same provision for strength has been maintained in the concrete vessel. If the frame type is used the water pressure against the hull is transmitted immediately to closely spaced transverse frames. On the other hand, if the Isherwood system is used, the water pressure against the shell is transferred to widely spaced transverse frames through the action of closely spaced longitudinal stringers. These frames may take various forms to withstand the pressure against the ship, such as an open rectangular frame, an arched frame, a frame with intermediate hold beams or decks and stanchions, and a frame with some form of trussed bracing.

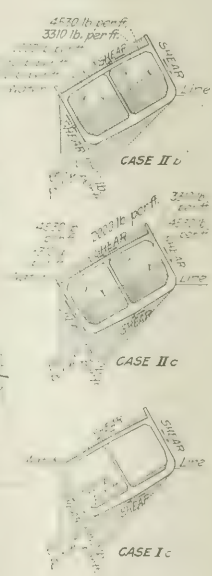
Practice in commercial naval architecture is at present to proportion the sizes of the transverse ribs and other members by data based upon previous experience

TABLE OF LOADING CONDITIONS

CASE NO.	STANCHION	LIST IN DEGREES	IMMERSION	LOADING IN POUNDS PER FT. DEAD DECK	DEAD HOLD	LIVE DECK	LIVE HOLD	HORIZONTAL HOLD LOAD
I	1	30°	ONE SIDE & BOTTOM	450	600	0	0	NONE
Ic	1	30°	DO	450	600	0	0	NONE
IIb	1	30°	DO	400	500	1600	4030	[illegible] STANCHION SIDE
IIc	1	30°	DO.	400	500	1600	4030	[illegible] STANCHION SIDE
Vb	1	0	15.5 FT.	400	500	1600	4030	NONE
VIb	1	0		400	500	0	2000	NONE







CRITICAL LOADINGS AND BONDING MOMENTS USED IN TRANSVERSE ANALYSIS OF GOVERNMENT 3500-TON CONCRETE SHIP

with various weights of frames. The rule books of the Registry Societies, for instance, often form the basis of a design of a steel or wood merchant ship, the sizes of frame members being taken directly from the tables therein.

Two methods are followed at present in the design of frames for concrete ships. The first relies upon the rule book to determine the size of a steel frame for a vessel of similar dimensions, and then duplicates this steel frame in concrete. The second method assumes possible exterior water pressures or interior cargo pressure, or combinations of both, and analyzes the frame according to some phase of the elastic theory. This insures the determination of the bending moments and shears developed under the loads applied which may be cared for by properly designing the members to resist them. If the transverse frame is formed of curved members for the most part, it is analyzed by some one of the various arch theories. If the members, however, are arranged in some form of polygon, the method of slope deflections may be found to give a ready solution. An ingenious treatment of slope deflections was independently developed by G. A. Maney and published by him in "Bulletin No. 1, Engineering Studies, University of Minnesota," in March, 1915. As an approximate check on results comparison may be made with steel vessels of similar size, the seaworthiness of which is known.

There are many advantages and disadvantages in each of the types of interior framing at present proposed or in use. The Isherwood and the frame types are the most common and have received the most consideration. The Isherwood system provided for its local stresses in the slab by rods running around the ship's girth and hence normal to the section of longitudinal stress. The ribs running between the wider spaced frames, however, are subjected to bending, which bending is in the section of the longitudinal stress and therefore must be considered in making the combination for maximum stress. The frame type, on the other hand, reinforces against local stresses in the slab by means of rods running longitudinally in the shell. It may be readily seen that this fact reduces the efficiency of the longitudinal steel because of its effect in lowering the component tension which is available for resisting longitudinal flexure. It is asserted by some that the frame type proves an inferior system when hogging or sagging occurs, because of the absence of longitudinals between frames to assist in carrying the compression.

Torsional Strength Important

Torsional strains in the vessel are the most difficult to compute. The stresses set up are essentially shearing stresses which must be carried by the shell of the ship. Since the common form of vessel is wider than it is deep, the maximum torsional shear is to be found in the deck and bottom, at the center line of the vessel. Because of the openings necessary in the deck the torsion produces the most severe results near the midship section in the neighborhood of the hatch openings, particularly at their corners. The torsional moment will not exceed a fourth of the loaded displacement of the vessel multiplied by its maximum righting arm. This will be somewhat excessive for the larger vessels now under design. The maximum torsional stress will not occur simultaneously with the maximum longitudinal stresses, because the vessel must be in a quartering seaway, with the wave period shorter than the vessel's length.

Details of equipment are no different from similar details for vessels constructed of other material, but the method of attachment employed with each separate fitting is very often far different from the method of attachment employed in steel or wood ships. Special care must be exercised in placing any casting which penetrates the outer shell or any casting which passes through any water-tight bulkhead. Many of the attachments on the deck and in the interior of the vessel may be made by molding the anchor bars permanently in concrete at the time of pouring. Any fitting, however, which is apt to require replacement should be so attached as to be removable for repair or renewal. The most difficult attachment of all is the cast-steel stern frame of the vessel. This frame supports the rudder and the after end of the stern tube, so it is required to take the lateral thrust of the rudder and the vibration of the propeller. The shoe of the stern frame which connects the lower end of the rudder stock at the point of juncture of the keel with the lower end of the stern post is so designed as to be able to withstand the riding of the vessel on a bar or other obstruction. Particular attention is paid to the ease with which the stern frame may be repaired if once broken. It is probable that a large percentage of breakage of stern frames on concrete vessels will occur in the shoe or in the lower end of the rudder stock. This portion of the stern frame should be so scarfed as to be removable for repairs. The frame may be designed so that the whole stern frame may be detached from the hull. This may be accomplished by putting on cheek plates which extend from either side of the stern frame casting back along the side of the skag or surface of the ship at the stern. The reinforcing rods may be rigidly attached in a number of ways to the inner face of these plates. In some instances these plates may be cast as flanges from the stern frame and the same method of attachment of the reinforcing bars effected.

Water-Works Material and Labor Go Up

Commenting on the fact that water rates at Los Angeles were reduced during 1917, the Department of Public Service of that city, in its July "Bulletin," points out that labor and materials have gone up in price in the past three years and that it has been necessary to make "serious retrenchments" in improvements, extensions and reconstruction. Increases in the cost of materials and of labor in 1917-18 over normal prices paid in 1914-15 are thus summarized in the bulletin: Cast-iron pipe, 124%; galvanized pipe, 80 to 149%; pig lead, 68%; steel pipe, 214%; fuel oil, 149%; brass goods, 102 to 116%; cement, 50%; well casing, 393%. Increases on other materials are about parallel to the foregoing. Unskilled labor has increased one-third in cost, and skilled labor has advanced 50%, without the department being able to compete with war industries, so that its very valuable construction engineers, foremen and mechanics are leaving city employ for shipbuilding and other trades.

St. Louis Checks Public Works But Pushes Post-War Plans

Big Sewer and Paving Programs Heavily Cut—Local Materials Go Up—Plans for All Projects Being Continued

By W. W. Horner

Chief of Design and Construction, Division of Sewers and Paving, Board of Public Service, St. Louis, Mo

EARLY in 1918, the Board of Public Service, St. Louis, reviewed all contemplated improvement work in the hands of the Division of Sewers and Paving and arranged a tentative program for the year. Under this program it was proposed to defer all large sewer work, amounting to about $15,000,000, for which it had originally been proposed to issue bonds. This work was made up of the River des Pères main drainage project and storm-water relief sewers for a part of the older section of the city. The only sewer work proposed consisted of about $200,000 worth of small extensions. Bids were recently received for a portion of this work.

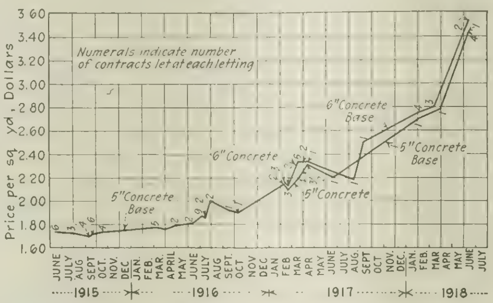
One contract originally estimated at $65,000 was awarded at $95,000, as it was considered to be essential to the operation of certain necessary industries. Another contract for sewers in a residence section, for which the bids were practically equal to the city's estimate, was rejected on the protest of property holders that the money was necessary for expenditures in other directions. This plea was accepted by the board, as the district was partly served by private sewers. Other bids exceeded the estimates by 10 to 15 per cent.

At the beginning of the year the street and alley paving work under procedure amounted to 152 contracts, estimated at $1,750,000. Of this amount it was decided to defer about half, some contracts for a period of one year, others to the end of the war and still others to await lower prices. Of the remaining amount, the city has awarded 53 contracts, amounting to about $520,000. All of this amount has, however, been let on a rising market and probably at an average of 30% above the estimates in the preliminary program.

As an example of the rate of increase, the curve for brick paving is given herewith. The city was prepared to proceed with work at prices of $2.75 or $3 but it was felt that the June, 1918, bid of $3.50 made it necessary to reconsider the whole situation. A canvass was made of the sentiment of property holders and a careful analysis of the value of the paving to the city at large. As a result, six proposals of the June letting amounting to $156,000 were rejected and these items laid over indefinitely.

In rejecting these projects the board was of the opinion that the bids were probably reasonable under the circumstances and that the work could not be obtained at a lower price for a number of years, but reached its adverse decision on the ground that the high prices indicated that the labor and material were seriously needed elsewhere, and also that it was inadvisable to force the citizens to spend money for this purpose when so many demands were being made on account of matters related to the war.

It appears, moreover, that if a decision to defer work had not been reached in this way, the same effect would have resulted from the curtailment of materials and the shortage of labor. This is all the more notable because the materials entering into brick pavement in St. Louis are entirely local in their origin. Sand is dredged on the city river front. Stone comes from local quarries. There are two cement mills practically within the city limits, and the largest paving brick yards in this district are quite centrally located in St. Louis. The local brick companies have found it necessary to advance paving brick from 88c. per square yard in 1914 to $1 at the end of 1917, $1.15 this spring and $1.30 at the present time. This advance in brick is due to the increases in the price of coal and labor, the former increase being due in part to higher freight charges. On account of high labor cost both sand and stone have increased in price from 20% to 40%. The actual labor used by the contractor has increased from $2.50 for a 10-hour



BRICK PAVEMENT PRICES GOING UP AT ST. LOUIS
Prices are averages of low bids for number of jobs indicated at each letting and include concrete base

day to $3 for nine hours and in some cases 35c. per hour. Labor used on sewer work has gone much higher, in some cases to from 40 to 45 cents.

Brick manufacturers may soon find it necessary to close their plants on account of having used up the amount of coal allowed by the fuel administration. Already a large sewer pipe manufacturer has announced that he will have to close about Aug. 15.

Sheet asphalt materials are also of local origin, except the asphalt itself, but several contracts are at present held up, awaiting Government license to purchase the asphalt.

Increased freight rates and the uncertainty regarding the final rulings under the new rates make it almost impossible at present to obtain quotations on any material where railroad transportation is involved.

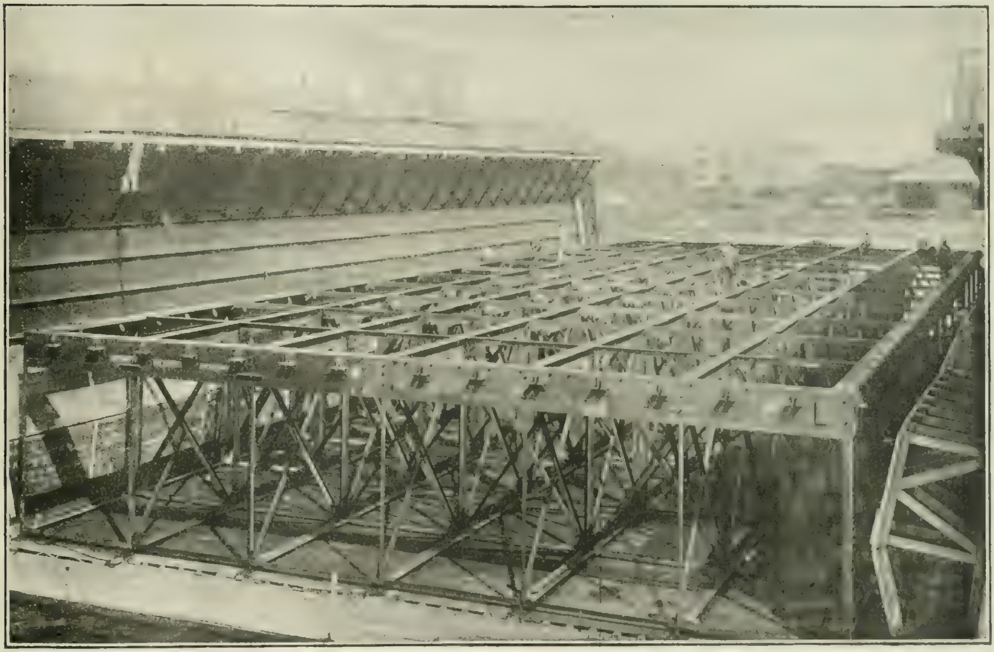
As a result of this unsettled condition, St. Louis will probably defer a considerably greater portion of its improvement work than was originally contemplated. If the transportation and labor situation shows a tendency to become very stable, probably a number of projects will be offered for bids in August, but decision on most will be deferred at least until next season.

In the meantime the city is going ahead with the preliminary work for all its contemplated projects. It is securing the passage of ordinances, preparing plans and specifications and is laying aside finished results until the arrival of the opportune time. As a result, the city now has partly completed the necessary procedure for $12,000,000 to $15,000,000 worth of sewers and pavements to be brought forward after the war.

Construction of the Pearl Harbor Drydock Completed

Novel Method of Placing Unit Sections of Concrete Base and Walls from Floating Dry Dock and Building Upper Works in Movable Cofferdams Put Through in Two Years

PEARL HARBOR dry dock in Honolulu harbor, Hawaii, constructed by the radically new method of floating into place massive concrete sections weighing close to 8000 tons apiece, is rapidly approaching completion. All 16 of these sections are in place and have been connected up by tremie-placed concrete joints up to high-water line. There remain only the completion of the installation of the mechanical equipment, the placing of the steel caisson gates and the continuation of the sectional joints from the high-water line to the top of the dry dock. The first service test of the structure is expected to take place late in July.

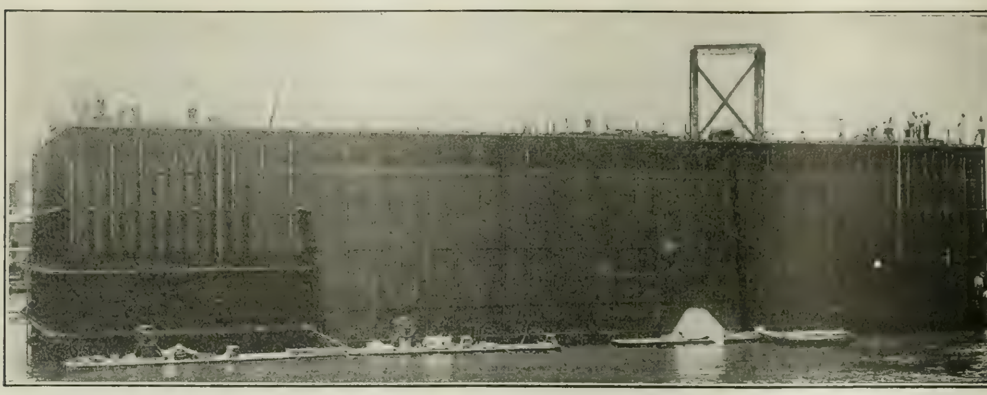


STRUCTURAL STEEL REINFORCING WAS ASSEMBLED ON FLOOR OF FLOATING DOCK

The Pearl Harbor dry dock, being built by the United States Navy Department, is 1029 ft. long out to out, 152 ft. wide out to out and has a clear water basin 1010 ft. long and 101 ft. wide at the bottom clearance. It is 43½ ft. deep from top of coping to floor. The dock has a long history. It was originally planned about 10 years ago, and construction started soon thereafter. On Feb. 17, 1913, a blowout occurred in one of the cofferdams and stopped all construction work on the dock. The Bureau of Yards and Docks of the Navy Department early in 1915 adopted a new plan for the construction, and a supplemental agreement with the original contractor, the San Francisco Bridge Co., of San Francisco, was entered into. Construction work was soon started. An extensive report on the dry dock, including the history of the early construction and a full description of the investigation preceding the adoption of the new design appeared in the *Transactions* of the American Society of Civil Engineers, Vol. 80, 1916, p. 223, in a paper entitled "Pearl Harbor Dry Dock," by Civil Engineer H. R. Stanford, U. S. N., then chief of the Bureau of Yards and Docks of the Navy Department. Current reports on the new design also appeared in *Engineering News* of Jan. 14, 1915, p. 87, and *Engineering Record* of Jan. 16, 1915, p. 82.

The revised scheme of construction involved the dividing of the 1000-ft. concrete structure into 16 transverse sections, each 60 ft. long and the full width of the dock, the building of a portion of these sections as precast units on a floating dry dock, the sinking of these units onto a prepared and piled bottom, the continuation of the construction of the sections—that is, the side walls and the upper part of the base—inside a cofferdam made up of a floating tank movable from section to section, and the final joining together of the 10 separate sections partially by tremie-placed concrete.

Each section was built on a floating dry dock 160 ft.



DOUBLE BOX STEEL COFFERDAM WAS USED TO CONCRETE EACH SECTION IN TURN, BEING DETACHED AFTER SIDE WALLS OF DRY DOCK WERE COMPLETED

long and 100 ft. wide, with lifting capacity of 3500 tons. The actual weight of the sections handled was more than 7000 tons, but their load on the floating dry dock was reduced by flotation. Before the floating dock was constructed it was found that it could as well be made to conform to the requirements of the Inter-Island Steam Navigation Co., at Honolulu, and it was accordingly designed with that end in view. It was sold to the company after the completion of the Government work. The floating dry dock was designed by William T. Donnelly, of New York. It consisted of five wooden pontoon sections and continuous steel sides. Each section was served by two 10-in. centrifugal pumps operated by a 150-hp. motor on each dock wing.

The operations in constructing a concrete section in the floating dry dock began with the placing of the bottom forms, which were laid directly on the deck of the floating dock. These forms were made in sections, and to facilitate their recovery so they could be used over again, they were fastened together with wire ropes. Heavy reinforcement of structural steel was placed in the bottom of each concrete section in the shape of heavily crossbraced longitudinal trusses. These trusses have

HUGE CRANE PART OF FLOATING EQUIPMENT

a depth of 16 ft., the thickness of the dock bottom, and are placed on 12-ft. centers with 12-ft. panel spacing. All four sides of the framework terminate on top in a heavy structural shape to which lugs were attached to receive the anchor bolts used to connect the sections to the steel tank cofferdam. About 120 tons of structural steel were used as reinforcing in each section.

All of the forms used were of wood. The forms for the sides around the structural steel framework were attached to the sides of the floating dry dock and so hinged that they could be swung back clear of the concrete. With steelwork and forms in place, concrete was poured over the entire area of the section to a depth of about 8 ft. Around the sides and end of the sections the concrete was brought up to the full depth of 16 ft., in order to form in conjunction with the tank a floating caisson.

After this first stage of the concrete pouring had been completed, the floating dock was submerged, the steel tank floated in over the concrete section, brought accurately into position, and a few of the anchor bolts were made fast by divers. The floating dock was then raised enough to bring the joints between the concrete section and the tank above water level. This could be done without exceeding the 3500-ton capacity of the dock. All of the remaining anchor bolts were then placed. To secure a tight joint, strips of canvas were previously laid on the exposed steel shapes bordering the concrete section, and after the anchor bolts had been tightened a continuous row of wedges was driven along the joint on the inside. Leakage was thus practically eliminated.

The next operation was to submerge the dry dock fully so that the steel tank, together with the attached portion of a concrete section, could be floated clear. The steel tank with the concrete attached, forming a floating caisson, was then towed into position and carefully sunk in place by admitting water to the tank.

Previous to this the excavation of the site was made entirely by dredges—dipper, clamshell and suction dredges all being used. The formation of the underlying material necessitated a pile foundation, and about 12,000 piles were driven and cut off about 1 ft. below the finished grade desired. The site had been excavated

with great care to a uniform grade, and after the piles were driven a shallow layer of crushed rock was placed on the bottom and swept to grade by dragging a heavy steel girder back and forth.

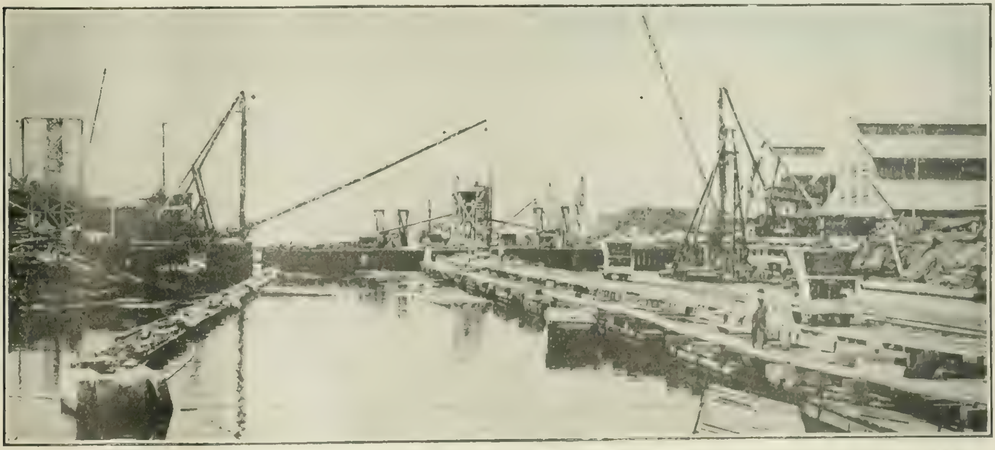
In placing this finished layer of crushed rock, special precautions were taken to keep down to a minimum the amount of leveling that would be required. Timber framework was used both for taking soundings and insuring the accurate placing of the rock. This framework was 12 ft. wide and extended entirely across the site. Cross timbers divided it into a succession of openings 12 ft. square. From each corner of these squares soundings were taken and the amount of rock necessary to bring the foundation up to grade was then dumped in that square. After this method had been applied for the portion of the site to be occupied by a section it remained only to scrape off the tops of a series of small pyramids. After this, inspection by divers showed the foundation to have a uniform level grade.

The steel tank served the double purpose of affording, in conjunction with the concrete section, the necessary buoyancy, and providing cofferdams in which the walls and floors of the sections could be built. It was 152 ft. long, 60 ft. wide and about 45 ft. deep. The central portion, 104 ft. long, consisted of a steel tank. Attached to each end of this tank was a steel inclosure 24 x 60 ft. in plan, without bottom, which was used as a cofferdam. The tank itself had a bottom supported on a structural steel framework 6 ft. above the finished floor of the dock, so that there was at all times a 6-ft. clearance between the bottom of the tank and the top of the concrete section. Thus, after a tight joint between the steel tank and the concrete section was made, the open spaces could be pumped out and the tank with the concrete section floated into place, sunk and held in place by water admitted to the tank. The remainder of the concrete—that is, the side walls and the upper 8 ft. of the bottom—could then be placed entirely in the dry.

After the concrete work had been finished on a section in place, the steel tank was removed by releasing the anchor bolts, letting the water in the tank run into the cofferdam and pumping out the rest of the water so that the tank would rise free of the concrete section. As the tops of the concrete walls extended above water level, gates were provided at bottoms of the inboard cofferdam walls so that the floating tank could be towed off without interference. For pumping out the central section of the steel tank, 15-in. centrifugal pumps were used, belted to 125-hp. motors. Pumps and motors were carried in an elevator cage which could be raised and lowered to suit the level of the water.

SIDEWALLS BUILT WITHIN STEEL TANK

To resist the water pressure against the cofferdam walls after the tank had been sunk it was necessary to provide struts extending from wall to wall. For the greater portion of their length these struts were made of reinforced concrete. Thus, as the concrete walls were built up to the struts they were embedded and the work proceeded without the interruption that would have been occasioned by the necessity of removing tim-



CONCRETE WAS CARRIED TO SECTIONS AFTER BEING PLACED ON FLOATING BRIDGE DOWN CENTER OF DOCK

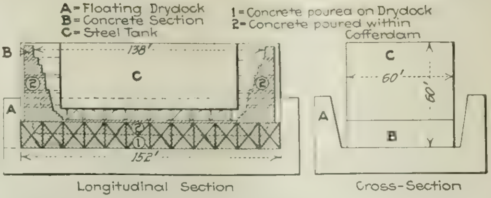
ber struts. The ends of the reinforced-concrete struts were made of timber, and contact with the side walls was through wedge-shaped shoes which could easily be tapped out when removal became necessary.

While concrete was being placed in the cofferdams the structural steel and concrete bottom of another section was being built up in the floating dry dock. When the steel tank was released it went at once to the floating dry dock to be attached to the next section. For the most part, a complete cycle of operations on a section was finished in from 30 to 40 days. The first section was sunk on July 7, 1916, and the last one on Feb. 13, 1918.

The shore end of the dry dock is circular in plan and is formed by 14 concrete blocks cast on shore, each weighing about 145 tons. These blocks are about 35 ft. high and of varying widths at the base. All these blocks were set on concrete, placed inside the floating cofferdam and provided with dowels for accurately determining the exact position of each block. On account of the great height of these blocks, the bottom section had to be leveled with great accuracy and its surface floated to a true level, in order to insure true alignment. The blocks were handled bodily by a large floating gantry crane owned by the United States Navy.


MONOLITHIC 145-TON BLOCKS FORMED INSHORE END

A space of 4 ft. was left between adjacent sections of the dock as they were put in place. On the bottom this space was later divided up into 12-ft. lengths by cross forms, or bulkheads, in which concrete was deposited by tremies. In the tremie work great care was used to keep the end of the concrete pipe submerged in concrete, to prevent washing. Concrete to a thickness of about 8 ft. was so deposited in the joints, thus leaving an additional 8 ft. to be deposited in the dry after the dry dock is pumped out. In the side walls the joints were filled in their entirety, tight-fitting cofferdam shields being used for this purpose. These were fastened securely into place with hose gaskets, so the space could be pumped out and the joint concreted in the dry.



SECTIONS BUILT SUCCESSIVELY IN FLOATING DOCK

The steel caisson, or gate, for the entrance to the dock was furnished by the Government and is now at Pearl Harbor. It is expected this will be put in place about Aug. 1, after which time the dry dock will be pumped out for the first time. The upper portion of the joints in the bottom between sections will then be concreted, and the final layer of pavement over the entire floor of the dry dock will be placed in the dry. It was necessary to leave this until the last so that bilgeways and trusses could be accurately located at exact grade and alignment.

The contractor opened quarries about 12 miles from the site, where most of the materials for concrete were obtained. As no sand suitable for concrete is found in the islands, lava rock had to be crushed to obtain a substitute. A mixture of two parts of this ground rock and one part coral sand was used in place of sand for all concrete poured in the dry. This combination showed satisfactory tensile strength. For all concrete deposited through tremies, sand brought from Puget Sound was used.

Two concrete mixing plants, each equipped with a 2-cu.yd. mixer, were established. One was at the floating dry dock, for supplying concrete to the work at that point, and the other was at the shore end of the site, whence the mix could be supplied on a track over floating pontoons to the successive sections as their walls were built up in place. From cars on this track, buckets were picked up by traveling derrick on either side of the site and dumped into chutes delivering in the cofferdams. Two-cubic-yard steel cars were operated on the floating track by means of a cable from the mixer plant. This made a flexible arrangement and permitted of ready extension of the track as additional sections of the dock were completed. The total amount of concrete used in the dock is about 140,000 cubic yards.

The pump well was constructed as a separate concrete structure built upon the floating dry dock in the form of a reinforced-concrete box with buoyancy enough to float. It was removed from the floating dry dock and the sides were built up while it was floating. This pump well is about 96 ft. long, 40 ft. wide, and the full depth of the dock. It will be sunk into position near the gate to the dock and connected to the main structure by concrete deposited through tremies.

At the inception of the work the contractor installed a steam-electric power plant operating two 250-kw. generators. This was shut down when the Government

Navy Yard plant was put in operation and was found a more economical source of energy. All contractors' equipment and machinery was motor-driven wherever possible. This included a rock crushing plant, a sawmill, a planing mill, a machine shop, pumps, concrete mixers, saws for cutting piles under water, etc. Derricks and pile drivers were operated by donkey engines using fuel oil. The labor problem was a serious one, as there was a scarcity of skilled labor in the islands. Most of the mechanics and enginemen had to be sent out from the Pacific coast. The common labor consisted largely of Japanese and Hawaiians. The latter were found to learn quickly and developed into good derrick engineers, piledriver men, riveters and divers.

The work has been carried out under the general supervision of Admiral C. W. Parks, now chief of the Bureau of Yards and Docks, and until recently stationed at Pearl Harbor. The contract for the work was held by the San Francisco Bridge Co., S. G. Hindes, president, and W. F. Dillingham, manager for the Hawaiian Islands. Construction was entirely in charge of Francis B. Smith, chief engineer for the contractors.

Some Things Engineers Serving as City Managers May Be Expected to Meet

Notes Based on Two Years' Experience at San José—Accounting, Civil Service, Legal, Health, Fire, Police, Engineering and Political Problems Solved

BY THOMAS H. REED
City Manager, San José, Cal.

SO MANY engineers are in these days being called upon to act as city managers that a brief sketch of the things that they may expect to meet in the office should prove interesting to the readers of *Engineering News-Record.* It should be borne in mind that the city manager is primarily an executive officer and that the first quality which he must possess is executive ability. It should be further remembered that the management of a public enterprise such as a city government calls for something more than mere executive ability. It is necessary to manage not only the city government but, in a certain sense, to manage the people of the city as well. It is absolutely essential that there should be public approval of a city administration.

First Task of City Manager Under New Charter

The first task which confronts one who, as did the author, becomes the first city manager under a new charter, is that of a very thorough and complete reorganization of the city administration. San José had been governed, prior to July 1, 1916, like hundreds of other American cities, in a somewhat haphazard manner. There was a variety of independent officials, boards and commissions, with no one supreme authority. There was no habit of looking to a single head for direction. This habit had to be created, and it was created with some difficulty. There were officials in charge of certain departments, who, belonging to the old political school, took their lead from forces outside the city government. It was necessary to remove some of them because they could not realize there was under the new plan but one head. There formerly was considerable friction between departments. Each was jealous of another, and it took time and effort to get them all working together harmoniously under a common leadership. With two or three exceptions, this was accomplished without changing the personnel of the departments.

Next in importance to engendering this habit of united effort the most necessary improvement, it was found, was a modern accounting system. San José, like many other cities, had a system which kept account of the inflow and outflow of cash, but nothing else. It gave no administrative information. When the city manager plan was inaugurated it was impossible to tell in just what condition the previous administration had left the finances of the city. This situation was immediately corrected by the installation of a first-rate accounting system which brings to the attention of the city manager all the information usually offered to the manager of a large private corporation. The importance of this cannot be overestimated. When any organization grows beyond the point where its transactions can be carried in the head of some individual an adequate accounting system becomes immediately necessary. It is the eyes and ears of the manager. It keeps him in touch as nothing else can do with what is occurring in the various departments.

Putting Employees on Merit Basis

Next in importance was the installation of a method of placing the procuring of municipal employees upon a merit basis. This had been provided for by the new charter, and as soon as that document went into effect the civil service commission was appointed and proceeded to adopt rules and to conduct examinations with a view to eliminating politics from appointments. In many instances examinations were held for positions which, under the charter, were technically outside the classified service. Such a system of merit appointments had a tendency to improve the quality of municipal employees and to remove the corrupt influence of politics. From the manager's point of view, perhaps, its greatest advantage is the happy release it gives him from the pressure of office seekers and office seekers' friends. A manager cannot help thinking at times that he could by the use of his own untrammeled judgment make better selections for office than can be made through the artificial medium of examination. But on

the whole his administration is better off for having a more or less automatic method by which employees can be selected.

Importance of City Attorney

Another matter of great general importance to the successful reorganization of a city government is the prompt and cordial coöperation of a competent city attorney. This is true even where, as in San José, the city manager was himself trained as a lawyer. It would certainly be a matter of very great importance where the city manager was an engineer by profession. Next to the manager the city attorney is the most important general officer of the government. Upon his wisdom and helpful spirit depends to a large extent the success of every venture.

Having taken care of these concerns of the whole administration, the next step is the internal reorganization of the several departments. In San José under the old system the city money was kept partly in an unsafe vault in the city hall and partly in safe deposit boxes in one of the banks. It drew no interest. A fund of \$49,000 lay in the vault in actual gold for 16 years without one penny of return. One of the first steps of the new administration was to deposit the public funds in a bank which agreed to pay 2.52% interest on average daily balances. As part of the transaction, the bank furnished gratuitously the services of its cashier as treasurer. Altogether, a permanent saving of \$5000 a year to the city was accomplished in this manner.

Full-Time Health Officer Engaged

The health department had been conducted as the health departments of small cities frequently are, by a physician who received \$100 a month for a part of his time. The amount of assistance received by him was inadequate, and the work of the department was necessarily incomplete. The new administration recognized at once the necessity of improvement in this direction. The department was placed under the nominal headship of one of the leading physicians of the city, and an assistant health officer of high professional training was employed to give all his time to the work. A diagnostic laboratory was added, and there has been a pronounced improvement in public health conditions.

The fire department illustrates what can be done under the city manager form of government without change of personnel. The fire chief was a man of excellent capacity, who had been obliged, however, to devote a large part of his time to the kind of politics necessary to retain his office. He was told that under the new régime all that would be required of him was to run his department properly and that if he did so he would be sustained. He has loyally and steadfastly followed out this suggestion. Under the old system his control of his men was inadequate, because they could successfully appeal over his head to the members of the board of fire commissioners. Under the new system his discipline has been greatly improved, because he is an unquestioned authority in his department. The improvement in the efficiency of the fire department is variously estimated at fifty to one hundred per cent.

The chief of police in office at the time the new form of government went into effect was one of those officers who failed to give adherence to the new order. It was found necessary to remove him and to put in his place a man who was prepared to devote himself exclusively to bringing his department up to the modern standard of efficiency. Perhaps the most important single change in this department was the introduction of an adequate system of finger-print identification, the absence of which had long been a source of criticism on the part of up-to-date police officers in neighboring cities.

City Engineer Made Important Executive

Under the old system the engineering department had been entirely separate from the street department. The new charter provided for a department of public works of which the city engineer was to be the head. Experience has justified this arrangement. Under the old system the engineer received \$150 a month and had nothing to do except prepare plans and specifications and supervise construction work. Under the new system he became a very important executive officer in charge of the department through which passed about one-third of the money expended by the city. The salary of the city engineer was fixed at \$275 a month plus an allowance for transportation. A very competent young man of both engineering and executive experience was obtained for the place. Under his management the work of the public works department was done more cheaply and at the same time better than ever before.

It is not to be supposed that these changes were made without arousing opposition. The removal of the chief of police brought down upon the manager the wrath of the leading newspaper and of numerous politicians. The change in the office of the city engineer aroused great criticism. Many persons affect to see in the new arrangement a too great allowance for overhead. They do not realize the change in the nature of the department. The \$3000 expended for the accounting system has been regarded by some as a reckless extravagance, and there even have been persons who have pointed the finger of ridicule at the system of identification employed in the police department. Similar criticism awaits the conduct of the city manager in any city, and can be avoided only by refusal to meet the plain obligations of his position. No man of courage or vision will be turned aside from his purpose by reason of the fact that opposition of the character described is to be his portion. It has been demonstrated in San José that the people are inclined to ignore the council, which is supposedly responsible to them for the acts of the manager, and to direct their attention straight to the manager himself.

City Manager Plan Works Admirably

There can be no doubt that the city manager plan of government works, and works admirably. The experience of San José is sufficient proof that even under somewhat difficult circumstances it will produce administrative and financial results fully up to the expectations of its advocates. The great difficulty with the city manager plan of government is the difficulty which underlies all democratic governments; namely, the attitude

of the people toward their own institutions and representatives.

A successful manager should be a man capable of leading public opinion. This does not necessarily mean that he should be a speech maker or a brilliant writer, but a man with some idea of what the public wants and of sufficient pliability of temperament to adjust himself to the prejudices of the people. I have known of men who have won distinct success as managers of great corporations, but who, on taking up political tasks such as that of mayor of a city, have met with failure—not so much because their plans were bad as because their methods were dictatorial. A manager must possess tact as well as firmness, and he must be prepared to handle men—in the widest sense of the term—if he is to succeed. There is no absolute certainty that any city administration will please the public. The present administration in San José, for example, has earned the displeasure of that large section of the public most nearly controlled by the old-time politicians. This is one of the difficulties—grave misfortunes, indeed—of the city manager form of government and of the lot of the city manager, but it is incident to democracy itself.

Algae Growths Increase Value of *n* in Kutter's Formula

Studies Made in 1912-16 in Tieton Irrigation Canal Lined with Reinforced-Concrete Blocks Indicate that Growths Raise *n* from 0.012 to 0.014

By Paul Taylor
Assistant Engineer, United States Reclamation Service, North Yakima, Washington.

ALGAE growths have a marked effect upon the capacity of the concrete-lined main canal of the Tieton unit of the Yakima Project of the United States Reclamation Service in the State of Washington. Observations detailed below indicated that for this canal a fair value of n in Kutter's formula is 0.014. Data on the effect of structural and other local conditions were also obtained.

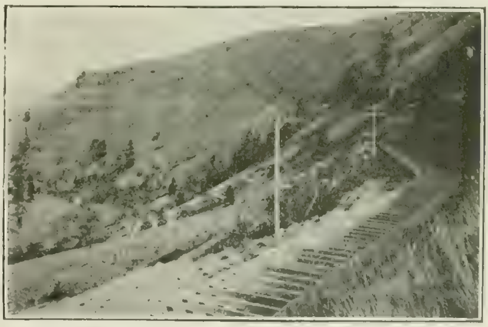
The design of this canal is unique. The structure is approximately 12 miles long, about 17½% of which is tunnels. The greater part is lined with standard reinforced-concrete shapes, 2 ft. long, with a minimum thickness of 4 in. The open section (see view) has a clear depth of 5 ft. 10 in. and an inside radius of 4 ft. 1 1/16 in., the shell being held in shape by a cross arm 4 in. wide and varying in thickness from 4 in. at its union with the shell to 6 in. in the center.

Of the six tunnels, two are short and only about 60 ft. apart, and are lined with standard open-canal shapes. One is lined with monolithic concrete, the cross-section being of the horseshoe type. The roof is unlined throughout the greater part of its length. Where the roof is lined the clear distance is 6 ft. between the base of the invert and the roof, while for the unlined portion the distance is 5 ft. from the invert base to the plane of the side-wall top. The remaining tunnels are alike in cross-section, a standard, circular reinforced-concrete ring being used, the inside radius being 3 ft. ⅝ inch.

To protect the canal during the irrigation season five wasteways have been inserted for handling the water, as the canal is tortuous in alignment and skirts numerous steep, rocky bluffs from which large boulders sometimes fall, temporarily blocking the structure. These wasteways all possess sumps in the canal; the least of these is 9¾ ft. long and 8½ ft. deeper than the canal bottom.

As designed, the canal was to carry 300 sec.-ft., when foul and 326 when clean. The value of 0.012 was assumed for Kutter's n, and the depth of water was to be 5¼ ft., with a freeboard of 7 in. when the slope was 0.00165. From 1912 to 1916, inclusive, data were gathered for the purpose of determining the actual value of Kutter's n in a stretch of the open section, and in 1915 and 1916 further data were secured to determine the application of the coefficient, as found in this section, to the canal as a whole.

When the canal was built gages were located at Sta. 10 + 00, 158 + 35 and 170 + 08. The gage at Sta.

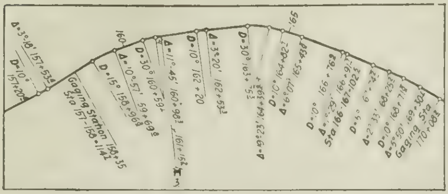


TIETON IRRIGATION CANAL HAS CIRCULAR SHAPE AND IS LINED WITH REINFORCED CONCRETE

10 + 00 is in an earth section, 600 ft. above the standard open-canal shapes, and is of the slope type, supplemented by a float gage. The latter is so arranged in an electric circuit as to ring a bell if the rise or fall of the water surface exceeds a predetermined limit. By the use of this gage a uniform discharge is maintained. The gages at Sta. 158 + 35 and 170 + 08 were installed for experimental use in determining Kutter's n and were so placed as to show the depth of water in the standard section at their situation.

Readings were obtained by the watchman at the headworks. It was his custom to read the gage at Sta. 10 + 00 as he started his daily patrol, pass on down the canal and take the lower gage readings. These readings are fairly reliable, as the water in the canal flows faster than a man can walk.

The alignment of the canal involves numerous curves



ALL THE CURVES IN THE CANAL WERE TO THE RIGHT BETWEEN THE LOWER GAGES

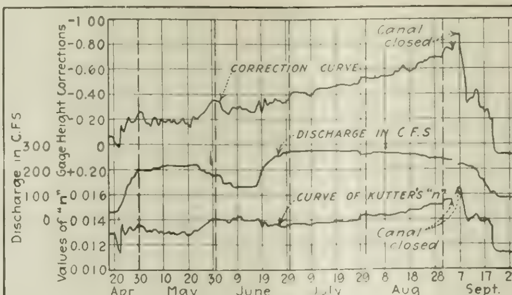


FIG. 3

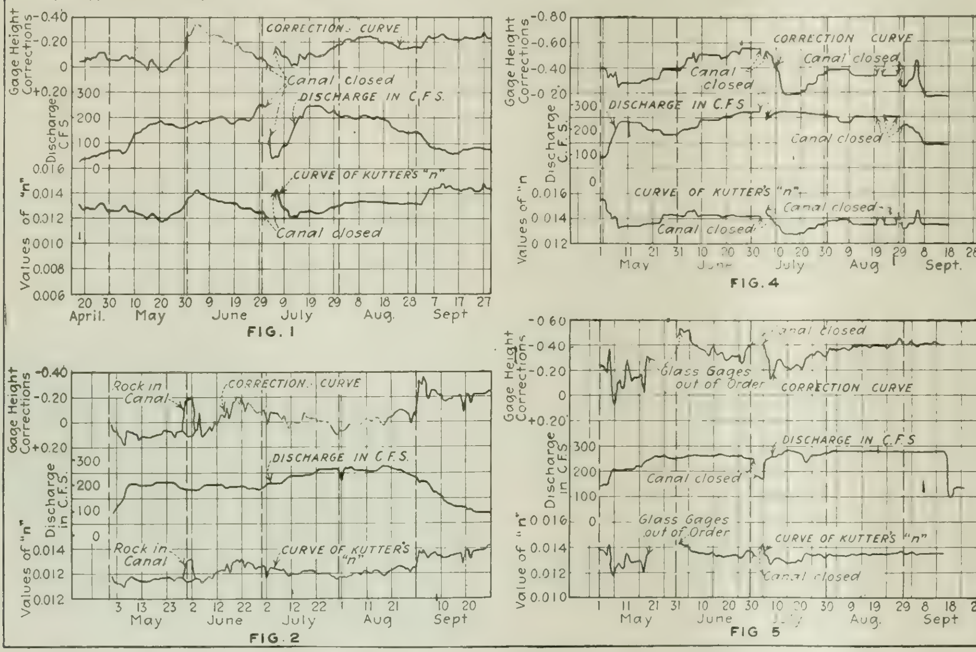


FIG. 1

FIG. 2

FIG. 4

FIG 5

FIGS. 1 TO 5. CORRECTION CURVES WERE USED TO GET VALUES OF KUTTER'S *n* IN TIETON MAIN CANAL
All the observations were made between Sta. 158 + 35 and 170 + 11. The correction curve assumes $n = 0.012$ as correct.

varying from 10° to 100°, many of which are reverse and some of which change the direction more than 90°. It so happens that the general direction between the gages is that of a curve to the right. There are no reverse curves in this stretch, and the sharpest curve encountered is 30 degrees.

Knowing the discharge of the canal secured through the gage at Sta. 10 + 00, the discharge at the lower gages is known, since the losses between are very slight. From the five years' observations a fair record of the variation of n was secured. Knowing the slope, the depth of water and the value of hydraulic radius for different depths, discharge curves for the lined sections based on the Kutter and Chezy formulas were computed and drawn, using values of $n = 0.012$, 0.013, 0.014 and 0.015. The mean observation of both lower gages and the discharge were platted on the curves and the value of n for that particular condition was obtained. From these data the n curves, Figs. 1 to 5, were drawn. The discharges in second-feet are also shown graphically, while the correction curve shows the increase or decrease in depth, depending on whether n is greater or less than 0.012, it being assumed that this value was correct. Negative corrections therefore indicate an increased depth. From a study of these curves it is seen that the value of n generally increases as the season advances, due to the growth of algae on the canal sides.

The lowest portions of the shapes have scoured down to a good wearing surface which is rougher than the higher sides. Fig. 6 plainly shows that the roughness does not vary with the quantity carried, because of the continual changes due to the algae growth. This seasonal growth produces a roughness on the higher sides equivalent at least to that of the bottom wearing surface. In appearance the algae were fine, pale green, hairlike growths, reaching a length of almost 2 in.,

SUMMARY OF VALUES OF KUTTER'S *n* IN LINED OPEN IRRIGATION CANAL, YAKIMA PROJECT, WASHINGTON

Construction Stations From	Construction Stations To	Actual Distance Ft	Slope of Subgrade	Value of *n* Mean	Value of *n* Max	Value of *n* Min	Dates Data Were Secured
16+00	77+18	6,100	0 00165	0 0133	0 0144	0 0122	7-12-16, 7-13-16, 7-14-16
77+18	91+18	1,400	0 00168	0 0139	0 0145	0 0121	7-14-16
91+18	103+18	1,200	0 00161	0 0133	0 0138	0 0128	7-14-16
103+18	156+04	5,300	0 00168	0 0135	0 0147	0 0121	7-14-16, 7-15-16
158+35	170+08	1,176	0 00175	0 0137	0 0142	0 0129	7-31-15
292+40	320+00	2,760	0 00161	0 0124	0 0135	0 0111	7-22-15, 7-23-15
320+00	340+00	2,000	0 00165	0 0127	0 0140	0 0119	7-23-15, 7-24-15 7-26-15
340+00	360+65	2,000	0 00175	0 0126	0 0132	0 0115	7-26-15, 7-27-15
360+65	365+56	500	0 00168	0 0126	0 0132	0 0119	7-27-15
365+56	375+16	960	0 00195	0 0126	0 0132	0 0114	7-27-15
375+16	377+40	905	0 00220	0 0146	0 0160	0 0129	7-27-15, 7-28-15
377+40	389+96	1,205	0 00199	0 0139	0 0148	0 0116	7-28-15
389+96	407+56	1,760	0 00175	0 0136	0 0146	0 0116	7-28-15, 7-29-15
407+56	440+30	3,240	0 00165	0 0133	0 0141	0 0126	7-29-15, 7-30-15
456+84	459+16	230	0 00199	0 0139	0 0146	0 0130	7-30-15

and were attached to the sides of the canal in a green strip about 3 in. wide at the water surface. Each season they become seeded in the concrete at the water mark, producing a series of green horizontal bands when the water is turned out at the height of the season. Constant discharge seems productive of rank growth, while a variable discharge has a retarding effect. When the canal is closed for a few days the growth seems to dry up. It scales off when the water is turned in, causing n to increase at first. As the scale wears off n decreases. In a short time the growth starts again, and increases unless the season is too far advanced. Light is necessary for the growth of the species, as none is found in the tunnels. Warmer temperature also produces ranker growth. During the year 1915 the growth seems to have been early, the season being long with an unusual low-water period and a discharge consequently warmer than the average.

In contrast, the 1916 season was short and the water was cold, due to an exceptionally heavy snowfall and a late season, and as a result so rank a growth was not produced. Fig. 3 is exceptionally interesting, as the 1914 runoff was slightly below the average with a long warm season. The value of n varied from approximately 0.013 to 0.0155. The increase in value was almost constant and produced an increased depth of 0.76 ft. greater than that required at the beginning of the season, which means that 0.76 ft. of freeboard was absorbed by the variation of n. These data are based on mean water surface conditions only. Local conditions produce considerable variation between maximum and minium water surfaces.

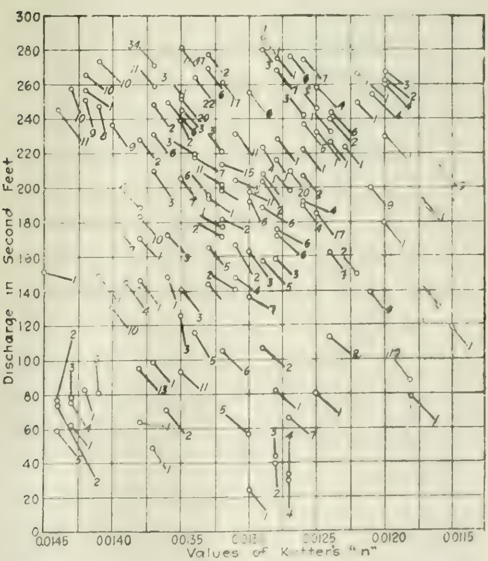


FIG. 6 MEAN VALUES OF KUTTER'S *n* BASED ON TIETON STUDIES MADE DURING SEASONS 1912-16

The figures given show the number of observations made to secure each mean value plotted.

Having obtained some idea of the conditions affecting n between the lower gages, it was desirable to find if these conditions were applicable to the remainder of the structure. Accordingly, during 1915 and 1916 levels were run over most of the canal, obtaining mean maximum and mean minimum water surfaces and elevations of cross-arm bottoms at center, left and right, taken usually at 10-ft. intervals, this distance being greater or less, dependent on the field conditions at the locality in question. The accompanying table summarizes the data thus obtained.

From a study of this table and Figs. 1 to 5, it is evident that, due to the growth of algae, 0.014 seems a fair value of Kutter's n, and that the data secured from the stretch between the lower gages is applicable to the canal as a whole, except localities influenced by curvature, offsets of shapes at joints, settlement of canal foundation, insertion in the canal of wasteway sumps, and velocity irregularities caused by transitions, where allowance should be made for increases in n from 0.001 to 0.002. No data were obtained on the variation of n in the tunnels. This variation is probably not so great as in the open canal, as the growths therein are of a thin, fungoid nature and appear to possess less tenacity than the algae.

Advocates Licensing Drivers of All Vehicles

The advisability of properly licensing all drivers of vehicles in the cities of the first and second classes in the State of New York was called to the attention of the mayors' conference at Newburgh, N. Y., June 11. Police Commissioner Richard C. Enright of New York stated that this would not only give the police authorities a control over chauffeurs, making them more accountable, but would eliminate a class of drivers who employ trucks for petty thieving, and who make up a considerable part of the criminal classes in the cities.

Army Engineer School in France Standardizes Work in the Field

Gives Courses of Training to Men Recommended for Commissions—Operations Conducted Mostly in the Open—Classes Trained in Mining, Pioneering, Bridging, Topography, Camouflage, Sound Ranging and Interpretation of Aërial Photographs—Model Battle Sector Laid Out and Completely Equipped

BY ROBERT K. TOMLIN, JR.
War Correspondent of Engineering News-Record

(Concluded from last week)

THE British say that "an army advances astride a 4-in. pipe." To familiarize our students with water-supply, they are taught the organization of our water-supply service, and the requirements of men and animals in gallons of water daily, and they are warned of the probable difficulties they will encounter. To make these difficulties appear more real, they are worked into interesting water-supply problems, approximating as closely as possible those which occur daily in trench warfare, and which graduates of the Engineer School will be undoubtedly called upon to solve. Working out such examples in a classroom has proved excellent training for the efficient execution of water-supply schemes at the front. The accompanying British official photographs show the kind of water-supply work done at the front.

The inclusive heading of "Pioneering" takes in practically every subject in military engineering except those specifically relating to mines or bridges, and everywhere at the Army Engineer School one sees encouraging evidence that no point has been overlooked.

SOUND RANGING

Students at the school are receiving instruction in certain highly specialized phases of mapping and plotting in connection with artillery work. Among these is sound ranging—the registering of an enemy battery by means of apparatus operating on the general principle of a seismograph. It is disclosing no secret to outline the general principles of this work as practiced by the American Army, inasmuch as the scheme has already received publicity in the French press. In fact, one of the papers gives to French sound-ranging apparatus the credit for locating the long-range guns which have been bombarding Paris since the German drive began, although it is asserted in other quarters that *la grosse Bertha* was spotted by means of aërial photographs.

Briefly, the sound ranging work involves the installation of recording apparatus at three points, some distance apart, the location of each being definitely known in advance. The detonation of an enemy gun will be heard at point A at a certain time, at point B, let us say, a second later, and at point C, two seconds later. Knowing the velocity at which sound travels, it is easy to determine that the gun is a certain distance, x, nearer A than B. By taking A and B as origins, plotting pairs of circles, one radius always being longer by x than the other, and connecting the intersections, we get a curve on any point of which the enemy gun may be located. This curve is obviously a hyperbola, for the difference between the distances of any point on it from the two fixed points, or foci, A and B, is always the same.

Repeating this performance for points A and C we plot a new series of circles, the radii differing in this case by a distance of y corresponding to the time elapsed between the recording of the sound of the shot at A and at C. Again connecting the intersections of these pairs of circles, we get a second hyperbola which forms another locus of points for the gun position. Obviously, the intersection of these two hyperbolas gives the true position of the battery which is doing the firing.

Of course the actual registering of a battery position does not involve all of the clumsy details cited above to explain the principle of the method. Graphical charts have been developed for accelerating the interpretation of the data, and the recording apparatus operates with sensitized paper, which passes into a chemical developing solution and is ready for use in a very short time.

The first thought that comes to mind is that with many guns firing along the front the work of interpreting the sound records would be exceedingly confusing. To some extent this is the case, but with a proper location of the recording posts and practice in reading the records, surprisingly accurate results are obtained. It must be remembered that a gun will probably fire a number of shots from one position and that every time the same *series* of time intervals will be recorded at the three observation posts. Thus, by comparing several records which are apparently complicated by other sounds than that from the gun it is desired to register, it is possible to identify the recurring *series of three marks* on the sensitized paper, eliminate others and spot the position of the battery.

Another aid to confirming the position of an enemy field piece is the method of flash ranging; that is, taking the direction of the flash of a gun at night from two or more posts of observation, the intersection of the azimuths, of course, disclosing the gun positions.

AËRIAL PICTURES AID TOPOGRAPHICAL WORK

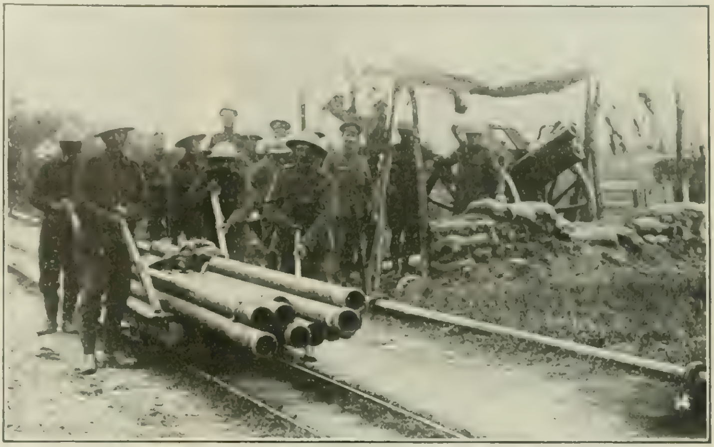
In a previous article, in *Engineering News-Record* of May 23, p. 984, I touched on the subject of the interpretation of aërial photographs for mapmaking and artillery purposes. At the Army Engineer School I had an opportunity of seeing a class being instructed in this fascinating branch of work; the offcer in charge is a former topographic engineer of the United States Geological Survey.

The aërial picture must be accompanied by data giving the approximate height of the camera when the exposure was made, the date and time of day, direction of north, etc. It is examined under lenses and stereoscopes, the latter bringing out objects in relief. The study of shadows is a vital part of the work, for where

camouflage covers up an object from a point of observation overhead the shadow it casts is often the telltale mark by which important bits of information are disclosed. It is clear, therefore, that in the interpretation of shadows it is desirable to know the time of day at which the picture was taken.

Tracks or trails of any sort also are carefully studied, for they always mean activity of some kind—possibly the delivery of ammunition to a dump which is otherwise protected from observation by camouflage. A favorite enemy trick is to place "dummy" batteries in the field to fool the mapmakers. Absence of a track or trail leading to these places shows them up as "fakes." Sometimes, too, "faked" tracks and blast marks are fixed up with the white chalk so abundant in the war zone of France. The canny interpreter of photographs, however, is not misled by these subterfuges.

All of these data are reduced to map form by means



THE BRITISH SAY: "AN ARMY ADVANCES ASTRIDE A FOUR-INCH PIPE LINE." AT THE ARMY ENGINEER SCHOOL OUR MEN ARE TRAINED IN WATER-SUPPLY WORK, THE SCOPE OF WHICH IS INDICATED BY THESE BRITISH PICTURES

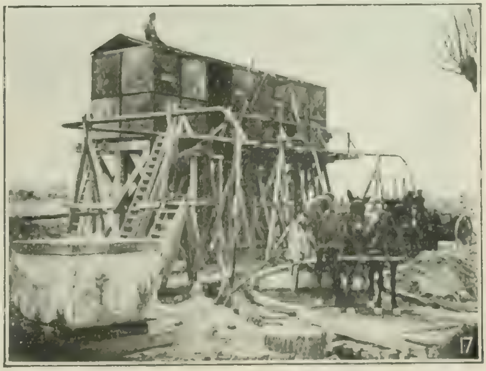
FIG. 14. BRINGING UP WATER PIPES TO SUPPLY THE FRONT LINE

FIG. 15. PUTTING UP A WATER TROUGH FOR THE CAVALRY

FIG. 16. TEMPORARY WATER TANKS

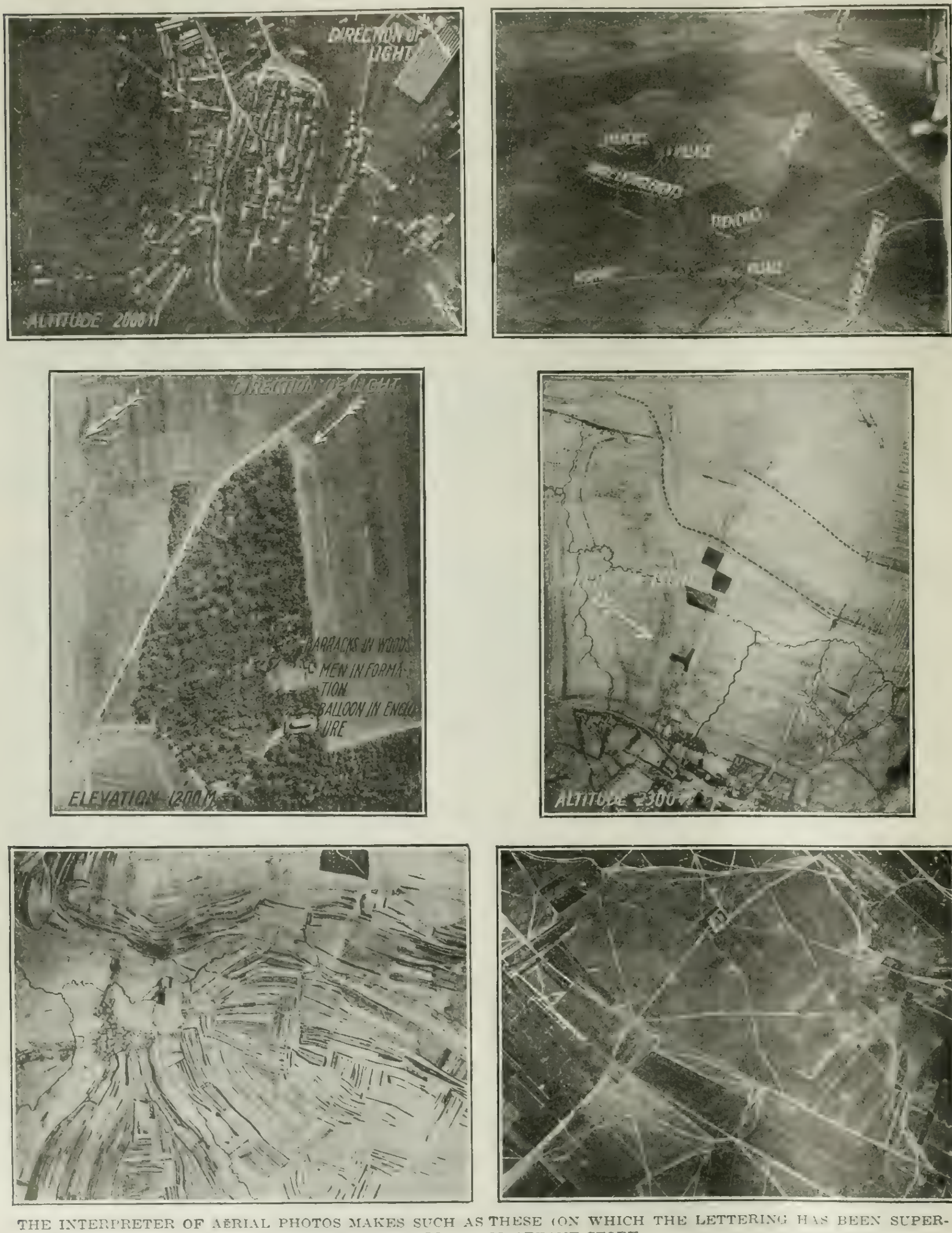
FIG. 17. A BIG WATER DEPOT

British Official Photographs.



of straight-line intersections, by the use of the *camera lucida* and the *appareils roussilhes.* The first named method is most generally used, and the several steps are as follows:

On the photograph, select four points easily identified on the map, which are so situated that the lines joining them intersect on or close to the particular detail it is desired to fix. On the map, draw lines joining the corresponding points. The intersection of these lines will give the true position of the particular detail



THE INTERPRETER OF AERIAL PHOTOS MAKES SUCH AS THESE (ON WHICH THE LETTERING HAS BEEN SUPERIMPOSED) TELL AN IMPORTANT STORY

in question. The remainder of the detail can be quickly drawn in with the aid of proportional compasses. This method simplifies the matter of adjusting errors.

The *camera lucida* is nothing more than a prism mounted by means of extension rods upon a light wooden framework comprising a base and a sliding easel. The photograph is pinned on the easel, and the map on the drawing board, the plane of the photograph being perpendicular to the plane of the map. Looking vertically through the prism, a faint image of the photograph is projected down on the map, and with a pencil small sections at a time are traced.

The *appareils roussilhes* method is carried out by means of an *optique cinématographique*. A photographic plate is used and the image thrown on the map in the same way screen pictures are shown. By various adjustments of the instrument the proportion of the image projected on the map is reduced or enlarged until it fits the map scale, and then the lines are traced. The accompanying aërial photographs show the kind of material that must be made to reveal its story.

The topographic section of the school, of which the interpretation of photographs is a part, also gives instruction in map reading, surveying and landscape sketching, and includes an artillery orienting course.

The camouflage section has a wider scope than any other in the Engineer School, inasmuch as camouflage must be applied to every branch of the service. It includes heavy artillery; field artillery; trench mortars, light and heavy; gas projectors; dugout and mine entrances with spoil banks; observation and listening posts of many types; tanks; snipers' posts, and the numerous not-to-be-described "fakes" and front line work.

Many people have the idea that camouflage work is mostly done by artists, painting in studios far removed from the front. About one per cent of it is produced in studios. The rest is military engineering erected under fire, and the camoufleur must have a working knowledge of all *materiel* of war.

On account of the broad scope of camouflage, the students in this section of the school range from major generals to privates. Special attention is given to camouflage discipline. Another interesting study is the camouflage of shadows, which are successfully concealed.

It is obvious that this subject can not be written about in detail. *The familiar illustrations often published in magazines and newspapers are the obvious and theatrical ones, seldom used. The real camouflage would not make an interesting picture, because no one would see it in a photograph.*

The Army Engineer School, to the technical man, is one of the most interesting places in France today. It is, in effect, a museum where one sees the practical application of the new military engineering.

Railway Engineering Association Assigns Work for 1918

COMMITTEE work of the American Railway Engineering Association during 1918, as assigned by the board of direction, is to continue largely on lines and subjects already under consideration. The principal new subjects are noted below:

Ballast—Design of gravel-washing and stone-crushing plants.

Buildings—Design of buildings for track laborers; toilet facilities for small stations without water or sewers; electric lighting of passenger stations and platforms.

Wooden Bridges and Trestles—Specifications for construction timbers and for timber which is to be treated by a preservative process.

Masonry—Concrete culvert-pipe; depositing concrete under water; concrete in sea water; specifications for slag aggregate; relation of moisture to strength and durability of concrete.

Signs, Fences and Crossings—Manufactured fence posts; strain posts for use with steel posts; bracing concrete end or strain posts.

Signals and Interlocking—Short-circuiting track circuits to display signals for protection of track workers; code of signal rules; time interval for release of devices on switch or signal apparatus.

Records and Accounts—Filing plans in connection with estimates; forms for analyzing expenditures.

Rules and Organization—Rules for construction, maintenance, operation and protection of buildings to reduce fire risk; rules for inspection of bridges and culverts.

Water Service—Locomotive tube failures due to improper water conditions; methods of treatment to correct such conditions.

Yards and Terminals—Unit operation of terminals in large cities; use of a small gravity sorting yard between the classification and advance yards for the purpose of switching cars into station order.

Iron and Steel Structures—Track-scale superstructures; flashing, drainage and reinforcement for waterproofing purposes.

Wood Preservation—Treatment of Douglas fir; indicators for determining the burnetizing of ties.

Economics of Railway Operation—Increasing traffic capacity; analysis of operating costs; effect of train speed upon cost of maintenance; economic length of operating districts; distribution of maintenance expense between passenger and freight service; reclamation and utilization of scrap.

Economics of Railway Labor—Organizing to obtain a labor supply; equating track sections; plans for boarding cars and boarding houses; determining a normal maintenance expense; separation of expense between track, signal and bridge and building departments; ratio of labor cost to total cost; labor-saving devices.

New chairmen have been appointed for six committees. G. J. Ray succeeds John D. Isaacs as chairman of the rail committee, and is succeeded as chairman of the track committee by J. R. Leighty; W. H. Hoyt succeeds E. A. Frink as chairman of the committee on wooden bridges and trestles; W. H. Finley follows Joseph Mullen as chairman of that on rules and organization; B. H. Mann replaces E. B. Temple as head of the committee on yards and terminals, and C. M. Taylor replaces Earl Stimson as chairman of that on wood preservation.

Repair Washout Under Dam by Sheet Pile Cutoff Embedded in Concrete

Hole in Cutoff Wall and Deep Erosion of River Bed Contribute to Accident—Closure to Coon Rapids Dam Made Rapidly Behind Steel Sheet-Pile and Timber Crib Cofferdam in Reservoir

PREPARED BY THE STAFF OF H. M. BYLLESBY & CO., CHICAGO

A WASHOUT through the pile foundation of the Coon Rapids dam in the Mississippi River, 11 miles above Minneapolis, occurred on Sept. 1, 1917. By energetic work in planning and carrying out the repairs rapidly in spite of difficulties, the power plant was put in operation again on Feb. 24. The break was due primarily to a gap in a steel cutoff wall beneath the face of the dam. The leakage saturated the material under the dam and caused a large cavity. Erosion beyond the toe of the apron below the dam contributed to the accident by forming a deep hole and thus increasing the head against the cutoff wall. The break occurred during the repairs on the hole in the river bed, and these repairs were carried on simultaneously with the closing of the break under the dam.

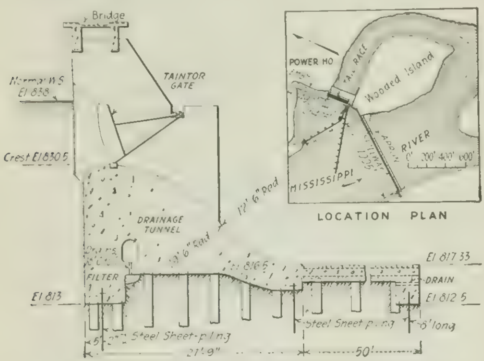


FIG. 1. CROSS-SECTION OF SPILLWAY DAM AND APRON AS BUILT AT COON RAPIDS, MINNESOTA

The Coon Rapids dam is part of the hydro-electric plant of the Northern States Power Co., a development of 10,500 hp. under a normal head of 17½ ft. The entire plant was designed by H. M. Byllesby & Co., and was built by day labor under their direction as engineers and managers for the power company. It was completed early in 1914. The repair work also was planned and carried out by the Byllesby company. When plans for repairing the dam were under consideration this company called into consultation J. G. Giaver, Chicago, and Francis C. Shenehon, Minneapolis.

The concrete spillway dam, under which the blowout occurred, is of the gravity type, with a height of about 21 ft. and a base width of 27 ft. 9 in., as shown in the cross-section, Fig. 2. It is built on a glacial drift formation. The south bank, to a height of about 20 ft. above low water, is a so-called hardpan, but is really only a mixture of sand, gravel and clay, very hard and dense in places, though easily crumbled in the fingers when broken off in small pieces. It is practically impervious to any head created by the dam. This hardpan has a decided dip to the north, and after passing below the river bed is overlaid by a deposit of clay containing a considerable percentage of very fine sand. The clay deposit, extending in general from the river bed down to the hardpan, is interspersed with pockets of sand of varying degrees of fineness. Near the head of the island at the north end of the spillway it is overlaid by a deposit of boulders and sand. The accident occurred in this vicinity.

Wood piles were so driven as to insure a safe bearing value of 10 tons per pile. Cutoff walls of steel sheeting were placed under the heel and the toe of the dam; the sheeting was driven to such a depth as to penetrate at least 5 ft. into material that would be impervious under the head developed at the dam. This depth was determined by test borings; the maximum length of the steel piles was 25 ft. A 50-ft. concrete apron beyond the toe of the dam is also carried on wood piles, and has a toe wall with a line of 8-ft. steel sheeting to prevent scour from cutting back under the apron.

The dam with its gates and other works was described in *Engineering Record* of Jan. 17, 1914, p. 77, and in *Engineering News* of July 16, 1914, p. 118.

Locating the plant at the head of an island (see key plan in Fig. 1) gave a 1000-ft. spillway across the south channel and a 255-ft. power house across the north channel; the total length between abutments is about 2000 ft. Formerly the north channel, being the deeper of the two, carried probably more than half of the flow during floods, but since the works were built practically the entire flood-flow goes over the spillway into the shallow south channel. This condition was a factor in the erosion which took place below the dam. It was assumed that with the high velocity in the south channel, due to its greatly increased discharge, there would be some scouring until the river reëstablished a permanent condition of flow.

The history of the case is as follows: In January, 1914, the dam and the power house substructure were completed and the gates were then closed. The spring flood, which was not of large proportions, carried over the spillway a quantity of logs. Soundings made after the flood showed that considerable erosion had taken place, but not near the apron; it was deemed safe to await further developments.

The spring flood of 1915, considered to have been the maximum for this part of the river, amounted to more than 60,000 cu.ft. per second. Soundings made in the fall showed that irregular scouring had proceeded along the entire length of the spillway. The condition was such as to make it necessary to carry out protective work before the next flood. For this purpose rock-filled timber cribs about 24 ft. wide, with their tops be-

low the top of the apron, were sunk against the toe of the apron for something more than half the length of the spillway section.

Soundings made in the winter of 1916-17 showed that the cribbing had been damaged considerably. The erosion also had extended so that protective work of a more extensive character was rendered necessary. After a contour map of the river bottom had been made from soundings, and studying the situation, it was decided that during the following summer a cofferdam should be built around the hole to admit of pumping out the water and placing a concrete floor or paving. Arrangements were made to carry out this work after the high water of 1917.

The spring flood of 1917 carried large quantities of logs and heavy ice over the spillway, so that although the flood was not nearly so great as that of 1915 it caused probably more scouring than any previous flood.

Construction of the cofferdam was commenced in June. An area below the apron two-thirds of the length of the dam was inclosed. Owing to the low stage of the river only an earth embankment 3 to 5 ft. in height was required to keep out the backwater. On Aug. 11, 1917, the hole was unwatered, and on Aug. 31 all was ready for filling it with concrete the next day.

No leakage or even seepage had been observed as coming from under the dam. At 2 a. m. on Sept. 1, however, the watchman noticed that the water in the hole was gaining on his pumps. He reported this immediately to the superintendent through the operator at the power house, but the flow developed so rapidly that the hole was filled with water before anything could be done to stop it except to open the sluice gates and thus hasten the lowering of the pond level.

Steps were taken immediately to build a rough cofferdam of rock-filled timber cribs faced with wood sheeting driven by hand, so as to obstruct the flow of water under the dam and thereby retard or stop the erosion. In the meantime the ends of the break were covered with brush and sand bags to prevent it from widening.

As this temporary work progressed, materials were ordered for a more substantial cofferdam in the reservoir, the construction of which was commenced with steel sheet piling on hand in Minneapolis. Additional piling was rushed from Buffalo and Louisville, so that the floating driver was not delayed for lack of material. This cofferdam was about 350 ft. long, with its face about 150 ft. upstream of the dam. It consisted of steel sheeting driven to a penetration of about 30 ft. and supported by rock-filled cribs 16 and 24 ft. wide. The earth cofferdam around the scoured hole below the dam was repaired where it had been breached by the washout, and it served its purpose until the completion of the repairs.

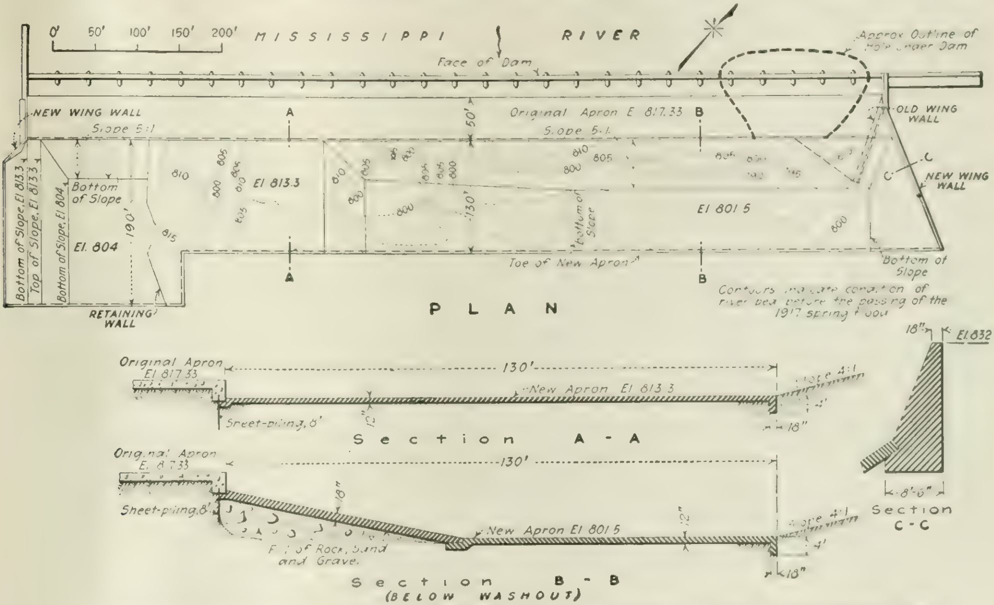


FIG 2. FIVE BAYS OF DAM UNDERMINED BY WASHOUT—NEW APRON BUILT OVER SCOURED-OUT AREA

During the period of repair the river flow was taken care of through the wheels and the sluice gates. Provision was made for raising those portions of the cofferdam not already up to 3 ft. above the crest of the dam, in the event that high water should be reported from upstream stations.

When the cofferdam was pumped out it was discovered that a hole about 200 ft. long had been eroded under the concrete dam. This hole was about 26 ft. deep at the center and sloped up to the base of the dam at each end. The foundation piles were not undermined, so that they sustained the load, and no portion of the dam was lost or seriously damaged. There was no settlement or sign of distress. The two lines of steel sheeting under the dam were not damaged, but they were undermined at the break by the washout. Two 54-ft. sec-

tions of the apron collapsed, as the shorter foundation piles and sheeting under the apron were undermined.

In the original construction of the dam, the sheeting and foundation piling in the portion where the washout occurred were driven from the ice before the cofferdam was built. The steel sheeting was driven first. Considerable difficulty was experienced on account of boulders and old logging cribs. There was some apprehension that these obstructions might split the webs of the piles or pull the interlocks apart, but nothing of the kind was discovered.

Examination of the sheeting exposed by the erosion, however, revealed the fact that when one of the bearing piles was driven it had been set on top of a steel pile and, while the former was badly split, it had nevertheless carried the head of the steel pile to the bottom of the adjacent piles, thus leaving a slot partially filled by the wooden pile. When the excavation was made for bedding the heads of the steel piles in concrete this opening should have been discovered and a new pile driven to close the opening, but if it was noticed by the inspector it was covered up without the defect being remedied. This opening through the cutoff wall is considered the cause of the accident, beyond doubt.

Three Plans for Work Were Considered

Three plans for the repair work were considered, though two of these differed only in detail. As the driving of additional piling under the dam seemed impracticable, and as the original steel cutoff wall had been undermined at the break, the main points to be determined were the bearing value of the clay and the possibility of constructing a new cutoff wall or water-stop which would tie in with the original cutoff wall beyond the limits of the break.

Plan A was to fill the hole under the dam with 1:3:6 concrete, and face this on the upstream side with 1:2:4 concrete, incasing the heads of the steel piles of a new cutoff wall to be driven about 5 ft. upstream from the face of the dam. Plan B was practically the same, except that the concrete was to be of a very lean mixture, approximating the adjacent hardpan in rigidity though not in density.

Plan C provided for a reinforced-concrete mat under the dam, extending from the downstream side of the original cutoff wall a sufficient distance beyond the toe to distribute the pressures properly. Cross-walls resting on this mat would support the undermined portion of the dam. After cutting out the two upstream rows of bearing piles a reinforced-concrete cutoff wall would be built in line with the original cutoff, bearing against the upstream ends of the cross walls and carried down to bond into the hardpan. The spaces between the walls were then to be filled with sand and the apron was to be restored in its original form.

Objections to Plans A and B were the increase of weight and the difficulty of bonding the new cutoff wall with the old so as to make it continuous and of equal effectiveness. The original steel cutoff is more than 2 ft. in from the face of the concrete, and as the new steel could not be driven closer to the dam than about 12 in. there would have been a gap of at least 3 ft. between the two rows of sheeting. By the removal of part of the bridge and the cutting of a slot from the crest to the base of the dam it would have been possible to turn the new line of sheeting perpendicular to the axis of the dam and drive it up to the old sheeting. But no junction with the old sheeting would have been possible, nor would there have been any assurance of contact between the two lines. This difficulty would be eliminated in Plan C because of the new cutoff wall being in the same plane as the old one, so that it would only be necessary to extend the concrete wall sufficiently to bond over the edge of the old steel sheeting.

Leakage of the cofferdam proved to be the deciding factor. Although the amount of the inflow was not serious, the water was difficult to collect and pump, and that which was not controlled seeped through the ground inside of the cofferdam and flowed into the deep part of the hole. This made excavation difficult and of questionable benefit, because any disturbance of the clay in the presence of water quickly turned it into mud. Under these conditions it was deemed too hazardous to attempt to make a deep trench excavation for the cutoff wall as required by Plan C. Plan A was therefore adopted.

Reconstruction Carried Out in Very Cold Weather

The new cutoff wall driven according to this plan was 175 ft. long. The sheet piles varied in length and were driven into the hardpan.

On account of the close spacing of the bearing piles under the dam, placing the concrete was very difficult, except in the lower part, where it could be spouted. As it was desired to get the concrete packed in so solidly against the base of the original structure as to avoid the necessity of grouting, the pneumatic method of mixing and placing was adopted. This method was not as satisfactory as had been anticipated, due largely to the adverse conditions and to the occasional necessity of operating the mixer with inexperienced help. Some difficulty was caused by the concrete clogging in the discharge pipe. This probably could have been reduced materially had it been possible to keep a trained man at the mixer. Some segregation of the materials occurred as the concrete was deposited, probably due to the difficulty of proper manipulation at the outlet of the discharge pipe on account of the interference of the bearing piles. Wear of the discharge pipe was another trouble. There was no way of ascertaining easily the amount of wear, and blowouts had a way of occurring at inopportune times. Notwithstanding the difficulties, good work was done, and it was considered that pneumatic placing was the only method practicable in the circumstances.

Most of the concrete under the dam was placed during weather that was near or considerably below zero. The space where the concrete was to be placed was inclosed by hanging tarpaulins from the original structure, all materials were heated, and salamanders were used when necessary to prevent frost getting into the concrete.

Junction between old and new cutoff walls at the south end was effected by excavating a well between the end of the new sheeting and the face of the old sheeting, down to the bottom of the former. A section of the old sheeting about 2 ft. wide was then cut out with a blow torch and sufficient excavation was made behind the sheeting to get a good bond. Finally, the well was filled with concrete placed solid against the undisturbed

earth. As the cutting and excavating proved to be difficult the method was changed when the junction at the north end was made. An angle iron was tap-bolted to the web of one of the piles in the old sheeting and the outstanding leg was embedded in the concrete. The latter method was much more easily carried out and resulted in more satisfactory work.

The toe of the new concrete under the dam was extended 10 ft. beyond the toe of the original structure, and in this 10-ft. width three lines of bearing piles were driven.

After the work under the dam was completed a fill was made on the downstream side to level up the eroded bed, and the apron at the two collapsed sections was rebuilt as in the original structure. Where erosion at the toe of the apron had taken place to a depth of 10 ft. or more, a fill with slope of 1 on 5 was so made that the concrete pavement laid on this slope bonded in under the toe wall of the original apron, as shown.

The river-bed protection was extended about 135 ft. beyond the original apron, or to about the limits of the deep erosion. In placing this protection only such grading was done as was necessary to eliminate abrupt changes of section. A new wing wall was built, flaring away from the dam so as to allow the free escape of the tail water.

Full reservoir head has been maintained since the repairs were completed, without any indication of further trouble, and it is thought that if additional erosion takes place in the river bed it will not be of such a nature as to require further protective work.

Machinery Ordered for One Purpose Cannot Be Tested for Another

Court of Claims Decides That Dry Dock Contractor Can Recover When Use for Which Engines Were Intended Is Changed

By William B. King

of King & King, Attorneys-at-Law, Washington, D. C.

In a decision handed down by the United States Court of Claims Apr. 29, it was decided that machinery ordered for one purpose by a contractor on a naval drydock cannot be subjected to a test with reference to a different service from that covered by the original contract.

The case was that of the trustee in bankruptcy for the Scofield Co. against the United States Government, arising out of the contract made by that company on Mar. 9, 1903, for completing the dry dock at the Philadelphia Navy Yard. The principal question arose over the rejection of the three main engines furnished by the contractor and purchased by the Government, and the purchase in their place of more powerful and expensive engines. The three original engines were sold practically for junk, and after crediting the price obtained by the sale the cost of the three new engines was charged to the contractor.

The three engines originally furnished were found on final test to have a speed regulation which did not come up to the requirements of the specifications. The contractor, as well as the subcontractor, the maker of the engines, endeavored to bring them within the specification requirements. While this work was in progress the contracting company became financially involved and the Government took over the completion of the dock and the machinery.

The Government then made a contract with the Providence Engineering Works to alter the three engines to bring them within the specifications. One engine was to be altered, and if it were satisfactory $8400 was to be paid for altering all three. It was agreed that if the alteration of the first engine was unsatisfactory, it was to be returned to its original condition and nothing was to be paid for the work done.

The first engine was altered, and failed to meet the test. It came so near it, however, that the Providence Works asserted that by further slight alteration it could be brought within the specifications. The Government, however, paid the Providence Works a proportionate part of the agreed price for the alterations, rejected all three engines and sold them at a small price. Three larger engines were then purchased and charged to the contractor.

While the original contract was solely for a dry dock and machinery to operate it, the tests of the engines were conducted with reference to their capacity to operate not only the dry dock but a central station which would furnish heat and light for the entire yard, and power for all the shops in the yard. The court held that no such requirement could be made, and that the contractor had complied with all his obligations when he furnished engines capable of operating the machinery and dry dock. Therefore, it credited the contractor with the price of the new engines, and held that from this there must be deducted the price which it would have cost the Government to have the Providence Engineering Works alter the old engines to bring them within the specification requirements. Subject to this credit of $8400 the contractor recovered from the United States the increased cost of the new engines.

The case was presented for the contractor by the writer and Russell H. Robbins, of New York, while Philip G. Walker appeared for the Government with Assistant Attorney General Houston Thompson.

Culvert Maintenance Cheaper Than Upkeep of Bridge Floor

Repair on the road surface has been found to be the most expensive item in the maintenance of canal highway crossings in the South San Joaquin Irrigation District of California. As a result, culverts which can be jacked beneath paved surfaces without disturbing the roadway are considered to be very much cheaper than small bridges or culverts of the type which involve the removal of the highway surfacing. Large pipes therefore are used in place of the old type bridge-culvert whenever feasible. By using two or more pipes in parallel, ditches of comparatively large capacity have been provided for at crossings. Corrugated iron pipes as large as 48 in. diameter are now being successfully jacked under highways. A description of the method of jacking appeared in *Engineering News-Record* of June 27, p. 1236.

Concrete Road Resurfaced with Concrete in Good Condition

After Two Years' Service, Inspection Shows No Separation Between the Base and the Three-Inch Reinforced-Concrete Cover

A CONCRETE road in Wayne County, Michigan, which was resurfaced two years ago with 3 in. of reinforced concrete, and which has passed through two severe winters, was recently inspected by a representative of *Engineering News-Record* and found to be in almost perfect condition. Some immaterial longitudinal cracks have developed down the center, but none of these is over the joint between the old pavement and the extra width which was added when it was resurfaced. No separation has occurred between the resurfacing and the base, so far as can be determined. A description of the construction and the methods employed in resurfacing was given in a paper presented before the Portland Cement Association by Edward M. Hines, chairman of the board of county commissioners of Wayne County, which was published in *Engineering Record* of Oct. 7, 1916, p. 434.

The work was done as an experiment, and a section of the Grand River Road built in 1910 which is subjected to very heavy traffic was selected for the experiment. The original road was of two-course concrete construction and was 16 ft. wide. The bottom course was 4 in. thick and made of $1:2\frac{1}{2}:5$ concrete. The top course was $2\frac{1}{2}$ in. thick and made of $1:2:3$ concrete. The slabs were 25 ft. long and were separated from one another by expansion strips of tar paper $\frac{1}{4}$ in. thick which extended entirely through the slab. The pavement, being six years old, had received the usual amount of maintenance, and the cracks and holes had been filled with tar. On account of the heavy traffic upon this road, it was decided to widen it from 16 ft. to 20 ft. by adding a 2-ft. strip on each side. To secure a good joint, the edges of the pavement, where they had rounded off, were chipped off, and, the excavation having been made, 6 in. of $1:2:4$ concrete was placed. Before the resurfacing was proceeded with, the surface of the old pavement was thoroughly cleaned. The Tarvia which had been used to make repairs was thoroughly cleaned from the holes and cracks, and these were filled with concrete, thus bringing the entire 20 ft. of surface to an even bearing for the cover which was to be laid. Where expansion joints had cobbled they were cleaned and repaired.

After the foundation had been prepared and immediately before the new surface was laid, the base was sprinkled with water and received a coating of Tarvia A and Tarvia X mixed, which mixture was sprinkled on hot. The water caused the Tarvia coat to spread out uniformly over the surface and chilled it, which gave a uniform surface upon which to spread the concrete. The resurfacing was composed of 3 in. of $1:1\frac{1}{2}:2\frac{1}{2}$ concrete. Marquette trap rock of sizes up to 1 in. and washed screen bank sand were used. Triangular mesh reinforcement No. 26 was used for reinforcing the surface. A Baker automatic finishing machine was used to finish the concrete. A more complete description of the construction of this road may be found in *Engineering Record* of Oct. 7, 1916, p. 434, as mentioned above.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Want Engineer as University Regent

The desirability of having an engineer on the board of regents of the University of Minnesota was discussed recently by the Minnesota Joint Engineering Board. The present personnel of the board includes four lawyers, of whom one is an ex-officio member, one doctor, two agriculturists, one banker, two educational men (ex-officio) and two business men. The work of the engineering department is one of the large activities of the university and is deemed worthy of a representative. The *Bulletin* of the Affiliated Engineering Societies of Minnesota points out that the welfare of the College of Enginering is largely dependent upon the personnel of the faculty and the budget allowance, both of which are controlled to a large degree by the regents. With an engineer on the board, it is argued, the engineering department would be understood more adequately, and its needs presented and protected more carefully than by men who are not engineers.

Minnesota Engineers Co-ordinate Society Activities

Evidently the Minnesota Joint Engineering Board is becoming a factor in society affairs in the Northwest, for membership in it is being sought by the Engineers' Club of Northern Minnesota, a live organization of 85 mining and civil engineers on the iron range, with headquarters at Virginia. This is the first organization with headquarters outside of the Twin Cities to propose joining the movement. Final acceptance by the board cannot be effected until November.

The germ of coördination is working in Duluth, too, as evidenced by the recent get-together banquet of 200 engineers representing sections of the four national societies. A committee was appointed to draw up a permanent plan of organization of an engineering club. Four plans are under consideration: (1) to have an all-inclusive organization for professional engineers, juniors and associates, with a different status for each; (2) an organization made up of members of the four nationals; (3) society members with a limited number of associates; (4) professional engineers only. Three elements were named as essential—professional, social and civic. It was suggested that affiliation be made with a civic body so that the entire community might be bettered.

British Municipal Engineers in Service

One-third of the membership of the Institution of Municipal and County Engineers, or 580 out of 1762, were reported, at the recent meeting of the Institution held in London, England, to be in active service. The loss of membership during the year, notwithstanding war conditions and the rivalry of the Institution of Municipal Engineers, was only seven.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Passaic Valley Sewer Contract Suit Settled by Agreement

Sir—Some time ago you referred at considerable length to the charges made by us in the complaint of O'Rourke Engineering Construction Co. vs. Passaic Valley Sewerage Commissioners, in which you went into the importance of engineers giving fair play to both parties to a contract. You also expressed a hope that this case would be tried, so as to determine whether the chief engineer had actually resorted to misrepresentation and fraud, as alleged.

Judgment for the amount due under the contract with interest was recently entered by consent of both parties. Our reasons are contained in the following letter addressed to us by Hughes, Rounds, Schurman & Dwight, New York City, and Griggs & Harding, Paterson, N. J.:

"Confirming our verbal advice to you that under the circumstances we would recommend the abandonment of all the counts in the above entitled action excepting that demanding judgment for $72,123.34, the amount admitted by the defendant to be due under your former contract, with interest, we beg to say:

"The situation as it existed on the eve of the trial of this action differed very materially from the situation existing at the time the action was commenced. The various counts in the complaint may be embraced in two groups:

"1. A claim for the loss of profits which it is estimated you would have made if the conditions had been as represented to you by the chief engineer of the defendant.

"2. Claims for actual losses sustained by reason of your having entered into the contract induced thereby by the representations alleged in the complaint to be false.

"With respect to the claim for loss of profits, we were compelled to advise you that after considering the matter carefully we were of the unanimous opinion that in an action based upon fraud and deceit you could not recover such prospective profits, but that as a matter of law your measure of damages was the actual loss which you had sustained. This rule of damages has been distinguished in some states and has been severely criticised by many text writers, including Sedgwick in his treatise on the law of damages, but in the jurisdiction in which the action was brought, i.e., the United States District Court for the District of New Jersey, we were of the opinion that you could not escape the rule as laid down in the case of Crater v. Binninger, 33 N. J. Law, 513 and the case of Smith v. Bolles, 132 U. S. 125. We feel that the rule is an unfair one and penalizes too lightly misrepresentations made to contractors, but we were and are obliged to advise you upon the law as defined by the highest courts in the jurisdiction in which the action was brought.

"We were of the opinion that we could not recover for loss of profits on account of breach of warranty due to the misrepresentation, inasmuch as the representations made by the engineer and contained in the plans as to the borings, in our view, would not be held to be a warranty, since both in the contract and in the plans which were made a part of the contract the language expressly provided that the representations were not to be warranties.

"With respect to the second class of claims, i.e., actual losses sustained by reason of your having entered into the contract, these were substantial at the time the suit was commenced, but during the progress of the suit the land and bay shafts with the buildings erected thereon were sold to the present contractor; part of the plant purchased for use on the work, which under ordinary circumstances would have been worth only a fraction of its cost, was sold for sums substantially in excess of the cost thereof, and plant remaining on hand, instead of being worth less, was, notwithstanding its use, worth if anything substantially in excess of the price at which it was taken upon the work. This was also true of materials and supplies. As a consequence, on the eve of the actual trial of the case, after minimizing the loss as you are compelled to do by law, the balance hardly exceeded if indeed it equaled the amount admitted to be due under your contract.

"A consideration which was of great weight in inducing us to advise you to withdraw the counts based upon fraud and deceit was that although we had the utmost confidence in your case, the entire question of damages would under these counts be a question for the jury and that, although the trial resulted in establishing your allegations of fraud, you might well have recovered damages for a sum less than $72,123.34, and interest. In that event you could not recover on the count for $72,123.34 and interest due under the contract, since you had chosen to try your case on the counts for fraud; so, though entirely successful, you might have been left with a verdict for a lesser amount than was due under the contract, owing to your losses having been so greatly reduced as above stated.

"Such a result would of course follow from the fact that under the rule for damages in case of fraud and deceit the plaintiff would get only the difference between what the work cost and what it has received, irrespective of whether that amount was found to be more or less than the sum due under the contract.

"Under these circumstances, we felt that it was our duty to advise the entry of judgment for the amount above stated."

Trusting that this will make our position clear as to why this suit was not tried, we remain,

O'Rourke Engineering Construction Co.,
John F. O'Rourke, President.
17 Battery Place, New York City.

[To present both sides of the case equally, *Engineering News-Record* asked the attorneys for the Passaic Valley Sewerage Commission to set forth the circumstances of the settlement. The reply of Riker & Riker, Newark, N. J., gives the statement which follows. —Editor.]

"The answer filed in the suit of the O'Rourke Engineering Construction Co. against the Passaic Valley

Sewerage Commissioners in the United States District Court for New Jersey admitted that there was due to the plaintiff the sum of $72,167.97, and stated that the defendant was always ready and willing to pay said amount upon the execution and delivery of a proper receipt and release. All other claims of the plaintiff involved in this suit were expressly denied. The sum named consisted of reserves accumulated on monthly payments in accordance with the terms of the contract to the amount of $50,000, and the final estimate of the chief engineer of $22,167.97. The judgment entered in settlement of the suit was for $72,167.97 with accrued interest thereon."

Virginia Has New Highway Bridge Contract

Sir: I am sending herewith a new payment clause which we propose to insert in our contracts for bridge work. It reads as follows:

Payments: Profit-or-loss sharing agreement:

1. All bidders shall name prices for the quantities of work and materials shown in their proposals. The cost of the work as determined by such prices and quantities will be herein referred to as the contractor's estimate.

2. The contractor shall be paid actual cost for the labor and material used in the execution of the work provided to be done under this contract, whether the cost be more or less than the contractor's estimate. The cost of work thus determined will herein be referred to as the labor and material cost.

3. The contractor will be paid a fee of 20 per cent. of the contractor's estimate for his actual supervision of the work, the use, repair and up-keep of all equipment, and all office and other expenses, commonly known as "over head expenses," except that should the labor and material cost be less than the contractor's estimate, the contractor's fee will be increased by the amount of one-half the difference, or should the labor and material cost be greater than the contractor's estimate the contractor's fee will be reduced by the amount of one-half the difference.

4. Should it become necessary to increase or diminish the quantities of work or materials, shown on the proposal, the contractor's estimate shall be revised, accordingly, at the unit prices given. The contractor's estimate so changed shall be known as the revised contractor's estimate, and shall be compared with the labor and material cost in computing differences, instead of the contractor's estimate as first determined.

5. The prices to be paid the contractor for labor, teams, materials, and other items, of every kind and description, furnished by him, shall be subject to the approval of the engineer.

6. The contractor shall furnish bills and payrolls upon forms prescribed by the party of the second part, for all items included in the labor and material cost. Bills shall be certified to by the seller and by the contractor. Payrolls shall be signed by the payee and certified to by the contractor.

All commissions, discounts and allowances of every kind and description shall be shown on the bills and shall accrue to the party of the second part.

7. Payments will be made promptly upon receipt of monthly statements of amounts due, with certified copies of payrolls and bills in duplicate, attached, reserving 15 per cent until 90 days after final completion.

William R. Glidden,
Bridge Engineer, Virginia State Highway Commission.
Richmond, Va.

Iowa Engineers Favor Legislation for Examination and Licensing

Sir—Of course we are all agreed that the fundamental object of license laws is to safeguard the public from reckless and incompetent engineering work. Supervision of engineering plans and construction would accomplish this. In Iowa, however, we have come to believe pretty strongly that safeguarding the public from poor engineering plans and construction can best be brought about by raising the standard of the profession itself, so that every authorized engineer will be capable of supervising his own work. To carry out any adequate supervision of engineering plans and construction by any other method would lead to endless ramifications of engineering service, which would be entirely impracticable in a state of this character, where so much engineering work is on a relatively small scale. The task of supervising the engineering plans would be very simple compared with any adequate supervision of construction. Furthermore, there would be no easy way of making the necessary modifications in plans as the construction work progressed.

It is true that in order to get a license law through the legislature, engineers now in active practice and measuring up to certain standards will have to be licensed without examination. This means that during our generation the benefits of the license law will not be so apparent as we should like. We have come to feel here in Iowa, however, that the engineering profession, if it is to be a profession, must look farther ahead than its own generation.

While in theory it is true that people and corporations which employ engineers have ample facilities for determining their qualifications, yet in practice here in Iowa we find very little understanding of how to determine an engineer's ability to perform a given task. In a surprisingly large number of cases the deciding element in the engagement of the engineer is his price. Competitive bidding for engineering services is becoming all too prevalent, with engineers from neighboring states, anxious to get a foothold in Iowa, apparently forgetting profits in the scramble to secure the job.

Naturally, a license law for engineers is not going to prove a cure-all for every malady afflicting the profession. Nevertheless, engineers in Iowa have come to believe rather unanimously that it is a step in the right direction, and an important one.

J. H. Dunlap,
Secretary Iowa Engineering Society.
Iowa City, Iowa.

Population of National Capital Grows

Population in the District of Columbia increased by 38,198 in the year which ended Nov. 1, 1917, according to police censuses. The Federal census of 1910 showed a District population of 331,069. The police census of Nov. 1 showed 395,947.

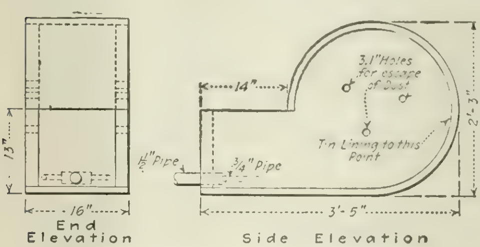
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

"Washwoman" Cleans Twenty Cement Sacks in Three Minutes

By B. G. Best
Ironwood, Mich.

THE accompanying sketch shows a device used by the Oliver Iron Mining Co., at Ironwood, Mich., for cleaning used cement sacks. This cleaner, or "washwoman," as it is called, is a box, into which compressed air or steam is admitted through a 1½-in. pipe. The sides and one end of the box are made of 2-in. plank, and the bottom and curved part of 1-in lumber. As protection against the abrasive action of the sacks



CLEANS SACKS WITH AIR OR STEAM

and cement dust the bottom is lined with tin or sheet iron to the point indicated on the sketch. A 12 x 12-in. opening, for throwing in and removing the sacks, is left in the top at the rectangular end of the box. A few feet back from the cleaner a valve is placed in the air line, and just inside the box the 1½-in. pipe is connected by a reducing tee to two nozzles made of short lengths of ¾-in. pipe.

In cleaning a batch of sacks the man operating the cleaner first partially opens the valve in the air line and throws in five or six sacks, one at a time. As the air picks up these sacks and carries them into the enlarged part of the cleaner the operator opens the valve wide and throws in about fifteen more sacks in bundles of four or five. The air whirls the sacks around in the circular part of the cleaner, beating out the dust, which escapes through holes bored in the sides of the box and through the opening in the top. When very little dust escapes the air is shut off and the sacks are removed, practically as clean as before they were used. The dust remaining in the box is blown out by turning on the air for a moment.

With 100-lb. air pressure a batch of 20 sacks can be thrown in, cleaned and removed in 3 min., and one man operating the cleaner can keep a second man busy tying the sacks in bundles. Two men working in this way recently cleaned 3000 sacks in eight hours, at a cost of less than ½c. per sack, while cleaning by hand two good men will have all they can do to clean 200 sacks in the same time, and at a cost of 4c. each.

Significant Events in the Contracting Field

LAST week there was held at Atlantic City a convention of building interests. How inadequately contractors were represented in this gathering by comparison with manufacturers of materials is discussed editorially on another page of this issue.

In the pages of this journal for July 18 appeared two articles which find an echo on page 192 of the Letters to the Editor as well as in the editorial on page 158, and that indicate the possibility of better things in the handling of construction contracts.

Editorially this journal was called upon last week to review two situations of national import affecting the contractor—the heavy penalty imposed upon construction work already under way by the freight increase, and the indifference to the important needs of the contracting business manifest on the part of the Government.

Had contractors a representative national organization, they would not rank below manufacturers at a gathering of those connected with the building industries. Could the strong and reputable contractors, who are in the great majority, get together, antiquated forms of construction contracts which impose unjust risks and restrictions on the contractor would vanish before the close of this war, never to return. Had the contractors of the country a strong central agency to represent them in Washington perhaps they would be relieved of unjust hardships imposed by the freight increase. At least, there is no doubt that they would take the place to which they are entitled in the councils of the Government. H. D. H.

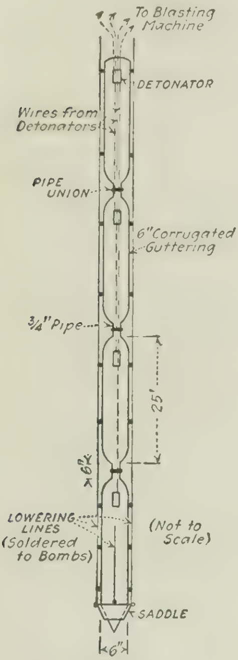
Shoots Well With Single Hundred-Foot Bomb in Four Sections

FULL thickness of the water-bearing stratum in a deep well at the Chicago stockyards plant of Miller & Hart, Inc., was shot recently with a single hundred-foot bomb. The water-bearing sandstone was struck at 1440 ft. and penetrated at 1575 ft. To avoid the storage of explosives on the grounds, Miller & Hart, Inc., asked that all the shooting be made a single operation. The contractor, the Whitney Well Co., Chicago, Ill., met the rqeuirement by fabricating the giant bomb shown by the sketch.

Ordinary galvanized corrugated gutter pipe was used for the shells. This was soldered into 25-ft. sections

and the ends were closed by bending and soldering. To connect the sections ¾-in. pipe nipples were soldered into the closed ends and threaded so that they could be coupled together by pipe unions. Each case was loaded with 75% nitro-gelatine, about 100 lb. to the case, and primed with a detonator consisting of a metal shell 2 in. by 1 ft. loaded with five No. 8 mercury caps and nitro-glycerine. Part of the work of closing the cases, placing nipples and threading the firing wires had to be done after each case was charged and of course involved very careful manipulation.

After the four cases had been charged and connected up, the string was put into a lowering sling consisting of a metal saddle with four lowering cables of extra strong telegraph wire. To prevent slack and to tie the whole together the sling wires were soldered at intervals to the cases. When all was ready for shooting the string of cases was lowered by the derrick to position in the hole, the firing wires were connected to the blasting machine, and the whole 100-ft. charge was fired in one shot. It was entirely successful.



SHOOTS DEEP WELL WITH STRING OF BOMBS

Daily Labor Report Carries Diary of Day's Happenings

By John T. Sullivan
Covington, Ky.

Daily labor report sheets used on the East Side High School work at Cincinnati provided, besides the usual data on working force, wages, hours of work and distribution of time, a daily letter on important happenings concerning the work. One of these letters, as filled out on the job, is reproduced here. The plan does away largely with any need of a separate letter to the home office telling of happenings which the head officials need to know and for which ordinarily the regular report blank makes no provision. Risk of loss of separate letters and of misplacing them is eliminated, and the labor of checking and filing reports is lessened.

Daily labor report blanks were, on the work named, filled out by the timekeeper. The blank carried on its face, first, spaces for the names and the time-card numbers of the workmen, for the hours worked, the rate of pay and the total day's earnings. Then followed vertically ruled columns headed by letters and numerals, referring to the cost-distribution chart. All the different divisions and subdivisions of construction operations were thus listed, and each man's time was apportioned according to the tasks in which he had been engaged. These are the ordinary kinds of labor report blank data.

On the reverse, the blank carried at the top, as shown by the illustration, space for the daily letter. Below were similar spaces suitably headed for a daily material report, a daily cost report and a daily cement report. Each morning the report sheet for the previous day's operations was mailed to the home office. The report was a part of the cost-keeping system of Roos Bros., Cincinnati, contractors for the work named.

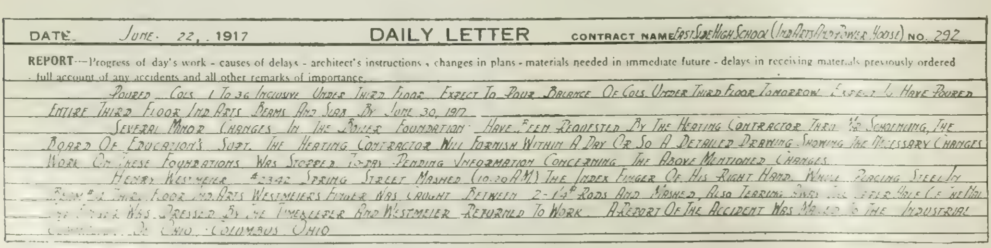
Wet Holes Successfully Exploded By Properly Connected Fuse

A successful method of adjusting fuses, for exploding charges under water, was described by T. F. Price, of San Antonio, Tex., in a recent issue of *Coal Age*. The main feature consists in properly waterproofing the connection.

Referring to the illustration, A is a stick of dynamite, B is the detonator and C is a paraffine seal. In preparing this cartridge, the covering at the end of the stick of dynamite is first opened. Next, with a stick of suitable size, a hole is made in the explosive to a depth equal to at least twice the length of the detonator.

The fuse should be trimmed to make sure the end entering the cap is perfectly dry. After the fuse is inserted, carefully crimp the detonator. The paraffine is now applied, being pressed firmly around the cap and fuse. It can be brought to the proper consistency by kneading in the hand

The detonator may now be inserted in the cartridge,


DATE June 22, 1917 DAILY LETTER CONTRACT NAME East Side High School (Ind Arts And Power House) NO. 292

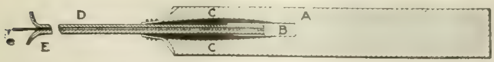
REPORT—Progress of day's work - causes of delays - architect's instructions - changes in plans - materials needed in immediate future - delays in receiving materials previously ordered - full account of any accidents and all other remarks of importance.

Poured Cols 1 To 36 Inclusive Under Third Floor Expect To Pour Balance Of Cols. Under Third Floor Tomorrow Expect To Have Poured Entire Third Floor Ind Arts Beams And Slab By June 30, 1917

Several Minor Changes In The Power Foundation Have Been Requested By The Heating Contractor Thru Mr Schoemling, The Board Of Education's Supt. The Heating Contractor Will Furnish Within A Day Or So A Detailed Drawing Showing The Necessary Changes Work On These Foundations Was Stopped Today Pending Information Concerning The Above Mentioned Changes.

Henry Westmeier #2342 Spring Street Mashed (10.20 AM) The Index Finger Of His Right Hand While Placing Steel In [illegible] 3rd Floor Ind Arts Westmeiers Finger Was Caught Between 2-1¼" Rods And Mashed, Also Tearing [illegible] Of The Nail [illegible] Was Dressed By The Timekeeper And Westmeier Returned To Work. A Report Of The Accident Was Mailed To The Industrial [illegible] Of Ohio Columbus Ohio

LETTER ON REPORT SHEET TELLS OF DAILY PROGRESS ON WORK ON CINCINNATI HIGH SCHOOL



FUSE AND DETONATOR SEALED WITH PARAFFINE AND INSERTED IN DYNAMITE

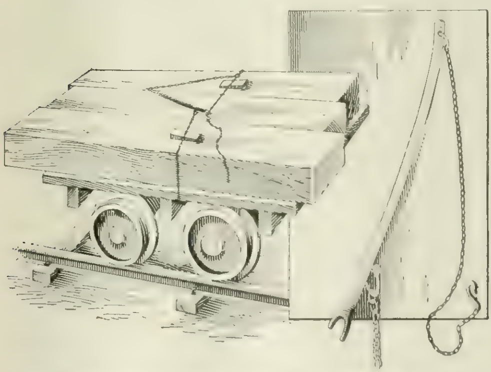
and the wrapping securely tied around the fuse. The other end of the fuse should be split, as shown at E, exposing the core. When the charge is properly placed and tamped, light this core and retire to a safe distance.

Mr. Price states that he has repeatedly used this method when firing charges submerged under 15 ft. of water and has had uniformly good results.

Lever and Chain Arrangement Binds Timber on Push Car

A CLAW lever and chains, to bind timbers securely on a push car, is shown in the illustration. The device is said to be very useful and works with either square or round material.

The details consist of a lever made of a slightly bent piece of 1-in. steel with a claw end, and two chains which are attached through two holes punched near the end of the rod. One hole is placed a fifth the length of the rod from the claw end, while the other is punched at the far end of the rod. The binding chain, which is long enough to pass around the car and its load, is attached to the rod by a clevis. To the other end is attached a chain the same length as the binding lever, and having a hook at the end to engage some link in the binding chain.



BENT LEVER ADJUSTED WITH CHAINS AND WEDGES

In use, the binding chain is passed under the car platform and over the load so that it can be gripped by the claw in the end of the lever. The free end of the lever is then pulled back as far as possible, and the fastening chain is hooked to a link in the binding chain.

When the truck is being used to haul plank lagging which is covered with ice, as is often the case in winter, extra grip can be produced by driving wedges between the chain and the outer rows of plank.

This device was described in a recent issue of *Engineering and Mining Journal.*

Trench Excavator Cuts Cost of Duct Line Between Tracks

CONSTRUCTION costs of an electric duct line between tracks on an Eastern railway line were substantially reduced last autumn by using a ladder-type trench excavator for removing the ballast and digging the trench. In round figures, the excavator work was 25 to 30% cheaper than hand labor, although, owing to loose rock in the trench, the excavator worked at considerable disadvantage. Machine work was also hindered by delays due to lack of men enough to keep the duct laying close up to the trenching.

Work with the excavator proceeded in two operations. Traveling between the trucks, the machine first removed the stone ballast down to the subgrade. The side conveyor delivered the ballast onto a screen installed under the conveyor. This screen dropped the fine material between the rails of one track and delivered the coarse stone on the outside shoulder of the same track. Canvas was laid between rails to catch the fine material. The second operation was the excavation of the 4½-ft. duct trench. To do this the trencher was shunted back and then run over the course a second time.

The duct was laid and the backfilling and reballasting were done by hand.

Specific figures gathered on the work are indicative of possibilities; they cannot be considered representative because the conditions mentioned greatly handicapped machine work. They were for:

Week Ending	Lin. Ft.	Cost	Est. Cost by Hand
Oct 20	970	64c.	95c
Nov 1	1,713	36c	63c
Nov 12	1,472	48c	70c
Nov. 20	1,517	49c.	64c
Dec 11	904	57c.	81c.

During the weeks which ended Nov. 27 and Dec. 4, 694 ft. and 869 ft., respectively, of duct were constructed by hand at an expense, respectively, of 81c. and 74c. per foot.

Air-Lift Pump Principle Improves Piledriving Jet

IN SINKING steel sheet piles at the Junction Dam, completed this year near Wellston, Mich., a combined air and water jet proved superior in effectiveness to a plain water jet. The piles formed a cutoff under a concrete core wall in an earth dike. They penetrated a number of veins of coarse gravel with thin layers of clay interspersed.

A water pressure of 200 lb. at the nozzle of the jet was had, and a 2-in. nozzle was employed. The air pipe, ½ to ¾ in. in diameter, was introduced into the top of the nozzle pipe and extended one-half to two-thirds its length. The combination jet was operated exactly as is usual in jetting piles, but its effectiveness in moving the gravel was markedly greater than that of the water jet alone.

The action appeared to be similar to that of the air-lift pump, and its efficiency was apparently due to the intermittent or hammer effect produced. The dam was built for the Consumers' Power Co. by the Fargo Engineering Co., Jackson, Mich.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Ohio Makes Special Appeal to Rail Administration

Asks Rebate on the Advance in Freight Rate for Road Contracts Let Prior to the Order

A hearing was given by the railroad administration to a delegation of Ohio officials and others, who made a special appeal that rebate be made on the advanced freight rate established by General Order No. 28, where such order affects road contracts executed prior to its issuance. The hearing was before M. B. Clagett of the administration, and data were presented by the Ohio officials, showing the hardship placed upon contractors by the order.

It was pointed out that the present laws in Ohio make it impossible for the state, counties or cities to assume any portion of the extra burden placed upon contractors by the advance in the freight rate, and that this would mean a gross loss of from $600,000 to $700,000 to the Ohio contractors. It was also stated that if this additional expense were placed upon them the contractors, already burdened by the excess cost of labor and materials, would be unable to continue with their work and would throw up their contracts, leaving road work in a chaotic condition.

The distinction between private and public contracts in Ohio was emphasized, and Mr. Clagett's attention was drawn to the fact that the method of letting and the form of contract are prescribed minutely by law and can only be altered by an act of the legislature.

As this is an uncertainty, it was the assertion of many of those appearing that a great many of the contractors would be compelled to refuse to go on with the work. It was also questioned whether the bonding companies could be held liable for the excess cost, and if the work had to be taken over by the state whether it would not cost from $2,000,000 to $3,000,000 more than the contract prices, to finish it.

At the completion of the hearing, Mr. Clagett advised the delegation that he would give careful consideration to their appeal and lay it before the Director General of Railroads. The following officials from Ohio were present: Joseph McGee, attorney general; Frank Davis, special counsel under the attorney general; Victor Donahey, state auditor; W. A. Stinchcomb, county surveyor of Cuyahoga County; W. A. Alsdorf, secretary Ohio Good Roads Federation; E. S. Humphreys of the State Highway Board; G. A. McCormick, of the Contractors' Association; Frederick Bramley, president of the Cleveland-Trinidad Paving Company.

Nitrate Plant Near Cincinnati

The $50,000,000 Government nitrate plant for the Cincinnati district will be erected at Broadwell, Ohio, on the Little Miami River, about 8 miles by air line and 11 miles by railroad from the center of Cincinnati. This plant was originally intended to be at Elizabethtown, Ohio, but the site has been changed, according to reports, because too much of the prospective trackage would be below maximum high water.

Emergency Fleet Corporation Has Requirement Section

Charles M. Schwab, director general of the Emergency Fleet Corporation, has created a new department called the Requirement Section, to which he has appointed as head George M. Brill, well known as a Chicago consulting mechanical engineer. In making announcement of the appointment, Mr. Schwab said: "It will be the purpose of this section to keep in touch with the shipyards and learn from them in a general way the amount of materials, supplies and equipment required for extension so that a proper schedule may be placed before the War Industries Board for survey and if necessary for allocation. I think you will appreciate that at this time, when the demand for many materials is so far in excess of the supply, it is most essential that a clearing house be provided so that the needs of different Government agencies may not conflict. The War Industries Board constitutes such a clearing house, and it is in my opinion a very essential instrument in the conduct of industry under present conditions."

Mr. Brill's main activity for the present will be directed toward the supply of steel to the various shipyards, many of which are not running at full capacity for lack of raw materials.

Opening New Sewage-Works at Albany Postponed

Owing to war conditions, the Board of Estimate and Apportionment of Albany, N. Y., has decided not to take steps to put into operation its new sewage-works, now almost completed. Difficulty has been experienced in maintaining a small number of men engaged on cleaning up the plant, writes Frank R. Lanagan, city engineer, thus suggesting still more difficulty in keeping up a full operating force. The possibility of a shortage of coal to operate the plant was also taken into consideration. It is believed that no harm will result if the sewage of Albany is discharged into the Hudson untreated for a while longer.

All-American Canal for Imperial Valley

Engineers Appointed to Make Studies for Proposed Route Render Preliminary Report

A progress report based on surveys of the route of the proposed All-American Canal for supplying Imperial Valley, California, has just been filed by the committee of engineers appointed to make preliminary studies of the project. Funds for this investigation were appropriated jointly by the Imperial Irrigation District and the United States Department of the Interior, $30,000 by the former and $15,000 by the latter. The board of engineers in charge of the work consists of C. E. Grunsky, appointed by the irrigation district; Dr. Elwood Mead, appointed by the University of California, and W. W. Schlecht, appointed by the Secretary of the Interior. The plan is to compile data concerning a canal which would have the advantages of being for its entire length on American territory and would increase the area that could be irrigated without pumping. Incidentally, such a canal would afford opportunity for considerable power development. A review of the main features of the committee's report follows:

The All-American Canal should be constructed, the report recommends, on the basis of irrigating 900,000 acres. It would be designed to carry 10,600 sec-ft. from the Laguna Dam to Siphon Drop and below the Siphon Drop 9000 sec.-ft. The canal would be about 15.5 ft. deep, nowhere exceeding 16 ft., the side slopes 1½:1. The velocity is to be 3.5 ft. per second when the canal is full and 2.5 ft. per second when half full. A velocity of 6 ft. per second is to be maintained in the concrete-lined sections and a velocity of 10 ft. per second in tunnel sections. All tunnels of considerable length will be constructed in duplicate some distance apart.

Until the main canal can be constructed around Pilot Knob, delivery would be made to the present canal below Hanlon Heading. Laguna Dam at the head of the canal would be raised from 1 to 2 ft. above its present crest, and the new canal intake would be provided with headgates of the flashboard type for a total length of 1200 to 1600 ft. The present desilting works at Laguna Dam will require enlargement and in addition the detention of silt would be provided for in two stretches of the canal, one occupying a mile of its length near the Laguna Dam and the other occupying a two-mile stretch near Hanlon Heading. Large sluice [illegible] tes would be

provided above the Rockwood gate and at other places between that point and Laguna Dam. The main canal around Pilot Knob should be concreted as well as sections where the soil conditions are not satisfactory.

Final estimates should be confined to two routes, the report recommends, one following the boundary and the other near the present plank road. The location of the point of delivery to the Imperial Irrigation District should take the power possibilities into consideration, it is recommended. Two sites of 25- and 35-ft. drops are referred to in the report.

Local Housing Engineers and Architects Appointed

United States Housing Corporation Has a Number of Projects Under Design In Many Sections of Country

Following the formation of the United States Housing Corporation, which will design and build the numerous housing projects authorized under recent Congressional appropriations, and hitherto carried out by the bureau of industrial housing and transportation of the United States Department of Labor, announcement has been made of the local boards which will have charge of the design of various operations. These boards comprise an architect, a town planner and an engineer, who will have entire charge of the design of each housing development, working under general standards set up by the Washington office and producing final drawings which have to be approved by the Washington office. The list of cities, together with the names of the engineers, architects and town planners, is given herewith.

The only one of these developments which has been started is that at Charleston, W. Va., where a contract has been awarded for the construction of 85 houses to the Wills-Egelhof Co. of New York City.

In connection with the announcement of the formation of the housing corporation and the accompanying announcement that this corporation would have charge of all the Government housing developments, the Department of Labor has issued a statement which reads in part as follows: "A. Merritt Taylor, director of passenger transportation and housing, Emergency Fleet Corporation, called on O. F. Eidlitz, director of housing and transportation of the Department of Labor, in Washington, and in a protracted interview Messrs. Eidlitz and Taylor gave out the following general statement: 'We have adopted policies whereunder our respective activities will be carried on in complete coöperation and accord, to the end that duplication of effort will be avoided and maximum results will thereby be obtained for the Government at a minimum cost with maximum efficiency. We have a complete understanding whereby the activities of the United States Housing Corporation of the Department of Labor and the passenger transportation and housing division of the Emergency Fleet Corporation will at all times be fully informed with relation to respective projects, procedures and all matters relating thereto. All information of one department will be available for the use of the other at all times.'"

This statement would indicate that for the time being at least the two departments will be conducted as separate entities.

LOCAL PROJECT BOARDS FOR HOUSING CORPORATION'S DEVELOPMENTS

Project	Architect	Town Planner	Engineer
Alliance, Ohio	Walker & Weeks, 1900 Euclid Ave., Cleveland	Alling DeForest, 222 Sibley Block, Rochester, N. Y.	R. Winthrip Pratt Hippodrome Bldg. Cleveland
Bath, Maine	Parker, Thomas & Rice 110 State St., Boston	Loring Underwood, 15 Exchange St., Boston	Weston & Sampson, 14 Beacon St., Boston
Bethlehem, Pa.	Zantsinger, Borie & Medary, 112 So. 16th St., Philadelphia	T. W. Sears, 1424 Walnut St., Phila.	L. J. H. Grossart, Bethlehem Steel Co., Beth., Pa., and Alexander Potter, 50 Church St., N. Y.
Bridgeport, Conn.	R. C. Sturgis, 120 Boylston St., Boston	A. A. Shurtleff, 89 State St., Boston	Alfred Terry, 886 Main St., Bridgeport
Charleston, W. Va.	Godley, Haskel & Sedgewick, 244 Madison St., Philadelphia	Jas. L. Greenleaf, 1 Broadway, N. Y.	Jas. L. Greenleaf
Davenport & Bettendorf, Ia.	Temple & Burrows, 208 Main St., Davenport	Geo. E. Kessler, 423 Security Bldg., St. Louis	W. S. Shields, Hartford Bldg., Chicago
Erie, Pa.	Albert H. Spahr, Keystone Bldg., Pittsburgh	C. D. Lay, 15 E. 40th St., N. Y.	Chester & Fleming, Union Bank Bldg., Pittsburgh
Indian Head, Md.	Donn & Deming, 808 17th St., N. W., Washington, D. C.		
Mare Island (Vallejo), Cal.	Geo. W. Kelham, Sharon Bldg., San Francisco	P. R. Jones, Sharon Bldg., San Francisco	S. E. Kieffer, Mechanic Institute Bldg., San Fran.
Moline, Ill.	Carvin & Horn, Rock Island, Ill.	Geo. E. Kessler, 423 Security Bldg., St. Louis	W. S. Shields, Hartford Bldg., Chicago
E. Moline, Ill.	Carvin & Horn, Rock Island, Ill.	Geo. E. Kessler, 423 Security Bldg., St. Louis	W. S. Shields, Hartford Bldg., Chicago
New London, Conn.	Hoppin & Koem, 4 E. 43rd St., N. Y.		Tribus & Massa, 86 Warren St., N. Y.
Niagara Falls, N. Y.	Dean & Dean, 137 So. La Salle St., Chicago		
Norfolk & Portsmouth, Va.	Geo. B. Post & Sons, 101 Park Ave., N. Y.	Geo. B. Post & Sons, 101 Park Ave., N. Y.	Nicholas Hill, 100 William St., N. Y.
Norfolk & Portsmouth, Va. (Colored)	Rossel Edward Mitchell, Paul-Gale-Greenwood Bldg., Norfolk, Va.		
Philadelphia Navy Yard	Rankin, Kellogg & Crane, 1012 Walnut St., Phila.		
Puget Sound, Wash. (Bremerton)	A. H. Albertson, 725 Henry Bldg., Seattle, Wash.	E. T. Mische, 394 Jackson St., Portland, Ore.	Sawyer Bros., 410 Lindelle Bldg., Spokane, Wash. Geo. B. Sawyer, Sawyer Bros., Seattle, Wash.
Quincy, Mass.	J. E. McLaughlin, 88 Tremont St., Boston	H. J. Kellaway, 12 West St., Boston	Ernest W. Branch 21 Adams Blvd. Quincy
Rock Island, Ill.	Carvin & Horn, Rock Island, Ill.	Geo. E. Kessler, 423 Security Bldg., St. Louis	W. S. Shields, Hartford Bldg., Chicago
Washington Navy Yard	York & Sawyer, 50 E. 41st St., N. Y.		
Washington Navy Yard	James A. Wetmore, Acting Supervising Architect's Office, Washington, D. C.		
Washington Dormitories	Waddy B. Wood, 816 Connecticut Ave., Washington, D. C.		
Watertown, N. Y.	Davis, McGrath & Kiessling, 175 Fifth Ave., N. Y.	F. Vitale, 527 Fifth Ave., N. Y.	E. W. Sales, Watertown, N. Y.

Engineering Division of Employment Service Meets

A conference was called by the division of engineering, United States employment service of the Department of Labor, at the Engineering Club, Chicago, June 28, at which it was suggested by the director of the division that the first problem before it would be to make a survey and registration of all technical persons, and that advice was sought as to whether this could not best be accomplished in conjunction with the work of the National War Industries Commission. In making this statement A. H. K om, director of the Division of Engineering, stated that such a survey would at once reveal the number, location and capacities of technical men employed, as well as the number and kind of technical men needed by employers engaged in essential war work.

The conference was opened by Dr. P. L Prentis, district superintendent, who explained briefly the functions of the United States Employment Service and cordially welcomed the assistance of those in attendance. William H. Finley was appointed chairman of the conference. Those in attendance were Dean John R. Allen, Dean Mortimer E. Cooley, W. W. DeBerard, C. E. Drayer, W. H. Finley, C. Francis Harding, A. H. Krom, Edgar S. Nethercutt, F. H. Newell, Edmund T. Perkins, J. A. Peterson, Dr. P. L. Prentis, Isham Randolph and George C. Dent.

Mr. Krom outlined the objects to be accomplished by the Division of Engineering, and stated that the engineers in attendance had been invited to assist in inaugurating the work and establishing standards for future guidance. He suggested that an engineering advisory board be named to act in a consulting capacity with the Division of Engineering.

A resolution was passed to the effect that an engineering advisory committee be named by Chairman Finley to act with the Division of Engineering in formulating and carrying forward its work. It was resolved that the desired register of all engineers be compiled in conjunction with the survey of the War Industries Commission, and that the classification be made by employing existing agencies represented by the various engineering and technical societies.

Record Regr t at Loss by Marburg's Death

The board of directors of the Philadelphia Association of Members of the American Society of Civil Engineers passed a resolution at a special meeting held July 8, recording the deepest regret at the loss sustained by the death of Prof. Edgar Marburg. The resolution passed is as follows:

"Resolved, that the board of directors of the Philadelphia Association of Members of the American Society of Civil Engineers record with the deepest regret the loss which they and the engineering profession at large have sustained by the death of Edgar Marburg on June 27, 1918.

"As a member of the board and as vice-president since April, 1915, he was a most faithful worker and was always keenly alive to the best interests of the society and the association. His remarkable energy, enthusiasm and sincerity will always be remembered by those who were privileged to have been associated with him."

Atlanta Cannot Issue Water-Works and Other Bonds

Lack of affirmative votes to the extent of two-thirds of the total registration, as required by state law, defeated a proposed $800,000 bond issue at Atlanta, Ga., July 10. Of the sum named, $500,000 was to go for water-works improvements, including much-needed pumps; $75,000 for construction work at the garbage incinerator designed to make possible the utilization of waste steam by the generation of electricity, the latter to be turned over to the local light and railway company; $125,000 for motorizing the fire department; and $100,000 for housing the cyclorama of the battle of Atlanta. It is expected that the most urgent of the water needs will be taken care of by a special tax of $250,000, and a personal guarantee to the pump manufacturers to be given by the mayor, Asa G. Candler. There is a movement now on foot to obtain an amendment of the state law governing bond elections, so that it would require three-fourths of the votes cast, rather than two-thirds of the registered votes, in order to issue bonds. Should this become the law, an election will be held very soon to vote the necessary bonds.

Army Establishes Lumber Depot

Emergency demands for lumber for the various Army construction projects have become so great, and the cost of immediate purchasing in local yards has run so high, that the construction division of the Army has established a lumber depot at Gilmerton, Va. In this yard, which is situated on the Elizabeth River a few miles from Norfolk and on tidewater, a stock of from 12,000,000 to 15,000,000 ft. of lumber will be carried. It is estimated that the yearly turnover will amount to from 50,000,000 to 60,000,000 ft. The average increase in price for lumber bought from local yards for emergency work has run from $9 to $12 per 1000 feet. By purchasing in large quantities and charging only for yard maintenance, a greater part of this excess price is expected to be saved by the Government.

Injunction Against Cincinnati Garbage Works Refused

Holding that all known devices for the elimination of odors at the garbage works of the Union Reduction Co., Cincinnati, were being used, the Superior Court of that city recently refused to grant an injunction against the operation of the plant sought by property owners on the score of alleged nuisance.

Zoning Ordinance Adopted By Saint Louis

Five use, five height and four area zones have been established by the Board of Aldermen of St. Louis, in general accordance with a plan worked out after long study by the City Plan Commission under the direction of its engineer, Harland Bartholomew. The ordinance will take effect Aug. 15. There will be a first and a second residence, a commercial, an industrial and an unrestricted residence district; a 45-, a 60-, an 80-, a 120 and a 150-ft. building height district; and four districts in which varying restrictions will apply as to rear and side yards, inclosed and outer courts and percentage of lots which may be built upon. Those interested in the details of the zoning scheme may obtain copies of the ordinance and accompanying diagrams and colored maps, in the form of a 21 x 16-in. pamphlet, for $2.11, postpaid.

Short Line Railroads To Make United Protest

Representatives of the 1700 short-line railroads of the country which have been relinquished by the United States railroad administration will meet in Washington Aug. 7 to take steps to have the Director General of Railroads reconsider their status, according to arrangements made at a recent meeting presided over by F. M. Robinson, president of the American Short Line Railroad Association. About 25,000 miles of short lines, representing an aggregate investment of more than $2,000,000,000, are concerned in the recent order of the railroad administration turning the short lines back to the former management.

It has been asserted that the cases involving these lines were disposed of without adequate investigation.

Denver to Vote on Buying Out Water Company

Continuing the steps toward municipal ownership of water-works at Denver, noted in *Engineering News-Record* of July 18, p. 117, the people will vote Aug. 6 on a bond issue of $13,970,000 to pay for the property of the company and also on the election of a board of water commissioners.

New High Dam Site in California Favorably Considered

The Modesto Irrigation District and the Turlock Irrigation District in the San Joaquin Valley, California (81,183 and 176,000 acres, respectively) are making a joint investigation of the cost of additional storage capacity. The situation known as the Don Pedro dam site, six miles above La Grange dam, the present diversion works on the Tuolumne River, has been favorably considered. The height of a dam at this point could be about 290 ft. A. J. Wiley, consulting engineer of Boise, Idaho, was retained to report on the site. His preliminary report, made af-

ter detailed examination, was favorable, and the contract was awarded to the International Drill Co., Spokane, Wash., for making foundation test borings. Thus far, after five holes have been put down to a 50-ft. depth, the results are reported to be entirely satisfactory. P. F. Jones is chief engineer of the Modesto Irrigation District, and R. V. Meikle is chief engineer of the Turlock District.

Government Takes Over Cape Cod Canal After U-Boat Attack

Following the U-boat attack on a coal-barge tow off Cape Cod on July 21, President Wilson on July 23 issued a proclamation assuming control of the Cape Cod Canal and directing the railroad administration to operate it after July 25. The railroad administration has announced that dredging of the waterway to a depth of 25 ft. will be begun immediately, that water-borne coal for New England will be routed through the canal and that the various New England steamship lines hitherto skirting the cape will use the shorter route through the canal.

French Impressed by Initiative of American Engineer Officers

PARIS, July 12.—The French people are showing increasing admiration of the businesslike manner in which Americans are handling the work of war here, and scarcely a day passes without significant stories being published demonstrating how the transatlantic ally insists on overcoming often absurd administrative fetters which hamper rapid progress in this country.

The *Petit Journal* recounts today how an American engineer captain surprised officials of the Est Railroad Co. by accomplishing in five or six hours what he had been assured would involve a delay of a fortnight. Near Gondrecourt Station was a huge collection of railroad ties condemned to be cut up for firewood. The American engineer officer cast a longing eye on these ties for use on the narrow-gage switchroad he wished to build close by.

On offering to purchase the ties the officer was told by the railway man in charge that sale was impossible, as the ties were condemned for firewood.

"Then sell them to me for firewood," said the American.

"Not possible," was the reply.

Eventually the official explained that the only thing to do was to obtain permission from the head offices in Paris, which would take at least a fortnight.

"When does the first express leave for Paris?" asked the officer.

"This evening," was the reply.

"Thanks," said the officer. "Good morning."

In the morning a gang of husky "Sammies" started loading up ties.

"Here is the permit," the officer told the railroad officials, showing a sheet of paper. "We shall start our narrow-gage road tomorrow morning."

Mississippi and Warrior River Traffic Taken Over

Further extension of the Federal control of the inland waterways took place July 11, when the Director General of Railroads issued a general order, effective that date, appointing M. J. Sanders, Federal manager of Mississippi and Warrior waterways for the United States railroad administration, with headquarters at New Orleans, La. The order states that Mr. Sanders is to have charge of the construction and acquisition of equipment for use upon the Mississippi River between St. Louis and New Orleans and for use upon the Warrior River between the Alabama coal fields and Mobile, and the connection therewith for use upon Mississippi Sound and connecting waters between Mobile and New Orleans, and will operate such equipment for the Director General of Railroads upon all such waters. Mr. Sanders is empowered to enter into contracts, either in his own name as Federal manager or in the name of the Director General of Railways, for the construction, acquisition or chartering of equipment, for the purchase of the supplies needed in the operation of the river, and for the transportation and traffic upon all the waters under his charge.

Mr. Sanders has been manager of the Leyland Steamship Line for the ports of New Orleans, Mobile and Pensacola for the past thirty years. In March last he became a member of the inland waterways committee of the United States railroad administration. He has long been an advocate of waterway transportation in the district over which he is to assume control.

Another Section of the New York Subway Opened for Traffic

A special train carrying city officials and invited guests was run over the Lexington Ave. line of the New York subway system on Wednesday, July 17, to celebrate its opening for public traffic. The section opened extends from the diagonal station (at the Grand Central Terminal) up Lexington and Jerome Aves. to 167th St. Only local trains will be run at present over this line; but eventually it will form the main east side line and trains will run over it as far north as Woodlawn.

Lincoln Highway Cutoff to Cross Desert in Utah

A short cut in the Lincoln Highway route across Utah, shortening the distance by 50 miles, will include the construction of a 6-mile highway along the line of the present trail through Johnson Pass, and a 17½-mile stretch of 18-ft. gravel road across the Salt Lake Desert. The present winding route from Salt Lake City to Ibapah skirts both the range and the desert, and has a length of 192 miles. The new direct route will be only 142 miles between the same points, cutting across the range and the desert.

The mountain section will start from the end of the present state highway at Clover, and will cost about $25,000, while the desert section will cost about $100,000. For the furtherance of this project, the Lincoln Highway Association is reported to have raised a fund of $125,000, of which the association pledged $25,000, The Goodyear Tire & Rubber Co. $75,000 and F. A. Seiberling, president of the association, $25,000. The association will also guarantee $5000 per year for five years for maintenance, after which the work will be maintained by the State Highway Department.

The new road is to be built by the state, and work has already begun under the direction of G. F. McGonagle, state engineer, and Ira R. Browning, state highway engineer. Convict labor is being employed, and the employment of German prisoners from Fort Douglas is proposed. The work will be finished before winter, it is expected.

Langfitt Now Pershing's Chief of Engineers

According to dispatches from the American Army in France, Maj. Gen. W. C. Langfitt has been made chief engineer of the American Expeditionary Forces. Gen. Langfitt was a colonel of engineers when war was declared and went over in command of one of the early engineer regiments. He has since had two promotions to his present rank.

Successor to Engineer Health Officer Wanted

Owing to the resignation of C. H. Wells as health officer of Montclair, N. J., on July 23, noted on p. 201, a vacancy exists in a suburb of New York City which for 22 years has employed a sanitary engineer as health officer and has retained the incumbents until they resigned to enter larger fields of usefulness. The position was first filled by Theodore Horton, now chief engineer of the New York State Department of Health. Other sanitarians who began their professional work in Montclair are Marshall O. Leighton, Prof. C.-E. A. Winslow and Horatio N. Parker. Applicants for appointment should address Secretary, Board of Health, Montclair, N. J. Full particulars as to education, experience and salary are desired in the first communication, as the board intends to fill the vacancy within a week or ten days.

Chinese Will Build United States Ships

Chairman E. N. Hurley of the United States Shipping Board has announced that contract has been closed with the Kiang-Nan Dock & Engineering Works, Shanghai, China, for the construction of four steel ships of 10,000 tons deadweight carrying capacity. The contract further carries the option for the building of eight more vessels of similar tonnage at the yard. The yard is under the exclusive control of the Chinese Board of Navy, which has assured

the Shipping Board that it will be able to furnish all labor and materials for the building of the ships, with the exception of less than 40,000 tons of steel plates, which must come from this country. Engines and other equipment for the entire 120,000 tons of vessels will be obtained in China.

Eastern Ontario Good Roads Association Formed

At a meeting of about 300 good roads men of eastern Ontario, held July 8 at Ottawa, a permanent association was formed, to be known as the Eastern Ontario Good Roads Association. The object of the association was declared to be the promotion of highway improvements, and the end in view is a continuous system of improved highways throughout the eastern part of the province.

Alderman William Findlay, of Ottawa, called the meeting to order, and after several speeches, explaining the purpose of the new organization, the following officers were elected:

President, Alderman William Findlay, Ottawa; vice-presidents, John Brennan, Armprior; W. B. Barker, Portland, and Dr. Smith, Hawkesburg. W. Y. Dennison, Ottawa, was elected secretary and treasurer.

A definite program of highways to be constructed was drawn up for presentation to the provincial Government, and arrangements were made for sending a representative committee to Toronto, to urge the building of three highways, one from Ottawa to Petawawa Camp, one from Ottawa to Point Fortune, Quebec, and one from Ottawa to Morrisburg. A number of prominent members of the association visited Kingston, Ont., in company with the Hon. G. S. Henry, minister of agriculture, and W. A. McLean, deputy minister of public works, and inspected several roads in the county of Frontenac. Mr. McLean announced that the Government would take over for maintenance purposes at once, and for construction after the war, nearly all of the road between Napanee and Brockville. Later the stretch between Prescott and Ottawa will be included in the system. He stated that the Government good roads policy would aid much in solving the problem of finding work for the returned soldiers.

Engineering Societies

The Engineers' Society of St. Paul made a trip of inspection of state roads, via automobiles, as a feature of the meeting of July 20. The route was through Shakopee, Henderson, Mankato, Faribault, and Farmington, returning to St. Paul.

The Washington State Good Roads' Association, Spokane, Wash., will hold its nineteenth annual convention in Pasco, Wash., Nov. 14-15, according to announcement of the executive committee. Horatio S. Earle, Detroit, Mich., will be included in the list of speakers.

The Saginaw Engineering Society Saginaw, Mich., elected the following officers at its recent meeting: President, R. W. Roberts; vice-president, W. L. Whitney; executive committee, J. H. Stewart and John P. Wood, with the officers.

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

Personal Notes

L. G. Curtis, who was recently appointed assistant chief engineer of the Baltimore & Ohio R.R., as mentioned in *Engineering News-Record* of May 30, p. 1066, has now been appointed chief engineer of the western lines of the Baltimore & Ohio system, with headquarters at Cincinnati. With the exception of one year shortly after his graduation from Ohio State University in 1899, Mr. Curtis has been continuously in the service of the Baltimore & Ohio system. Beginning at Zanesville, Ohio, he was transferred to Garrett, Ind., in 1901, as assistant division engineer of the Chicago division. Two years later he was promoted to division engineer and his headquarters were transferred to Chicago. When the Baltimore & Ohio acquired the terminal and trackage of the Chicago Terminal Transfer Co., Mr. Curtis was put in charge of its engineering work, first as engineer maintenance of way and later as district engineer. His jurisdiction also extended eastward over a part of the Baltimore & Ohio proper.

J. M. Braxton has been appointed United States district engineer, Jacksonville, Fla., succeeding J. W. Sackett, drowned recently in the wreck of the United States dredge "Florida" off the Florida coast. Mr. Braxton has been connected with the United States Engineering Department since 1897, previous to which time he was engaged in railroad work. In 1900 Mr. Braxton was placed in charge of the United States Engineer Office in Key West, Fla., having charge of the construction of batteries, the making of surveys for river and harbor work, jetty construction, and various other survey work until 1909, when he was transferred to Jacksonville to undertake the general supervision of the fortification works at Key West and Tampa, as well as surveys for the trans-Florida Canal and the intercoastal waterway from Fernandina to Key West. Mr. Braxton designed and built the first of the Government's all-concrete docks at Key West.

J. B. Carothers has been appointed assistant to the Federal manager, Baltimore & Ohio R.R., with headquarters at Cincinnati. Mr. Carothers entered the engineering department of the Baltimore & Ohio system in 1895 as assistant engineer at Cincinnati, becoming division engineer in the next year. In 1904 he was made division superintendent of the Ohio division at Chillicothe, Ohio, being transferred in 1905 to the superintendency of the Indiana division at Washington, Ind. In this position he remained until 1910, when he was promoted to chief engineer maintenance of way of the Baltimore & Ohio Southwestern R.R. He later became superintendent of the Philadelphia division, after which he was transferred to special engineering work on the staff of the chief engineer.

Prof. Frederic Bass, chairman of the department of civil engineering, University of Minnesota, has been appointed acting secretary of the American Association of Engineers. Professor Bass has been a member of the faculty of the University of Minnesota for 17 years, going there almost immediately after his graduation from the Massachusetts Institute of Technology. He will return to the university about Sept. 1, by which time, it is expected, a permanent secretary will have been appointed for the association.

W. A. Baldwin, transportation assistant, Erie R.R., has been appointed general manager, with headquarters at New York City. After his graduation from Cornell University in 1896, Mr. Baldwin entered railway service in the engineering department of the Erie R.R., first as a rodman and later as assistant engineer. In 1902 and 1903 he was train master, and from that time until 1909, division engineer, becoming superintendent of the Chicago & Lima division in 1910. Mr. Baldwin's entire service has been with the Erie.

Arthur B. Caldwell, train master of the Erie R.R. at Buffalo, and previously division engineer at Salamanca, N. Y., has been appointed superintendent of the Rochester division with headquarters at Rochester, N. Y. At the time of Mr. Caldwell's appointment as division engineer for the Erie, he was division engineer of

the New York, Susquehanna & Western R.R., with headquarters at Jersey City, N. J.

SYDNEY B. WILLIAMSON, construction engineer for the South American mining projects of Guggenheim Bros., has been commissioned lieutenant-colonel, 55th Railway Construction Engineers, United States Corps of Engineers. In the early part of 1916, Mr. Williamson resigned from the office of chief of construction of the United States Reclamation Service to become connected with the Guggenheim interests. Previous to his connection with the Reclamation Service he was construction engineer with J. G. White & Co., Ltd., London, England, and previous to that was division engineer for the Pacific division of the Panama Canal. He was graduated from the Virginia Military Institute in 1884 and, after somewhat more than a year as instructor of mathematics at Kings Mountain Military School, was engaged in railroad work until 1890, when he entered private practice at Montgomery, Ala. In 1892 he entered the service of the Government on Tennessee River improvement work and remained in that service, with the exception of a short period in Porto Rico as captain of engineers during the Spanish-American War, until 1904, when he went to New York City as designing engineer for the Expanded Metal & Engineering Co. In 1907 he went to the Panama Canal as engineer in charge of the Pacific locks, and, in 1908, was appointed division engineer of the Pacific division. He resigned from the Canal Commission service in the latter part of 1912 and went with J. G. White & Co., Ltd. He was appointed chief of construction in the Reclamation Service in December, 1914.

HARRY O. COLE, assistant construction engineer for the South American mining projects of Guggenheim Bros., has been appointed construction engineer, succeeding Sydney B. Williamson, who has received a commission in the United States Corps of Engineers as lieutenant-colonel, as noted above. Mr. Cole became associated with the Guggenheim interests during 1916 as assistant engineer in charge of the construction department in the development of the Chilo Exploration Co. and the Braden Copper Co.'s mines at Chilo, involving an expenditure of some $35,000,000. Mr. Cole is a graduate of West Virginia University, class of 1898. For three years after graduation he was employed as draftsman by several bridge and steel companies, after which he was for four years assistant engineer in the office of Virgil G. Bogue, consulting engineer, New York City. In 1907 he became bridge engineer of the Oaxaca & Pacific Ry. in Mexico, and subsequently served on the investigating committee of the Queensborough Bridge in New York City. In 1908 he was engaged by the Isthmian Canal Commission as assistant engineer of the old Pacific division, later becoming resident engineer of the fifth division of the Panama Canal, from which position he resigned in 1914. From this time and until his association with the Guggenheim interests he was a member of the engineering and contracting firm of Cole Bros., Inc., Baltimore.

PROF. OLIN B. LANDRETH of the department of civil and structural engineering, Union University, Schenectady, N. Y., has been appointed mechanical engineer in the production bureau of the Ordnance Department, Washington, D. C. Professor Landreth has been granted an extension of his leave of absence from Union University to undertake this work.

CHARLES BROSSMAN, consulting engineer, Indianapolis, and Frank C. Wagner, professor of mechanical engineering at Rose Polytechnic Institute, Terre Haute, Ind., have been appointed by the United States fuel administration to take charge of special fuel conservation activities in Indiana industries, as announced by Horace H. Herr, director of conservation of the state fuel administration.

F. C. WILLIAMS, assistant engineer, Miami Conservancy District, Dayton, Ohio, has been transferred to Hamilton as superintendent in charge of the construction of sewers and drainage work.

R. D. GOODRICH, city engineer of Lansing, Mich., has resigned to become a member of the staff of American engineers who are shortly to undertake the making of surveys, plans and estimates for rebuilding a portion of the Grand Canal of China, some 200 miles in length, according to present plans. Mr. Goodrich will sail from San Francisco July 27.

W. S. GEARHART, for the past nine years state highway engineer of Kansas, has received a leave of absence from the state highway commission to become a captain in the Engineer Reserve Corps. Mr. Gearhart has been assigned to duty at Camp Lee, Virginia.

WILLIAM HALL WALLACE, recently construction engineer for the Davison Chemical Co., Baltimore, Md., has received a commission as first lieutenant in the Engineer Reserve Corps and is now at Camp Lee, Virginia.

GEORGE H. RUHLING has resigned as office engineer in the office of the city engineer, Flint, Mich., to become resident engineer for the city of Highland Park, Mich., in connection with the construction of the new filtration plant for that city.

JOHN NEVINS, Seattle, has been appointed structural and mechanical engineer for the Government housing project at the Puget Sound Navy Yard, Bremerton, Wash.

CHESTER H. WELLS, health officer of Montclair, N. J., for the past 13 years, has been chosen by the Delaware State Council of National Defence to serve as state health commissioner. He will assume his new duties Aug. 15. Mr. Wells is a graduate in sanitary engineering from the Massachusetts Institute of Technology. For a time between his graduation and going to Montclair he was with the Bureau of Filtration, Philadelphia, while the filter plants there were under construction. He is secretary of the American Public Administration Association and a member of the National Commission on Milk Standards.

R. H. OBER, consulting engineer, Seattle, and formerly superintendent of buildings for that city, has entered Y. M. C. A. service as an ambulance driver.

ARTHUR H. YOUNG, director of the American Museum of Safety, has resigned to become head of the department of employee relations of the International Harvester Co. Since Mr. Young was recently elected to the vice-presidency of the Museum, succeeding the late Dr. Frederick R. Hutton, whose death was noted in *Engineering News-Record* of May 16, p. 977, he will continue to be connected with the affairs of the museum, although giving up the actual direction of its work. Recently the museum awarded to him the Louis Livingston Seaman medal, in recognition of his work.

R. M. LITTLE of the board of trustees of the American Museum of Safety, has become director of the museum, succeeding Arthur H. Young, resigned, as noted above.

W. J. ELMENDORF, of Campbell, Wells & Elmendorf, mining engineers, Seattle, has been appointed consulting engineer for the United States Bureau of Mines, assigned to the territory of the Northwest.

E. T. BOWER, resident engineer of the Alaskan R.R. at Turnagain Arm, Alaska, will become assistant engineer in the maintenance of way department, succeeding E. O. Archibald, resigned.

OBITUARY

EDWARD S. MELOY, for 32 years on the engineering staff of the Chicago, Milwaukee & St. Paul Ry., died in Chicago July 8. He entered the service in 1886 as a draftsman and four years later became assistant engineer. At the time of his death he was assistant engineer in charge of bridge inspection and construction.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Peat Industry Increased 420% in Ten Years

Its Use for Fuel and for Fertilizer Will Hasten the Development of Large Eastern Deposits

The peat industry in the United States in the past 10 years has increased 420%, according to statistics compiled by C. C. Osbon, of the United States Geological Survey, Department of the Interior. Although as yet a comparatively small business, a like increase in the next 10 years will make it a $3,000,000 industry. Fifteen to twenty million tons are consumed in Europe annually for generation of heat and power.

The average price received for peat in 1917 at the point of consumption was a little more than $7.29 per ton, and the gross market value of the output at present is $709,900; by proper productive methods the price can be reduced to $2.50 per ton. There were but 18 producing plants in the United States in 1917, distributed from New York to California, but mostly on the Atlantic Coast and in the Middle West, and all the producers reported that the demand for peat exceeded the supply

Deposits that can be used for fuel are found throughout Minnesota, Wisconsin, Michigan, New York and the New England states, and in the northern parts of Iowa, Illinois, Indiana, Ohio, Pennsylvania and New Jersey; also on the Atlantic Coast from New Jersey to southern Florida and westward along the Gulf coast to the Mexican boundary.

Owing to the fact, however, that it is necessary to subject it to considerable drying, its substitution as a fuel, will be purely local, but the large deposits in New York State and Pennsylvania on the middle Atlantic and the Gulf coasts, make it a potential source of fuel for future use if properly mined, as pointed out by Mr. Obson.

Peat or muck consists of partly decayed vegetable remains that contain enough carbon to ignite and burn freely when dry, and ranges from the imperfectly decayed kind, of a light yellow color, to the thoroughly disintegrated jet black type. In an undrained swamp it contains about 90% of water, which must be reduced to 30% before it can be used for fuel, so that the season for drying must be commenced as early as Apr. 15 and ends in September, except in the Southern region where it is somewhat longer. It is evident, therefore, that the season for cutting and drying peat is too far gone to afford any great relief in the fuel situation this season, especially since no artificial drying process of commercial value has been developed. The value of a deposit of peat as a source of fuel is dependent on many factors, most important of which are degree of decomposition, heating value and ash content.

This material has frequently been used as a source of charcoal and coke, of various byproducts from coke retorts, such as those obtained from the distillation of wood, and of fuel and illuminating gas, as well as in making paper, substitutes for wood and packing material. The prospective value of the peat deposits of the country as a source of these products is much larger than their value as a source of fuel.

Analyses of the peats of the United States show that they contain from 70 to 85% of combined nitrogen, a proportion that in some varieties amounts to more than 2% of their dry weight. This may be recovered in the form of ammonium sulphate, one of the valuable ingredients of commercial fertilizer. It has not yet been proved that the extraction of nitrogen from peat can be made on a large scale, but in view of the difficulty the United States is experiencing in obtaining salts of this nature for agriculture and the explosives industries, the process invites larger experiments, says Mr. Osborn.

Fuel Administration Needs Combustion Engineers

The bureau of oil conservation, oil division, United States fuel administration, is anxious to obtain a combustion engineer for each of the following districts, who will inspect all plants within his district using fuel oil and natural gas: Boston, Providence, New York City, Philadelphia, Pittsburgh, Buffalo, Detroit, Chicago, Minneapolis, Tulsa, Okla., New Orleans and San Francisco.

Only men who have had experience in fuel oil and natural gas combustion are desired, and it is asked that those who are able will volunteer their services. The administration, however, is prepared to pay a reasonable compensation to those who are unable to afford volunteering their services.

Large Tin Plate Mills To Be Built by Steel Corporation

A $10,000,000 extension to the Gary, Ind., plant of the United States Steel Corporation will be built by the American Tin Plate Co., a subsidiary of the Steel Corporation.

Tin production has been the subject of considerable study and discussion between the United States officials and tin plate producers the past few months, the Government demands becoming so heavy as to make necessary this large extension.

General Staff Centralizes All War Department Purchases

All future purchases of the War Department will be centralized in a division of the General Staff of the Army. The new system has recently been perfected which provides for a review of every contract by boards of control, the centralizing of purchases, the standardization of contract clauses, a daily fiscal survey and provisions for public information on War Department needs.

This action will eliminate competition among bureaus and will place technical purchases in the hands of experts in each commodity, reduce the personnel engaged in specialized purchases, centralize purchasing methods; all this, it is expected, will result in a large saving to the Government. As an illustration of the savings that will be effected in salaries and time, the purchase of leather goods for the Army. will be under one bureau instead of five, as formerly, and the same will hold true for hardware and other materials.

Each bureau of the War Department will have a board of award, which will pass on all contracts and will be composed of officers other than those who have conducted the actual negotiations. One officer from each of the bureau boards will sit in a superior board of awards of the General Staff and pass on all questions of general policy before they are presented to the Secretary of War for decision. This superior board will receive the instructions of the Secretary of War concerning such policies and thus make uniform throughout the War Department the execution of policies affected. A report is to be made by an investigation committee appointed several weeks ago, composed of officers and civilians who have made a thorough study of contract clauses and policies in all the agencies of the War Department. It will endeavor to prescribe the form of contract clauses that would best serve the interests of the Government and will have for immediate use well considered and practical forms for every conceivable circumstance of purchase. Another activity of this division will be to make an analysis and tabulation of the various Congressional appropriations from day to day and an accounting of expenditures, so that the Secretary of War may know each day the precise status of each appropriation at the close of the preceding day's business.

The commandeering of work, requisitioning and issuing of compulsory orders for the whole war machine has also been centralized under the General Staff.

Government Orders Large Number of Standard Auto Trucks

The War Department has ordered over 18,000 standard three-ton trucks, 3000 of which have already been delivered. The Quartermaster Corps has been working for a number of months on a standard truck, and this last order indicates the success reached in that this truck, known as the "Class B standardized truck," was selected after rigid tests in competition with the trucks offered by different manufacturers.

Truck manufacturers opposed the adoption of a standardized machine, but the War Department maintained that it was absolutely essential to standardize as much war material as possible, so that the matter of repairs and spare parts could be handled in the most efficient manner.

Will Withhold Priorities to Check Competition of Labor

The War Industries Board has passed a resolution in which it is stated that priority assistance will be withheld from employers who persist in pursuing peace-time methods in the procurement of labor. The withdrawal of labor from war industries on account of this competition is strongly disapproved, and the board will take this action through its priorities division.

A copy of the resolution has been certified to the chairman of the War Labor Policies Board and to all other Governmental agencies employing or dealing with labor, and is receiving general publicity.

Large Shipment of Motor Trucks for United States Engineers

The accompanying illustration shows a fleet of war trucks lined up for inspection before shipment to France. These, and several thousand others now in the service of the United States Engineers, are to be engaged in construction work, backing up the American Army in France.

They are Mack war trucks, handled by the International Motor Co., New York.

TWO HUNDRED MOTOR TRUCKS FOR EXPORT AWAITING INSPECTION

Summer Meeting of Industrial Traffic League

A summer meeting of the National Industrial Traffic League will be held at the Hotel Statler, Cleveland, Ohio, Thursday and Friday, Aug. 15-16. A program of subjects, which, according to the notice, will be of considerable importance, will be published and distributed about Aug. 1. Every member is urged to arrange his appointments so as to be able to attend this meeting, and the league invites traffic representatives of organizations or individual concerns not members of the league. The secretary requests a list of such names and of prospective members to be sent to E. F. Lacey, assistant secretary, 413 Tacoma Bldg., Chicago.

Object to Blacksmithing the Bumps Off Reinforcement

Advocates of the deformed reinforcing bar have ample field for publicity efforts among the members of the firm who recently addressed to the Truscon Steel Co. the following letter:

"Gentlemen—We received order of steel reinforcing bars. We find you sent 70 pieces ½-in. x 32-ft. round rib straight bars. We wanted these to be smooth round bars so they would, after being coated, slip in concrete as it expanded or contracted. Please ship 70 pieces of ½-in. x 32 ft. of smooth round bars and advice us where to return the above rib bars.

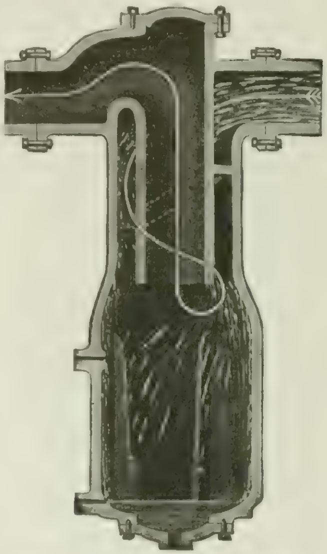
"We hope you will arrange to exchange as we do not wish to blacksmith out the ribs to smooth out bars."

Freight Rates Modified for Oil in Carload Lots

A modification of the increase in freight rates as established by General Order No. 28 on petroleum oils in carload lots, was authorized by the director of traffic of the United States railroad administration. The tariffs will be filed at the earliest possible date and will be effective on one day's notice, making the increased rates uniformly 4½c. higher than the rates in effect on May 25. However, the increased class rates for the ratings provided in the official Western and Southern classifications will not be exceeded.

Air Separator or Water Trap for Compressed Air Lines

The Stratton air separator, shown in the accompanying illustration, is a device for removing water from compressed air by the use of centrifugal force. It has been designed to eliminate trouble arising from water in the cylinders of compressed air tools, which not only reduces the efficiency of the tool but sooner or later results in damage. As the water-laden air passes



SEPARATOR FOR COMPRESSED AIR

through the device the water is thrown to the sides of the cylinder by centrifugal force and passes downward to the bottom of the cylinder, where it may be properly drained. Since the action is mechanical, it is essential that the air shall be sufficiently cool before entering the separator to condense as much of the water vapor as possible.

The separator is constructed of cast iron suitable for a working air pressure not in excess of 160 lb. per square inch, has no internal movable parts and will operate indefinitely with a minimum of attention. It is manufactured by the Griscom-Russell Co., 90 West St., New York, and is described in their latest Bulletin, No. 1109-C.

Government Controls Chlorine

Control of the chlorine industry of the United States was assumed by the War Industries Board on July 16, with the approval of President Wilson. For the present nothing more will be done by the Government than to regulate the distribution of the product under the direction of H. G. Carrell, chief of the board's alkali and chlorine section.

Available Steel Supply In England Increasing

The available steel supply in England is increasing on account of the diminishing exports to Russia and the increased capacity brought about to meet the enormous demand for war materials. The war demand is being adequately met with something left over to meet the requirements of civil trade. There is a more regular delivery of steel of all descriptions, and restrictions that have been in force for several months are now being removed. Local foundries are dispatching heavy rolling machinery to all parts of the country and large extensions of steel rolling plant are still being made in the iron and steel districts, which will further increase the current output. The position of the sheet makers has improved; black painted sheets for shelters for the American Army are being called for in very heavy tonnage.

Plan Rural Motor Express Lines in New York State

The need of rural express lines in New York State to relieve the congestion on the railroads is the reason given for the appointment of a highways transport committee of the New York State Defence Council. It is a result of a recommendation of the Council of National Defense and the council says in a recent bulletin: "In view of the war demands upon railroad transportation, the authorities at Washington state that all possible agencies of transportation should be developed and this movement will have their support, as well as the aid of the automobile truck industry." Samuel A. Miles, chairman of the motor truck committees of the National Automobile Chamber of Commerce, has been in conference with various road and automobile authorities of the state and has gone over the situation. The scope of the plan is such that if carried out it will result in the establishment of truck express lines operating in every county.

Business Notes

The Siems-Carey Co., New York, has opened local offices in Seattle, in the L. C. Smith Building. W. F. Carey is in charge of the Seattle branch. The firm is at present engaged in the construction of 40 miles of railroad into the western Clallam County spruce belt and connecting these lines with the present Milwaukee lines at Port Angeles. The Siems-Carey Co. is to furnish the Government with 300,000,000 ft. of spruce from this section in one year for airplane construction. The firm will build the railroad and mills and establish logging camps.

The Todd Dry Docks, Inc., Seattle, Wash., recently filed articles of incorporation. The company is capitalized at $1,000,000, to engage in the operation of dry docks, engine and ship building. Work has been started on a large repair plant on Harbor Island, Seattle, where three big dry docks are planned. The incorporators are H. W Kent, formerly vice-president of the Seattle Construction & Dry Dock Co., formerly owned by the Todd Co.; Judge William H. Bogle and F. T. Merritt.

The American Steel Export Co. has just announced the appointment of Philippe Berger, 2 Square de l'Opera, Paris, as its general agent for France and Belgium. This company recently announced the opening of a branch office at Rio de Janeiro, with J. D. W. Snowden as manager.

The Aspromet Co. of Pittsburgh (formerly the Asbestos Protected Metal Co.) announces the removal of its Chicago office on July 1 to the Railway Exchange Building. J. T. O'Neill will continue in charge as district manager.

P. B. Findley, formerly technical editor in the department of publicity, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn., has resigned from that company and is now in the training school, University of Pittsburgh, taking a special course in radio work with the Signal Corps. Prior to his connection with the Westinghouse Co. Mr. Findley was editor of the *Electrical Age.*

William T. Summers, of the Merchants' National Bank of San Francisco, has been elected vice-president of the Judson Manufacturing Co., Oakland. W. L. Booth has been appointed general manager of the company, succeeding W. D. Bunker.

D. W. Thurston, formerly superintendent for the Bates and Rogers Co., Chicago, Ill., has resigned to accept the superintendency of the John F. Casey Co., Pittsburgh, and will have charge of the Pennsylvania R. R. work at Sharpsburg, Pa. H. H. Sabin, formerly office manager for Bates & Rogers, in Chicago, will act in the same capacity for the John F. Casey Co., under Mr. Thurston.

C. A. Hall has been appointed manager of the electric light and power department of the Eastern Pennsylvania Railways Co., Pottsville, Penn., which is operated by the J. G. White Management Corporation, New York City.

A. Niedermeyer, formerly works manager of the Snow-Holly Works of the Worthington Pump and Machinery Corporation, has resigned to go into business for himself.

Trade Publications

"Austin Motor Road Rollers" is the title of a catalog received from the Austin-Western Road Machinery Co., Chicago, Ill. It is a 9 x 12 paper-covered book, giving complete description and illustrations of the road rollers manufactured by this company and using gasoline, kerosene and distillate. It also gives illustrations of the various parts of the engine, and catalogues machinery used in connection with road rollers, such as scrapers, scarifiers, etc.

"The Potentiometer System of Pyrometry and Temperature Control" is the title of a 60-p., 8 x 10½-in. catalog, published by the Leeds & Northrup Co., Philadelphia. It describes a system of pyrometry and temperature control in which the potentiometer method is employed for measuring the electromotive force of thermocouples. It is illustrated with many half tones, line cuts and diagrams and contains much information in this line.

The Hastings Pavement Co., 25 Broad St., New York, has issued a 12-p. catalog describing and illustrating the "Asphalt Block Industrial Floors" produced by the company. The pamphlet reprints "An Improved Floor Material for Shops and Warehouses," recently published in Bulletin 29, Public Works of the Navy.

Bulletin No. 9 of the Wellman-Seaver-Morgan Co., Cleveland, describes the W. S. M. car dumper. It is a 7-p. pamphlet illustrated by photographs and line cuts, and gives complete information, together with diagrams, regarding the handling of cars by this method.

The Bastian-Blessing Co., Chicago, Ill., has issued a catalog of the "Rego" line of welding and cutting apparatus, lead-burning equipment, regulators, etc., a loose-leaf paper-bound publication illustrating the machines and accessories manufactured by the company.

Irrigation Supplies Catalog No. 11, a booklet of 123 pages issued by the R. Hardesty Manufacturing Co., Denver, Colo., contains useful tables, curves, diagrams and other irrigation data.

The Iron Trade Review together with the *Daily Iron Trade and Metal Market Report* have issued a 75-p. paper-covered pamphlet in which they have compiled a complete list of base prices, differentials and extras on iron, steel and nonferrous metallic products, fixed under Government supervision.

Engineering News-Record

August 1, 1918

Devoted to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC.

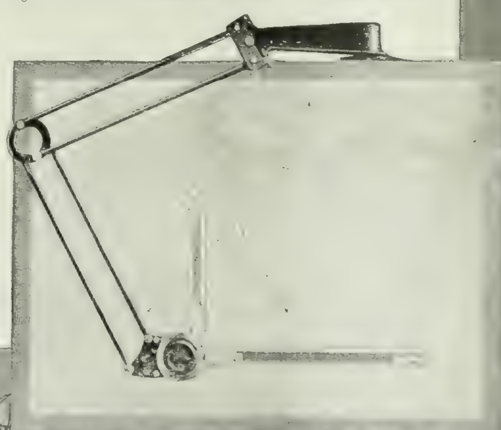
American Engineers Build Huge Docks in French Port—By R. K. Tomlin, Jr.

Helping the Draftsmen Who Stay

UNIVERSAL Drafting Machines

Among the first to heed the Nation's call for fighting men have been the draftsmen of America. Throughout the country drafting rooms with depleted forces are striving to keep pace with the demands for an increased industrial production.

The Universal Drafting Machine is an important aid in this emergency. It conserves fully 50% of the draftmen's time. You will be interested in the descriptive catalog showing its scope. Write for your copy today.



The accompanying view of Stone & Webster, drafting room, shows some of the full equipment of Universal Drafting Machines used by this company.

UNIVERSAL DRAFTING MACHINE COMPANY
Cleveland, Ohio, U. S. A.

A Consolidation of En... ...t Engineering Record | McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Me... | Charles W... Baker, Consult...

Volume 81 | NEW YORK, THURSDAY, AUG. 1, 1918 | Number 5

Engineers May Help Carry Meter Ordinance at Chicago

POSTPONEMENT, not defeat, was the outcome of the drive for cutting water waste and saving an immense tonnage of coal by the adoption of a water-metering ordinance at Chicago a few days ago. The American Association of Engineers has taken a hand in the movement for meters. If all Chicago engineers join forces the ordinance may be taken from the file and passed next September.

Adjusting Salaries to the Cost of Living

ENGINEERS in city or other governmental work who have had no increase in salary during these years of rising prices may well be interested in the account of the far different experience of the engineering employees of Cuyahoga County, Ohio, on p. 238. The story had added interest because the scheme for adjusting each month's salary to the cost of living is told by the engineer who worked it out. In some happy future day not only salaries but also other prices may be based on commodity price averages instead of the unstable dollar.

St. Louis Faces Possible Garbage Disposal Dilemma

ANOTHER city is about to go through the farce of receiving bids for garbage disposal by reduction for a very short contract and that, too, just as the existing contract expires. This time it is St. Louis. It invites bids Aug. 6 for a 400-ton plant which must be in operation on Sept. 1, as noted last week on p. 149. Such action is taking the chances of giving the new contract to the present contractor on his own terms. Before doing that, the city should seriously consider disposal by feeding to hogs. Had St. Louis followed sound engineering advice it would not be facing such a situation.

Zoning Progress Should Be Accelerated

CITY zoning makes progress. It should be emphasized at present, since it requires small expenditure of either money or man power, enables cities the better to meet war conditions and will be of immense aid when general building operations revive after the war is won. Following not far after New York City, the second large municipality to adopt a zoning plan is St. Louis. Building use, height, and area districts have been created in that city which will take effect immediately. Salt Lake City has called in an expert to assist in working out a zoning scheme. The San Francisco City Planning Commission is giving the subject attention. Other cities have adopted or are working on zoning plans. The good examples thus set should be followed by cities large and small throughout the country. Here is an opportunity for engineers and engineering societies to render great service to their communities.

Rural Against Federal Sanitation

NEW EGYPT, N. J., is puzzled if not indignant. It does not understand why it should be pressed to abolish privies, cesspools and manure piles for the benefit of visiting soldiers from Camp Dix when it is suffering what it believes to be a far worse nuisance occasioned by the camp sewage. The facts appear to be that the Camp Dix sewage works are badly overtaxed and are polluting the stream which receives the effluent, and flows through a pond in New Egypt. It is alleged that bathing and boating in the pond, once an asset of this New Jersey summer resort, are now impossible, and that the near-by residents suffer from bad odors. Presumably the War Department will soon enlarge the disposal plant. Certainly, the Government should set a good rather than a bad example in sanitation.

Seeing Is Believing: Or Mud, Meters, and Filters

SASKATOON has taught a lesson to Ottawa, or at least to the Mayor of the latter city, and has thus shown once more that the smaller and more progressive cities of the western part of the continent can teach the larger and more conservative cities of the East, if the latter are only willing to learn. As many of our readers know, Ottawa has been backing and filling with its very pressing water-supply questions for many years. It has turned down projects for slow-sand filters, for mechanical filters and also for gravity supplies from sources which were supposed not to require filtration. Journeying westward, Mayor Fisher of Ottawa on approaching Saskatoon noted the very muddy character of the water of the Saskatchewan River. On reaching his hotel he was apprehensive of the quality of water he would find, but was pleased with its tasteless and colorless condition, and found on investigation that a "small, inexpensive filtration plant" worked the transformation. Promptly he wrote back to his home city urging that "we forget that there ever was a water question in Ottawa," and saying that a filtration plant would be

a good investment even if it were scrapped after ten years on account of the introduction of one of the proposed gravity supplies. A further contrast in water-supply matters was found by Mayor Fisher at Saskatoon. His letter home states: "For a long time last winter, Ottawa pumped daily from 250 to 300 gal. for every man, woman and child in the place. The maximum pumped in Saskatoon during the same period was 72 gal. per capita. This is all the more remarkable in view of the fact that for weeks at a time the thermometer stands at —20° F. in Saskatoon." Every service in Saskatoon is metered, Mayor Fisher reports. The lesson is obvious. Unfortunately Ottawa is not the only city that prefers to pump and waste an immense quantity of muddy or otherwise unsatisfactory water, rather than curtail consumption by the use of meters and thus make filtration a comparatively inexpensive proposition.

Studying Projected Railway Lines From a Different Standpoint

THE Federal railroad administration has been petitioned to approve and provide funds for the completion of the branch of the Grand Trunk Ry. in southern New England to Providence, R. I., which was partly constructed in 1911-12. It is claimed that this additional outlet to tidewater from the Grand Trunk system would help relieve congestion on New England railways.

How brief is the time since those stirring events in railway history, of which that Providence extension of the Grand Trunk was a part, and what revolutionary changes have occurred since then! One recalls the ambitious projects for which the late Charles M. Hays, as president of the Grand Trunk, was responsible, and his reception in Providence and Boston and other New England cities, where he painted glowing pictures of the benefits of railway competition, while the countryside was excited by the operations of mysterious surveying parties, and New England imagined it was to witness another era of competitive railroad promotion and construction such as had prevailed a half century before.

Then came Hays' tragic death on the ill-fated "Titanic," followed by the revelation that the financing of his ambitious projects was not provided for. It was, in part at least, the public disappointment over this fiasco that led to the legislative investigation which revealed first the New Haven and Grand Trunk agreements and fallings out over New England territory, and later the extent to which the New Haven financial structure, once a tower of strength, had become a hollow shell.

Whether or not we are to return after the war to private ownership of railways, it seems unthinkable that we shall return to the old-time competitive railway construction—the building of strategic lines, not for public benefit but to defeat a rival. The public will never again look upon the railways of the country as private business enterprises as it did in the past, nor will it long endure any system of control that does not place the public interest first.

This means too that engineers will have to study railway construction problems from a broader standpoint than was ever possible in the past. Instead of the old-time questions, what profit will this proposed line yield to the company which is to own it, or what injury will it do to a competitor, the engineer must determine the problem whether the proposed line will render a service to the public that will make its cost a justifiable investment. If "public convenience and necessity" demands the construction of a road, then it may be built. If the contrary is the case, the construction cannot be permitted.

Contractors and Unions

CONFUSION threatens in the construction field at the close of the present war emergency—confusion which will be costly to the contractors, to the public and to construction labor. In the first place, readjustments caused by price reductions and the dissipation of our great abnormal holdings of gold will present difficulties which can be solved only through most careful planning. In addition, existing union wage agreements have been extensively superseded through Government intervention. Contractors and union workmen will, when the present rush of war work is over, find themselves without a basis of understanding on so many kinds of work that an unprecedented amount of bargaining will be required. Then, there is a general feeling among contractors on war work that the Government, in its anxiety to assure uninterrupted prosecution of vital projects, has gone more than half way to meet demands, and has in some cases established precedents founded rather on the urgency of the moment than upon sound economic principles.

Wages and working agreements which increase the cost of construction beyond a certain point must ultimately be readjusted, as they restrict the volume of work. If new construction is too costly, industrial enterprises cannot afford it. This results in failure to provide necessary facilities, which restricts the production of goods and reacts adversely for the entire population. The construction worker is directly and quickly affected, as the volume of work is held far below the point necessary to keep all employed.

The mere matter of increased wages and shorter hours of work, taken by itself, does not alarm the contractor. Indeed, where such conditions attract a better class of men to the field and improve the efficiency of the worker, they may lower costs, make more work possible and react favorably for all concerned. But many doubt seriously that high wages have so far had such an effect. Indeed, this result could hardly be expected in the absence of any effort to educate the worker in the basic principles that underlie the situation. The worker does not realize that the country cannot support high wages in one particular industry, unless unit production in that industry is so great that the labor cost of the things made compares favorably with the labor cost of other products. The construction workman rarely appreciates that his interest and that of the contractor in lowering the labor cost of construction—a thing quite different from the wages paid—and in maintaining a steady volume of business, should be identical. The reason organized labor has not yet seen the matter in this light is that those who have so far attempted to educate it along economic lines did not themselves, for the most part, have the necessary breadth, or were clever demagogues, each with an axe to grind. The right sort of

education, however, must come before there can be any real progress.

Split into dozens of sectional organizations, contractors will be at a hopeless disadvantage in the wholesale bargaining for new working conditions which must follow the war. Neither can contractors hope, without a national labor policy, carried out in every section of the country through a national organization, to avoid serious losses incident to the readjustment that will be forced in the money measure of wages. It will be all very well, after prices have fallen and there is no Government work to pay high labor costs, to tell a union official that his men can live better on $4 a day than was possible during the war on $6. It will be quite another matter to convince this same official that unless his men do live on $4 a day there will not be any work for them, and to make him see that this will not be the fault of contractors or of any other one group of interests.

To meet this situation planning of national scope should be under way at the present moment. The best brains that the contracting industry can produce and the men most successful in dealing with organized labor should be engaged on it. National planning and the concentration of the best minds in the construction business on the labor problem can come only when there is a representative national organization of contractors. The movement on foot to form such an organization, which had its inception at Atlantic City, and which is noted in the news section of this issue, cannot reach fruition a day too soon.

Is Sewage Treatment an Essential Industry?

ALBANY'S desision not to put its new sewage-works in operation, noted last week, raises an interesting question. Is sewage-treatment an essential industry? A well considered answer to the question must be based on the law of relative values and on the local conditions affecting each sewage-works. Such an answer must take into account the need of the nation and its allies for money, material and men to win the war; how the individual city can best utilize its curtailed funds, supplies and man power; and, last but not least, how much *actual* rather than *theoretical* good the operation of the works will do.

It might not be well to raise what at first thought may seem so reactionary a question were it not for a belief, based on observation extending over practically the entire history of sewage-treatment in America, that a large percentage of our sewage-works have been built under false assumptions of what can reasonably be accomplished, and that the country is dotted over with plants which are so inefficiently run as scarcely to jusify the expense of operating them even in peace times. In the present emergency, all sewage-works should be given a searching examination with a view to shutting them down where they are not helping win the war or seeing that, if really essential, they are made efficient. The scrutiny should be all the closer in the case of plants which require coal or other fuel for their operation and which are located in parts of the country subject to coal shortage, as is the case at Albany. The difficulty of getting and keeping trained operators, and the certain inefficiency of many if not most sewage-works without them, is another factor to be considered in deciding whether the operation of sewage-works in these war times is justifiable.

A few words may be said for the benefit of those who have not followed sewage-treatment closely or who for any other reason are not correctly informed as to its aims and possibilities. The real function of most sewage-works is to prevent nuisance. Of those fittingly designed to protect the public health in any marked degree very few indeed are so operated as to insure the attainment of that end.

This is a time to clear up false notions. Let us ascertain just what each sewage-works of the country should be called on to do from the viewpoint of relative values; shut down those works which are not needed and take vigorous steps through local, state and if need be Federal action to see that those plants having a vital service to perform do not continue to shirk their duty to their community and the world.

State Bars Against City Improvements

WHEN the qualified voters of a city declare 8444 to 128 in favor of a bond issue for municipal improvements, as was done at Atlanta recently, any one not familiar with the vagaries of state legislative restrictions on municipal activities would naturally suppose that the city concerned could go ahead with the desired work. Not so in Georgia. State legislation there requires that bond issues must be approved by two-thirds of the registered voters at the time of the election. Therefore, although the vote was 66 to 1 in favor of the proposed $800,000 bond issue at Atlanta, the improvements are held up because 784 more votes were required to meet a high and arbitrary statutory requirement. Of the proposed bonds $500,000 were very badly needed to carry out improvements to the water-works, some of which should have been made years ago and which are now doubly needed to meet city and cantonment conditions incident to the war. The emergency is so great that Mayor Candler has generously offered to underwrite $250,000 pump contracts in order that citizens and soldiers may not be threatened with water famine. Atlanta's sister city, Macon, profiting from Atlanta's experience, rallied a small margin of votes for a $200,000 bond issue by dint of hard work.

Throughout Ohio for several years past all municipalities, large and small, have been at their wit's ends to meet operating expenses owing to rigid taxation and restrictions. New Orleans is even worse off than the Georgia and Ohio cities. It has to secure amendments to the State constitution before it can embark upon quite ordinary municipal enterprises, such as a garbage reduction plant.

The time has come to sweep away many of these absurd State restrictions on city activities. This does not mean that no limit should be put on the taxing and bonding powers of cities, but that the limits should be reasonable. As a rule, too, State constitutions should be kept free from municipal bond and tax restrictions; and the state legislatures should attempt to lay down only broad limits or principles, leaving details to be handled by some central administrative body, whose decisions would be made after expert investigation.

American-Built Docks in France Completed by Pacific Coast Engineers

Second Battalion Had 4100-Foot Timber Structure Ready April 15—First Battalion at Work on Huge Storage Depot

BY ROBERT K. TOMLIN, JR.
War Correspondent of Engineering News-Record

Photographs D, G, H and N from Committee on Public Information—All Others by Engineering News-Record

AT AMERICAN-BUILT docks in France transatlantic freight from American-built ships has been unloaded, classified and routed to the front via American-built railway yards since the middle of April. With brand-new berths for 10 vessels, in addition to an existing string of docks near by, previously constructed by the French, the great marine terminal at Base Section No. — of the American Expeditionary Forces, a timber structure supported by wooden piles, extends for almost a mile over a site which was nothing but mud flats half a year ago. Long, low classification sheds flank the shore side of the docks; further inland a receiving yard and a departure yard for the handling of empty and loaded freight cars are well along toward completion; specially designed timber rigs, for the handling of ships' cargoes, and heavy steel gantry cranes are being erected; railway cars and motor trucks, in a steady stream, flow along the quay, picking up their burdens of freight for transport either directly to the advance section, or for storage at the base or intermediate depots.

Busy Scenes at the Docks

This is the scene at the docks: A solid background of spars, rigging and weirdly camouflaged hulls motionless at their moorings, and a foreground of action kaleidoscopic in its variety. Booms are swinging crates from ships' holds, engines are spotting cars along the quay, negro stevedores are trucking loads into the classification sheds. Motor trucks are darting to and fro over the broad timber flooring, and labor gangs are grading and laying railroad track back of the classification sheds. Here is a group of Spaniards, in brown corduroys and canvas slippers, unloading crushed stone from cars; there, German prisoners in the faded remnants of field-gray uniforms, piling lumber under the direction of a blue-coated French guard with a long bayoneted rifle slung over his shoulder. Back along the road which parallels the waterfront pass truck-loads of Chinese powder-factory employees, or negro stevedores going to or from work. Things are moving down at the American docks in France.

But what of the men who set the stage for this spectacle—the engineers who took the plans of the docks and transformed lines on blueprints into realities of timber, concrete and steel? Their job on the main dock structure practically completed, these constructors have stepped back from the center of the stage to make way for the operating forces, but they have left behind them a convincing record of achievement since they landed in France last September.

Men from Pacific Coast Did Work

The construction of the new docks and yards at Base Section No. — is largely the work of the second battalion of an engineer regiment consisting of men from the Pacific coast. It is a "hand-picked" organization of volunteers, for the regimental quota of about 1700 was culled from 6000 applications. Its commanding officer is the chief engineer of Base Section No. —, and, in addition to the dock and railway-yard construction, he is responsible for a score of other big projects—an immense general storage depot and railway yard, which is in charge of the first battalion of his regiment; hospital construction, railroad extension, ordnance warehouses, engine terminals, car-erecting plants, repair shops, a refrigerating plant, etc., all of this work being scattered over an area of a great many hundred square miles. The construction program in Base Section No. — is staggering. For example, entirely separate from the dock work—a huge job in itself—is the general storage depot six miles distant, which will consist ultimately of 144 warehouses, each 500 x 64 ft. in plan, and a railway yard with 170 miles of track.

A. WOODEN DOCKS ARE PROTECTED BY MOTOR-DRIVEN FIRE-FIGHTING APPARATUS—IN FOREGROUND, MAJOR COMMANDING ENGINEER BATTALION AND CAPTAIN WHO HAD IMMEDIATE CHARGE OF DOCK CONSTRUCTION

To anyone familiar with the army transport problem in France, the fact that the American docks at Base Section No — have been built and in operation for some time past is big news. It means *more tonnage* and, consequently, a general speeding up of construction work throughout the areas of France occupied by the American forces, for the big obstacle in the way of more rapid progress in the past has been delay in the deliveries of construction plant, construction materials and construction men. Everywhere I have gone I have heard this same story—not a complaint, but a frank statement of conditions as they have been. Lacking peace-time facilities for the handling of large-scale jobs, our engineers have succeeded in making progress without them. When machinery does not arrive the only recourse is hand labor. When the erection of a warehouse calls for a bill of timber of certain sizes and lengths, and nothing of the sort is to be had, something else must be made to do. It is no new experience for our men to build up 4-in. timber members from 1-in. stuff.

And that is the important point about the engineering work for the army in France. It must get along with the tools and materials at hand. It would be misleading and unfair to the men who have accomplished such wonders with the facilities available to picture the construction program over here as a sort of triumphal march over smooth roads. It has been nothing of the sort. It has been pretty hard sledding all the time, but never so hard as to make our men let up in their efforts to put the job through. And, in the case of the docks, they have put the job through splendidly, these engineers from the Pacific slope, for there is a great deal of the pioneer in their make-up, the sort of stuff inbred by life in the great open country of the West, which enables a man to face new and difficult conditions with a calm confidence in his ability to win out ultimately. And so, when they needed a sawmill for framing timber, for example, and could not get one ready-made, they ferreted out a steam boiler here, an engine there, other accessories where they could find them, and in a little while the outfit was assembled and cutting timber. "See that two-story classification shed down at the end of the docks?" asked Major R——, commanding the second battalion during my visit to the job. "The floor joists are the only sticks in it which are in accordance with the blueprint plans!" *But the building was up and ready for service.*

On the docks and railway yards the force comprised about 2500 men, including the engineer troops, labor battalions and a crew from the Phœnix Construction Company.

At Base Section No. — large shipments of transatlantic freight are being handled—just how large I am, of course, not in a position to say—but it should be realized that not all of our cargoes from the United States are being received at this one port. However, in the scheme of transport and supply to the front, this terminal is playing a large part. In a former article on the advance depot (see *Engineering News-Record* of July 4, p. 27) I outlined the general scheme of zoning and distribution back of the front. There are, as the main parts of the transportation and supply system, the advance depot, the point of distribution nearest the front; the intermediate depot, somewhere between the advance depot and the seacoast; and finally, the base depots, which are, of course, bigger than any of the others. Freight from ships, in the case of Base Section No. —, is passed either directly into railroad cars or into the classification sheds along the inner wall of the quay, and thence goes by rail either directly toward the front or into the huge base storage depot, from which it is later removed on requisition. The new docks at Base Section No. — parallel the waterfront and are 4100 ft. long, with berths for handling 10 ships simultaneously, as previously noted. Timber flooring, 86 ft. wide, carrying four parallel lines of standard-gage railway track and one line of 44-ft gantry-crane track, is supported by timber pile bents spaced 10 ft. on centers. As to the choice of the type of structure, it was essential to design something which could be built quickly and

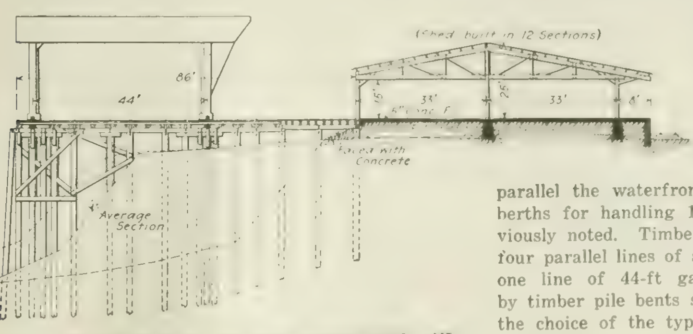
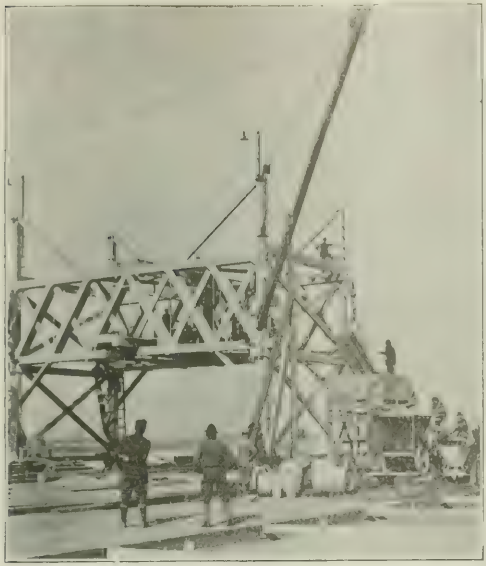


FIG. 1. CROSS-SECTION OF DOCK STRUCTURE AND CLASSIFICATION SHED



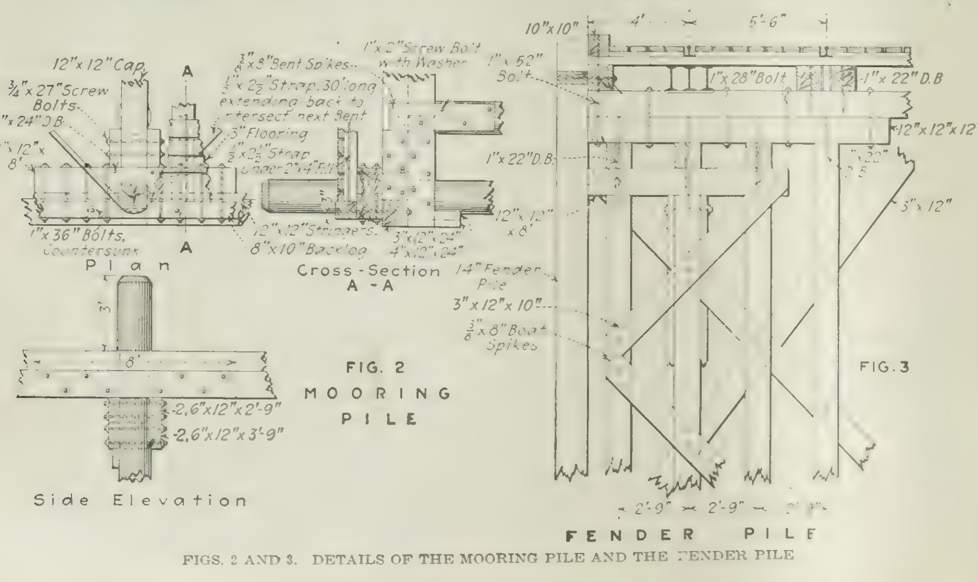
B. SPECIALLY DESIGNED CARGO-HANDLING DEVICE BEING USED TEMPORARILY FOR DELIVERING MATERIAL TO PORTABLE MIXER

with materials at hand or immediately in prospect. A wood-pile dock seemed best adapted to these conditions

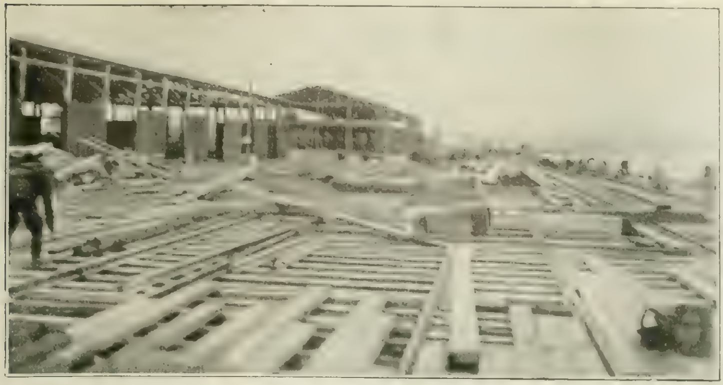
Too much emphasis cannot be placed upon this phase of the engineering work for the American armies in France. Our men cannot pick up a telephone or a telegraph blank and send in a rush call for the delivery of concrete mixers, locomotive cranes, cement, sand and crushed stone, sawmills, timber piles of predetermined lengths and sizes, dimension lumber, derricks and all of the other plant luxuries of peace-time construction. I say they cannot call for these things, referring to conditions under which the dock work was started late last year. Of course, the situation is improving every day, and our supplies of plant and equipment are now much more satisfactory than formerly. But the engineer at home must constantly keep in mind the fact that all of our work over here was *begun* with mighty few of the mechanical, material and transportation aids to which the engineer in civil life is accustomed. This condition of affairs, however, developed no Micawbers in the ranks of our engineer units; no one waited for "something to turn up." Instead, every one buckled down to the job, with the result that something was made to "turn up"—and that something is the string of classification sheds and the long line of completed quay at which loaded ships from the other side of the Atlantic are now discharging.

The timber structure for the docks was chosen at the beginning as being the only one possible under the conditions imposed on the designers—speed of construction and use of available materials. There is a considerable range of tide at the site (I am not allowed to state this quantity in feet) and the foundation material is a combination of silt and ooze, into which 9200 piles ranging in length from 45 to 70 ft. were driven for the dock structure proper. Piles put down at other places near by swell the total to about 13,000. A number of test piles were driven to refusal before the job was begun, and it was found that they could be depended upon to carry safely loads of 20 tons. The piles are of untreated timber, as no creosoted material was available for quick delivery.

The accompanying cross-section drawing, **Fig. 1**, renders unnecessary any detailed description of the dock structure. It should be noted, however, that a batter pile, not shown on the main cross-section, is driven under the inner gantry crane rail. While the plans call for three 12-in. steel I-beams under each gantry crane rail, this type of construction was employed only at the



FIGS. 2 AND 3. DETAILS OF THE MOORING PILE AND THE FENDER PILE



C. AT ONE END OF DOCKS SOME WORK REMAINS TO BE DONE

south end of the docks, where heavy steel gantries will be used. For the northerly section 12 x 12-in. timber stringers support the gantry rails, on which a special and lighter unloading device, shown in Photograph B, will operate. The piles are capped with 12 x 12-in. timbers, the stringers are also 12 x 12 in., and the decking is 3 x 8-in. stuff carried by 4 x 10-in. crossties. Practically all connections are made with 1-in. driftbolts.

For the standard-gage track on the dock flooring 80-lb. rails are used, but the gantry-crane rails are 100 lb. per yard, and are fastened to the ties by hookbolts. The pile bents are cross braced both transversely and longitudinally with 3 x 12-in. timber. Figs. 2 and 3 show the mooring-pile and fender-pile details.

An important feature of the design is the transverse fire walls underneath the decking, at about 300-ft. intervals. They are of solid timber planking to prevent the sweep of flames underneath the flooring along a considerable length of dock. From the photographs it will be observed that the decking planks are brought up flush with the tops of the rails, forming a surface on which motor trucks as well as railway cars may operate. Motor-driven fire-fighting apparatus, shown in Photograph A, is part of the dock equipment.

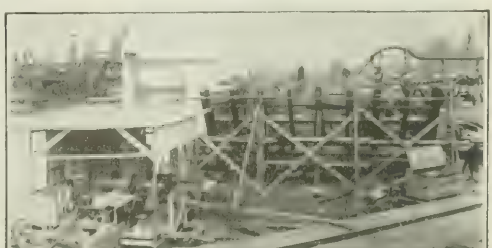
To furnish at a proper level a foundation for the concrete flooring of the classification sheds and open storage areas, it was necessary to make a fill of about 55,000 cu.yd. First, a concrete retaining wall, averaging about 8 ft. in height, was built back of the classification sheds for the entire 4100-ft. length of the docks. At the inshore side of the dock structure a dike of puddled clay was formed and faced on the waterfront slope with a 4-in. slab of concrete to prevent washing out by wave action during periods of high water. Between these two walls—the concrete-paved dike on the waterfront side and the concrete retaining wall on the shore side—the fill was made by hydraulic sluicing. The material is sand-dredged at a point 40 miles from the dock site and delivered by French barges. From the barges moored along the timber quay wall the sand was pumped out by a hydraulic dredge. This fill was compacted by steam rollers before concrete was laid upon it.

The floors of the classification sheds and the open storage spaces between successive pairs of buildings are all concreted, this job involving the covering of an area 4100 ft. long and 76 ft. wide with concrete 5 in. thick. The concrete was placed in transverse strips 12 ft. wide and is not reinforced. In all, three mixers were employed. One rig, shown in Photograph E, consisted of a 1½-yd. mixer, driven by a gasoline engine, the whole outfit being mounted upon a flat car which could be moved along the dock as work progressed. Distribution from this mobile plant to the floor area was by narrow-gage railway and V-shaped industrial cars. In addition there were used two smaller concrete mixing plants, as shown in Photograph F. The capacity of these mixers was ½ yd.; they were driven by gas engines, both mixer and engine being mounted on a low four-wheeled truck. Aggregate and cement were brought in by railway cars operating on the inner one of the four dock tracks. The aggregate was dredged gravel and sand obtained at a point some distance from the docks, and delivered by barges; the cement was shipped from England. With 160 men engaged on the work of concreting the classification-shed floors and open storage spaces, about 7500 sq.ft. of concrete 5 in. thick were laid each day with the three mixers available.

The following summary shows the volume in cubic yards of concrete required by the docks, yards and accessory structures, such as a new warehouse, 100 x 3000 ft. in plan, and a cold-storage plant.

Classification-shed floors	4,400
Retaining wall	3,800
Apron wall	4,400
New warehouse	7,200
Departure yards	2,200
Cold-storage plant	4,000
Total	23,600

Paralleling the docks, the classification sheds are located in a straight line with gaps between each pair for open storage. There are, in all, eight of these sheds; two of them are 312 x 74 ft. in plan, while the other six are 205 x 74 ft. They are timber-frame structures sheathed with corrugated iron, Photograph C showing one of the sheds partly completed. All are one-story in height except the building at the southerly end of



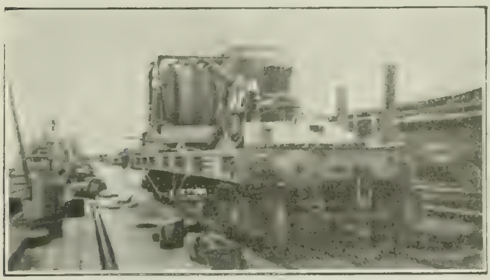
D. DREDGE PUMPING SAND FROM SCOW TO MAKE RAILROAD FILL—NOTE END OF ELEVATED PIPE LINE AT RIGHT, THROUGH WHICH SAND IS PUMPED

the string (Photograph C), which has a second story which will be used as the administrative offices of the dock-operating force The cross-section, Fig. 1, illustrates the prevailing type of structure. As a general rule a gang of 50 men worked on one shed. The frame was set usually in one day and the entire structure completed in one week.

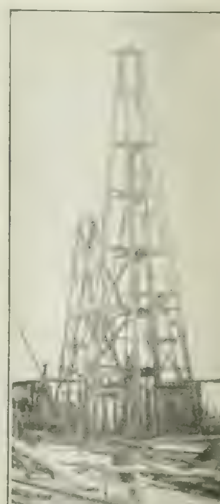
All of the timber for these sheds came in the rough from the States. It was framed by a homemade sawmill operated by a boiler obtained from Spain. The engineers were successful in receiving from the States a circular saw, but had to construct for themselves wooden pulleys and mount these on a piece of shafting obtained locally. On this makeshift sawmill most of the framing of timber for the classification sheds was done. The work was started by the making of templets for each member of the building, and with these as patterns the lumber was run through the mill in bunches of half a dozen pieces at a time. The members for the wooden roof trusses were bored by compressed-air tools and connected by bolts. On the erection of the timber framework double-block gin poles were employed.

Behind the string of classification sheds are three lines of depressed railroad track, 3 ft. 4 in. below the elevation of the floors. Then comes a platform 10 ft. wide, set at the same elevation as the classification shed floors, followed by a storage warehouse 100 ft. wide with an 8-ft. platform on the inshore side. Flanking this latter platform are two more lines of depressed track at the same elevation as those previously mentioned. Another accessory is a 25-ft. teamway for the use of trucks, followed by two other team tracks, making, in all, six additional miles of trackage in connection with the dock facilities.

While work on the docks was in progress other detachments of the engineer regiments, assisted by labor battalions, were grading and laying track in the receiving and departure yards. The plan of the whole project is roughly in the form of a quadrilateral whose sides are formed by the line of docks, the receiving yard, the de-



E AND F. MOVABLE MIXER PLANTS USED IN CONCRETING FLOORS OF CLASSIFICATION SHEDS



G. CAPPING PILES AND LAYING THE TIMBER DECKING AT THE AMERICAN DOCKS
H. LOOKING ALONG DOCK SITE—PILEDRIVER ON LEFT, TIMBER CLASSIFICATION SHED IN CENTER
J. THE ENGINEERS HAD TO BUILD THEIR OWN PILEDRIVERS AND DERRICKS

K. AT THE DEPARTURE YARD THE FILL IS BEING MADE BY HYDRAULIC SLUICING

L. PLACING FILL AND LAYING TRACK IN DEPARTURE YARD—ENGINEERS BUILT ELEVATOR COAL BINS IN CENTER

M. LABOR BATTALIONS AID IN TRACKLAYING—IN BACKGROUND TRESTLE-SUPPORTED PIPE USED IN MAKING HYDRAULIC FILL

N. OPEN STORAGE FOR SUPPLIES IS PROVIDED AT MAIN DEPOT

O. NEW RAILROAD, 6½ MILES LONG, LEADING FROM DEPARTURE YARD AT DOCKS TO BASE STORAGE DEPOT — NOTE GRADING FOR ADDITIONAL TRACKS

parture yard and the existing tracks of a French railway to which connections have been made for incoming and outgoing traffic.

Build Piledrivers

On Oct. 1, exactly one month after the engineer regiment arrived in France, the first shipments of piles and lumber from the United States came. At that time the men were without the cant hooks and peaveys with which they had been accustomed to handle lumber, and tools from home were arriving in mere driblets. A batch of French axes and shovels was purchased locally. One of the first jobs was to build piledrivers, derricks, sawmills and planers out of such material as could be found. For the railway yard excavation two 60-ton steam shovels were obtained from Spain. Purchases of French track and piping also were made, while Spain was drawn upon for railroad ties.

In all there were built two floating piledrivers, five skid and two roller piledrivers, and eight skid derricks for handling lumber. While working with the two floating drivers and four of the skid drivers the progress amounted to about 150 piles per day. The first pile was driven Nov. 12 and on Feb. 10 the driving of the 9200 piles for the docks proper was completed. Not all of the nine piledrivers, however, were working until about Christmas.

The piles themselves were of longleaf yellow pine which had been tapped for turpentine. They were driven with 3000-lb. drop hammers by the floating and skid rigs. The timber is not treated in any way, as there was neither the time nor the facilities for any such procedure. Taking into account the alternate wetting and drying of the dock substructure, due to tide variations, the life of the piling is estimated at from 12 to 15 years. Including piling, capping, stringers and flooring, the docks at Base Section No. — represent about 5,000,000 ft. b.m. of lumber.

Where the gantry-crane rails are carried by 12 x 12-in. wooden stringers rather than I-beams, which did not arrive in time to be used throughout the entire length of the docks, a special unloading device is to be used. It is of timber construction, as shown in Photograph B, and weighs considerably less than the 70-ton steel gantry cranes which will operate at the south end of the docks. This unloading device, called the "Boschke," after the name of the captain of engineers who designed it, is about 20 x 44 ft. in plan and consists of a timber-truss frame carrying a pair of 45-ft. ship's booms, tackle and hoisting engine. The rig is mounted on wheels which run on the regular gantry tracks, these being spaced 44 ft. apart. The hoisting equipment, electrically driven, is housed between the two overhead trusses, as shown in the picture. With this rig a line from the water-side boom is run down into the ship's hold and made fast to the load. The load is then hauled up by the hoisting engine and when clear of the ship's deck is swung shoreward, the weight being transferred by means of suitable tackle to the second or inshore boom, which deposits it on the platform of a classification shed.

A speed test of this apparatus, which, its designer explained to me, is merely an adaptation of the practice of generations of seamen in handling freight by ships' booms, resulted in a round-trip time of only 40 sec.; that is, 40 sec. for picking up a load from a vessel, delivering it to the classification-shed platform and returning empty to the point of starting. The device is capable of handling weights of five tons, although in the ordinary course of events the individual loads will average only two tons or less.

Railway Receiving and Departure Yards

The railway receiving yard immediately back of the docks will, when finished, have a track mileage of 6.25. From it connection is made to the main-line tracks of a French railroad. At the receiving yard empty freight cars will be delivered and sent forward along the trackage system on the dock structure as needed. The four lines of tracks on the docks are equipped with double-slip switches, and the layout is such that any one of the ten berths can be pulled without interfering with operations at the others. The construction work at the receiving yard involved nothing unusual in the way of grading and tracklaying, as the ground is fairly level.

The departure yard, where cars loaded at the docks are made up into trains, contains about 18 miles of track. The feature of the grading work here is the employment of the hydraulic sluicing method for making the fill. Sand dredged at a point 40 miles from the docks is brought up in barges and from them pumped by a French dredge boat to the departure yard through a 30-in. steel pipe line about one mile long, carried on timber trestles. Photograph K shows this work in progress. The dredge boat delivers at the rate of 2,250,000 gal. of water per hour, and the flow contains about 10% of sand. The fill required in all the yards amounts to about 450,000 cubic yards.

A number of accessory structures are being built at the departure yard. There are, for example, a group of overhead coal-storage bins (Photograph L) and an engine pit and repair shops of concrete construction, with timber-pile foundation. When I went through the yard, work was just about to start on a huge refrigerating plant. This structure is being built and equipped for a capacity of 7500 tons of meat.

At both the receiving and departure yards much of the grading and tracklaying is being done by American negro labor battalions under the supervision of engineer troops. Two 60-ton American-built steam shovels, hailing from Spain, were cutting down banks preliminary to the grading of the roadbed for track.

Because of the increase of traffic between the departure yard and the general storage depot for Base Section No. —, 6¼ miles distant, it was considered necessary to parallel the existing double-track line of a

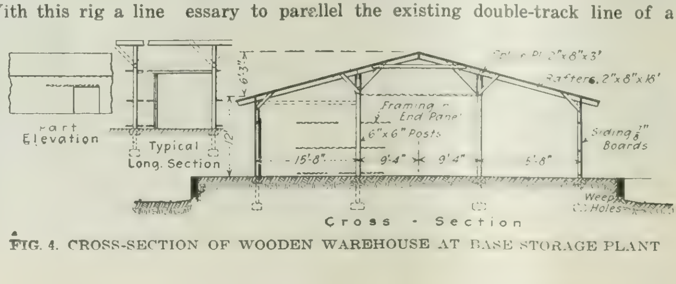
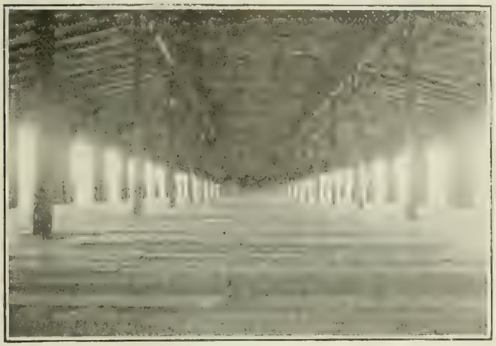
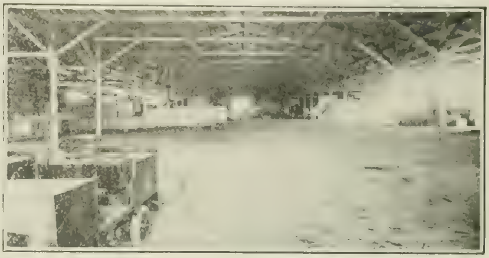


FIG. 4. CROSS-SECTION OF WOODEN WAREHOUSE AT BASE STORAGE PLANT



P AND Q AT THE BASE STORAGE DEPOT THERE WILL BE, ULTIMATELY, 144 WOODEN BUILDINGS OF THIS TYPE.



R. INTERIOR OF A SHED AT THE FRENCH DOCKS NEARBY

French railway with a third track, which is shown in Photograph O. To provide for future contingencies the new route has been graded for two additional tracks, as shown at the left of the picture, thus constituting, with the existing French tracks, a four-track railroad.

Base Storage Depot and Yards

The base storage depot, which is connected with the departure yards at the docks by the 6¼-mile railway line referred to in the preceding paragraph, is an immense project, designed to hold three month's supplies for 2,000,000 men. In its essential features it will consist of 144 wooden warehouses, each 64 x 500 ft.—30 of them were completed at the time of my visit—two railway classification yards, two receiving yards, one departure yard and three storage yards, involving a total trackage of 117 miles—of which 30 miles have been laid at this writing—and 815 switches, of which seven are of the double-slip type. This construction is in the hands of the first battalion of the engineer regiment whose second battalion handled the docks and classification sheds, the engineers being assisted by labor battalions of almost every nationality and by big gangs of German prisoners. The available labor force here numbered about 6000 on the day I called at the headquarters of the engineer captain in charge of the job.

Trained Gangs, in "Waves," Build Warehouses

The sight of row after row of these long wooden warehouses brings to mind the picture of the big-scale cantonment construction in the United States which was begun a year ago. This job at the base depot in France is one of quantity production and is being handled by gangs, each trained in a single specialty. The work has been carefully analyzed and segregated into certain major operations, as is the common practice in the manufacture of munitions, where a shell casing, for example, will pass down a line of machine tools, each operator performing a single operation upon it. Thus, in the case of the 500 x 64-ft. warehouses we have "waves" of construction crews passing in succession over each building. The first gang digs post holes and passes on to the next building. It is followed by a gang which sets the foundation posts. Then come, in order, gangs which saw off the posts at the correct elevations, erect the timber frames, sheathe the sides and finally apply the roofing material. On the warehouse construction about 700 men are at work.

Figure 4 shows the type of structure used for the base warehouses. It will be noted that it involves no roof trusses—merely posts, rafters and knee bracing. The drawing shows the building at the ground level with depressed track on either side, but as a matter of fact many of the buildings I saw were supported on posts to bring the floor and platform level flush with the floor of the freight cars operating on track not depressed but laid at about the general level of the ground.

Design Subject to Change

Of course, it must be understood that the publication of a sketch of this sort does not presuppose a rigid adherence to the theoretical design, particularly as regards the sizes and lengths of the members. The constructors use what they can get. Rafters, for example, are often built up of 1-in. plank. Railroad ties cheat destiny by becoming foundation posts for warehouses. Packing cases, weary with travel, find a permanent resting place as sheathing or bracing. As Captain S—— remarked, "We must be ready to change our designs with each new building erected, depending on the kind of material available for our use." Interior and exte-

rior views of one of the 500-ft. warehouses are shown in Photographs P and Q.

While the dock and railway yard work has been essentially a construction problem, it has made other and exacting demands upon the engineer officers in charge. Upon the fund of experience available in such a regimen as the one which is in charge of operations at Base Section No. —, it is possible to draw for the solution of almost any technical problem. But in the case of the dock and railway-yard project, not all of the difficulties the major in charge of the first battalion had to face were technical. What textbook or field manual gives the construction man the slightest hint of approved practice in mollifying an irate French housewife who has been informed that her house must be torn down to make way for American railway tracks? Over here the little one-story stone dwelling, with its red tile roof, which has been passed down from one generation to another for centuries, is something almost sacred. Surely *les Américains* will not be so stony hearted as to destroy it! The fact that they will pay the French handsomely for the privilege is a matter of secondary, though not of minor, importance. And so the scene in the engineer's office proceeds through the several stages of indignation, entreaty and tears. But our major has had his orders to let nothing interfere with the progress of the job, so he must remain obdurate—and sometimes this is one of the hardest decisions he must make.

Just as I was leaving the docks on my journey back to Paris the Major of the second battalion of the engineer regiment who had tramped over the whole job with me pointed to one of the ships lying along the new timber quay. "She's one of our new vessels," he said, "turned out at a yard in Seattle. Quite a coincidence—she's carrying a cargo of lumber from Seattle, and here she is unloading at a dock in France built by Seattle boys." As he looked out over the line of docks his men had built and spoke of the ship newly arrived from across the Atlantic, there was just a touch of wistfulness in the Major's voice. I discovered later that he, too, came from Seattle.

Street Grading Cost a Ward Charge

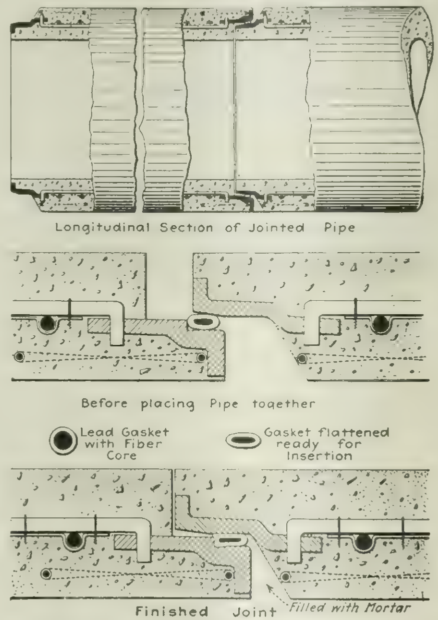
Grading streets and alleys in Minneapolis is a burden that falls upon the whole ward instead of upon abutting property owners. Contrary practice has prevailed for several years through the refusal of the City Council to accept new city plats for record until the streets and alleys have been graded. Recently an owner of 15 acres adjoining Glenwood Park brought suit to compel the City Council to accept the plat without grading. The case went to the state Supreme Court, which decided in part: "The city charter confers broad powers on the City Council in the matter of plats, but it does not confer absolute power of rejection." The court then referred to a portion of the city charter which provides that with the exception of bridges and their approaches, which are a city charge, all other expenses connected with grading shall be taxed upon the entire ward wherein the grading is done. By refusing to accept a plat until the streets are graded, the court held, the city council virtually requires the abutting property to pay the entire cost of grading, which is contrary to the charter provision cited.

New Concrete Pipe Joint Designed for High Pressure

Under Tests Proves Water-Tight for Heads Up to 250 Feet—Can Be Used for Diameters as Small as Four Inches

A PIPE joint capable of standing very high heads, forming an expansion and a universal joint and applicable to concrete pipes of sizes as low as 4 in. in diameter, has been developed by the Lock Joint Pipe Co., New York City. The company has been experimenting with the joint at its works at Ampere, N. J.

The joint is shown in detail in the accompanying drawing. The fundamental principle consists in the use



JOINT FOR CONCRETE PIPE MADE WATER-TIGHT

of a special lead pipe gasket which squeezes against the cast pipe ends when the pipes are drawn together and forms a water-tight joint which at the same time permits a certain deformation of the pipes themselves without affecting its tightness. The gasket is of specially made lead pipe of size varying with the size of the pipe to be jointed and is filled with a fiber core which insures continuity of surface when the pipe is flattened and squeezed. Where concrete pipes are used the pipe ends are of specially shaped castings which are placed in the forms before the concrete pipe is poured and, being fastened to the reinforcement of that pipe, become integral with it when the concrete sets. Two pipes are brought together by a screw-jacking arrangement extending back to the last pipe already in place in the line. In the tests in the yard on 4-, 9- and 36-in. pipe the pressure was put on up to 110 lb. per square inch and the pipe moved through a considerable amplitude under this pressure, without showing any leak.

Reciprocity Between National and Local Societies

Directors of Cleveland Engineering Society and A.A.E. Agree on Joint Membership Plan—National Sections Clannish

By C. E. Drayer
Of the Cleveland Engineering Society

MUCH thought has been given to making the engineering profession a solid working unit and to establishing a feeling of brotherhood and mutual helpfulness. While great progress has been made, there is a widespread and growing conviction that the bond must be even closer and that all members should be welded together in the community, in the state and in the nation. Such relationship must be workable, capable of vigorous growth and based upon the proposition of solidarity of the engineering profession for the good of the whole people.

Early this year the intersociety relations committee of the Cleveland Engineering Society proposed in its report a plan "for efficient organization and unselfish coöperation of the entire body of engineers" and recommended "that the national societies consider as a prerequisite to membership that a candidate shall show membership in an accredited local society." The directors of the society indorsed the recommendation, as did also the Ohio Association of Technical Societies and the National Coöperative Convention held in Chicago in May. A member of the Minnesota Joint Engineering Board suggested the following addition to the proposal just quoted: "and as a condition of this membership in a national society, he shall maintain his membership in the local society."

Reciprocity Plan Worked Out for Cleveland By Local and National Boards

Such a plan presupposes that the national and local societies shall be mutually supporting and not competitive. It presupposes also that the national and local societies will be able to work out a reciprocal agreement. Such an arrangement has been worked out and approved by the national board of directors of the American Association of Engineers and the board of directors of the Cleveland Engineering Society. In brief, the proposition is that a member of either society may become a member of the other under very favorable conditions as to entrance fees and dues. At the outset, no entrance fee will be charged a member of either society joining the other. A combined schedule of annual dues amounting to about 70% of the sum of the dues of both societies will prevail. Thus, the sum of the annual dues of the two societies in the active grade of membership is $25, which is reduced to combined annual dues of $18. The entrance fee for the engineer who desires to join both at one time is one-half the sum of both. Thus, the sum of entrance fees of the two societies is $14, the combined entrance fee is $7. The Cleveland chapter of the American Association of Engineers will thus become an integral part of the local society and not affiliated with it. Members of either society taking out the combined membership will be in full standing in both. The Cleveland society stands ready to make equally favorable arrangements with any other national society.

Some attention can well be given to the proposition that the national societies shall insist on membership in local societies as a condition of both new and continued membership in the national societies. Manifestly, this proposition depends upon the broad argument for solidarity of the profession and for the broader good of the people at large. If the general principle of compulsory membership in a local society be accepted, it becomes necessary to work out a plan by which local societies would become coördinated or articulated with the national societies. Discussion is invited to the end that the working arrangement proposed between the Cleveland Engineering Society and the American Association of Engineers may be improved and made applicable throughout the country for any local and any national society.

Would Aid Collective Endeavor

The plan proposed by the Cleveland society and approved by the other organizations above noted would tend to multiply local engineering societies, so that engineers in each locality would be brought into closer fellowship and be able to do those things which can only be done by collective endeavor. The local societies are now, and the new ones would be, very diverse in character and membership requirements. The point may be made that the standards of membership of some local societies are low. Why, then, should a man who is qualified for membership in say the highest grade of a national engineering society be held out of membership simply because he does not care to join the local society whose standards of membership may be low? Such a question presupposes instead of a feeling of common fellowship a pharisaical attitude. *The higher the standing of the individual engineer in the community, the greater is his obligation both to his profession and to the community. This obligation can be met most fully through the local society.* He is shortsighted and narrow if he has not already joined the local society, doing his part to improve, not so much the requirements of membership admission, but the standing and usefulness of those who are entitled to call themselves engineers. On the other hand, it may be said that any articulation of local and national societies would imply a viséing of the membership requirements of the local, hence a tendency to raise the standards of admission, for any man joining the national societies would of course have to meet its standards. No lowering of national standards is contemplated or necessary. It might well be expected that this plan would strengthen the national societies and increase the interest in them. It would gather in those who want to join both a national and a local but because of the expense, particularly of the first year, join neither. It would also, by raising the standards of the locals, tend to make the local societies become training schools for national society membership.

The minute the plan for coördination discussed in this article is proposed, some will say that the national societies already have sections or local chapters whose

geographical boundaries may be extended to state or group-state scope where the number of engineers is too few for city locals. The difficulty in the scheme of local sections of national societies is that it is clannish and tends to separation of local engineers into their special lines. Parenthetically, it may be said that no worse mistake in engineering organization has been made than the extension of the local section idea to undergraduates. Not separation but consolidation is the thing in the social and citizen relations of the engineer. Such ends will be attained by having local societies in every community where a dozen or more members may be had and by having all engineers members of a local society. Local societies can be set up more easily than national sections, for locals include all; sections, national members divided by four or more. The all-inclusive local is the foundation stone for complete unity. The problem, then, is to weld local societies and chapters or sections of national societies into homogeneous wholes in each community. It is felt that a satisfactory beginning has been made in the arrangement between the American Association of Engineers and the Cleveland Engineering Society.

In a discussion of such an arrangement as the one proposed above, there are those who are content only to see and take the next sure step ahead; others, less venturesome, want to know all the path to the end. Both types should be able to discern in their vision of the future the possibility of a single grand American Engineering Society, with technical sections and geographical divisions and subdivisions or chapters. Then indeed would there be no emulation necessary of the splendid work of such organizations as the American Institute of Architects and the American Medical Association, but another professional body of even greater capabilities would arise "for the good of engineers, and for the greater good of the people at large." Let us approach the subject with a "why not?" rather than a "'Yes, but."

Urges That Draft Contract for Federal Railway Operation Is Unfair

Railway Security Owners' Committee Asserts that Railways Are Asked to Give Blind Blanket Warrant of Release—Desires Mutuality of Contract and Provisions for Arbitration and Appeal to Courts

By Former General Manager

IMPORTANT terms of the tentative agreement with the railway companies for the operation of their properties under Federal control appear to be at variance with the proclamation of the President and with the act of Mar. 21, 1918, which clearly set forth the terms under which the roads shall be operated and their owners compensated under Federal control.

The conferences recently held by the railway executives' advisory committee of the National Association of Owners of Railroad Securities demonstrated that in certain important particulars the tentative draft of the contract was not acceptable. The points at issue are very clearly defined by the railway security owners' committee, and their contentions are in the main supported by the act of Mar. 21, 1918, entitled "An act to provide for the operation of transportation systems while under Federal control, for the just compensation to their owners and for other purposes." It is expressly declared in the act that the legislation was enacted to meet the conditions growing out of the war and was not to be construed as expressing or prejudicing the future policy of the Federal Government with regard to railway ownership, control or regulation, or capitalization.

The proclamation of the President of Dec. 28, 1917, and the act itself assure and guarantee to the owners just compensation and fair treatment. It is therefore not unpatriotic on the part of the owners of the railways to assume that the desire of the President and the plain intent of the law should be carried out, and an analysis of the situation will strongly bear out the contentions of the owners' committee.

It appears that the drafting of the agreement has been delegated in the main to subordinate officials of the United States railroad administration, represented principally by lawyers desiring to make a contract as favorable as possible to their client. It would seem that the Director General in his multifarious duties was obliged to delegate this important matter to his subordinates and that, when his attention is finally directed to the matter, the points of variance will be quickly adjusted.

The main features of the tentative draft of agreement not acceptable to the owners' committee are as follows:

1. A release to the Government whereby the owners would waive "any and all claims and rights at law or in equity which it now has or hereafter can have, under the Constitution and laws of the United States, for any and all loss and damage to its business or traffic by reason of the diversion or otherwise which has been or may be caused by said taking or by said possession, use, control or operation."

The owners' committee, relying upon express language of the act itself, is clearly within its legal rights to refuse to accept such a "blind blanket warrant of release," and no board of directors, trustees, receiver or agent would be faithful to his trust to accept such a claim which would absolutely surrender the rights guaranteed by law and the very act itself.

The act expressly provides that "the President is authorized to enter into an agreement with such carrier for just compensation upon a basis not in excess of that reported by board (of referees) and may include therein provisions similar to those authorized under Section one.

"Failing such agreement, either the United States or such carrier may file a petition in the Court of

Claims for the purpose of determining the amount of such just compensation, and in the proceedings in said court the report of said referees shall be *prima facie* evidence of the amount of just compensation and the facts therein stated."

The release clause exacted by the lawyers of the railroad administration nullifies the act itself and should be eliminated, and in its stead a modern arbitration clause inserted which would be eminently fair and just to both parties.

2. Granting to the Director General of Railways the right to make such additions and betterments, purchase new equipment, build new terminals and extension of road as in his uncontrolled discretion may be necessary, and charge the same to capital expenditure without the approval of the board of directors of the carrier and regardless of whether such improvements are necessary to handle current traffic or are required for war purposes.

Plain Intent of the Act

The act specifically provides that the President may also order any carrier to "make any additions, betterments or road extensions, and to provide terminals, motive power, cars and other equipment necessary or desirable for war purposes, or in the public interest, or in connection with the property of any carrier. He may from said revolving fund advance to such carrier all or any part of the expense of such additions, betterments or road extensions, and provide terminals, motive power and any other necessary equipment so ordered and constructed by such carrier or by the President, such advances to be charged against such carrier and to bear interest at such rate and be payable on such items as may be determined by the President, to the end that the United States may be fully reimbursed for any sum so advanced.

"Any loss claimed by any carrier by reason of any such addition, betterments or road extensions so ordered and constructed may be determined by agreement between the President and such carrier; failing in such agreement the amount of such loss shall be ascertained as provided in Section 3 hereof."

It is plainly the intent of the act that the cost of any additions, betterments or improvements which are not needed by the carrier shall be borne by the Government. Provision should therefore be made in the contract that all additions, betterments, extensions of roads, terminals, equipment, etc., before being made shall be submitted to the board of directors of the carrier for approval or disapproval, and that, upon failure to agree on their necessity, the questions at issue should be submitted to arbitration, and any redress for loss to the carrier adjudicated by the Court of Claims, all as provided in the act.

3. The agreement does not protect the carrier in the payment of fixed charges paid during the test period.

The draft agreement provides that the cost of excess-maintenance which the Director General may incur at his discretion on the property of the carrier must be first deducted from the standard return, although in some instances it may result in the carrier defaulting in the payment of fixed charges.

One of the principal reasons given for Federal control of railways was the stabilizing of the financial interests of the carriers and assuring that the fixed charges would be paid. The effect of the clause cited will defeat this very purpose and discredit the stability of railway securities.

The situation may be illustrated from everyday life. If one were the owner of a dwelling and a tenant were to draw up the lease and insert a clause that any expense for maintenance which he might choose to make should first be deducted before payment of rental, the owner might naturally object and be concerned as to his ability to pay taxes, insurance and interest on mortgage, to say nothing of interest on the investment. The case is precisely a parallel to the one the carriers now face.

The question of the maintenance of the property of the carrier is one that should be settled between the parties to the contract after considering the experience of the test period. In case of nonagreement the question should be submitted to arbitration in the usual manner.

4. The provision of the draft agreement, that all disputed questions as to upkeep of the carriers' property shall be referred to the Interstate Commerce Commission, whose decision shall be final except as to questions of law, is not acceptable to the owners' committee for the reason that it leaves the broad question of fact, which is the main one in matters of upkeep, absolutely in the hands of the Interstate Commerce Commission, and without giving the carriers any redress by appeal to the courts, which the act itself specifically contemplates.

Mutuality of Contract Lacking

The position taken by the carriers that such disputed questions should be subject to review by the United States Circuit Courts of Appeal is eminently fair and reasonable and will be concurred in by all fair-minded men.

5. No assurance is provided that dividends heretofore paid will continue to be paid until after deducting the amounts necessary to reimburse the Government for all additions and betterments (except road extensions and additions and betterments made solely for war purposes.) There is absolutely no mutuality in this clause of the contract. It leaves the carrier at the mercy of the Director General, who is the sole judge as to the necessity of any improvement in the carrier's property. In order to be eminently fair to both parties and establish proper mutuality of contract, all matters of improvement should be submitted to the board of directors of the carrier for approval or disapproval before being carried into effect. Any disagreements should be submitted to arbitration in the usual manner.

6. No restriction whatever is placed upon the extent to which the Director General may make or order the carrier to make additions, betterments, etc., for war purposes or otherwise, whether the carrier requires them or not, and charge the same to the carrier. The only redress which is left to the carrier is to claim a loss in a litigation against the Government, with the burden of proof on the carrier. This is eminently unfair to the carrier and is altogether one-sided, lacking entirely the element of mutuality. No corporation

chargea with the trust of safeguarding its interests in law and in equity could willingly subscribe to such an arrangement, and the act itself does not require the carrier thus to waive its rights under the law.

7. The draft contract does not fix definitely the rate of interest to be charged the carrier on the costs of additions, betterments, road extensions, etc., but places the matter wholly within the power and discretion of the Director General, which may subject the carrier's return to ever-varying deductions and further reduce the amount available out of the standard return to pay its fixed charges and other expenses.

Let it be supposed that the Director General orders an improvement costing \$10,000 to be made by the carrier, which may result in a saving in operation of 30% per annum. It is not fair that the carrier should be obliged to pay the Government 5% or 6% interest on this investment and have its standard return reduced by that much while the Government obtains the increased return in its operation and the carrier derives absolutely no benefit therefrom. It is only fair that in such cases the Government and the carrier should equally share in the benefit of such expenditure during Federal control. It is all the more important that all matters regarding additions, betterments, etc., which are charged to capital account, should first have the approval of the carrier in order to safeguard the public against extravagance and waste in expenditures which are unnecessary and not justified.

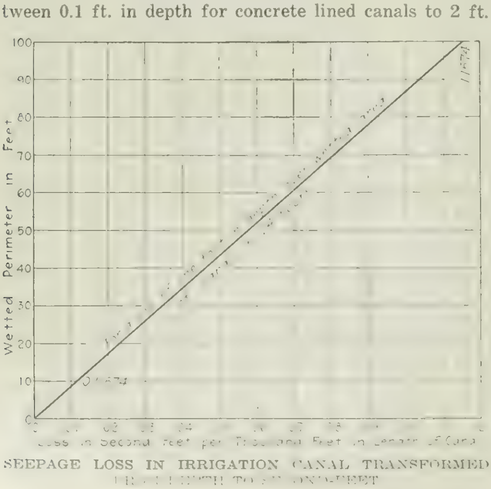
Who is better able to judge the necessity and wisdom of an expenditure chargeable to the property? The owner who must carry the burden or the transient tenant who has no interest in the property and no financial responsibility? It is against all law and the rights of property to depart from business principles in this manner, as proposed by the lawyers who drew the tentative contract.

It is of the utmost importance in the interests of the stability of the financial status of the railways directly and the country at large that an equitable contract be concluded with the railways at an early date, as the railways generally are wholly at sea as to any definite policies or future course. Interests involving some eighteen to twenty billions of dollars are absolutely marking time until this important question of contract is settled.

Transforming Canal Losses in Terms of Depth to Quantity

By Percy A. Cupper
Assistant State Engineer, Salem, Ore.

THE practice which prevailed a few years ago of estimating seepage losses in canals in per cent. of water carried has given way to the more accurate method of estimating the loss in depth over the wetted area of the canal. This method is based on the assumption that the seepage loss will vary directly with the wetted area of the canal, which in turn varies with the wetted perimeter. It will be observed that the seepage loss is therefore independent of the quantity of water carried by the canal. The loss of water over the wetted canal area in a given time will vary with the character of the bed of the canal but will probably fall between 0.1 ft. in depth for concrete lined canals to 2 ft. in depth for canals in loose material in a period of 24 hours. However, what the designing enginerr wishes to know is how much the canal will lose in cubic feet per second and probably the most convenient and practical diagram or tabulation is one showing loss in second feet per thousand feet length of canal for any given wetted perimeter.



SEEPAGE LOSS IN IRRIGATION CANAL TRANSFORMED FROM DEPTH TO SECOND-FEET

The accompanying simple diagram gives this information for wetted perimeters from 0 to 100 ft. for a loss of 1 ft. in depth over the wetted canal area in 24 hours. The points on the curve were obtained by multiplying the wetted perimeter in feet by 1000 and dividing by 86,400. Should the loss be estimated at 2 ft. in depth in 24 hours, the number of second-feet shown in the diagram should of course be doubled. Likewise, if the loss be 0.1 ft. in depth in 24 hours, the result shown in the diagram should be divided by ten, and so on for any estimated seepage loss.

It is believed that the use of such a diagram will not only prove a time saver but will also have a tendency to cause more attention to be paid to the probable seepage losses in the design of a canal.

City May Adopt Municipal War Program

Curtailment of municipal improvements at Minneapolis to meet war conditions is reported by F. W. Cappelen, city engineer. Only some nine miles of sewers and ten miles of water mains are being laid this year, compared with twice that amount normally. Paving has been cut down in like manner. The water-filtration plant is being extended, this being considered a necessity and money for the work being available. Minneapolis is working under a budget system. Next year's budget will be taken up by the Board of Tax Levies in August and later on by council committees, and then by the City Council. Mr. Cappelen expresses the hope that a municipal war program will be adopted in connection with the budget for 1919.

Fully Metered Plant Treats Highly Turbid Arkansas for Tulsa

Venturi Meters of New Type Supply and Control Dry Chemical Feeders—Weighted Swing Gates Equalize Resistance in Mixers

FOR treatment of the unusually turbid Arkansas River water at Tulsa, Okla., a rapid filter of 8,000,-000-gal. daily capacity has recently been put into operation, to serve a population growing so fast on account of the oil-well developments as to make entirely unreliable the census figures taken a year ago. Best estimates, however, place the number of consumers at eighty thousand.

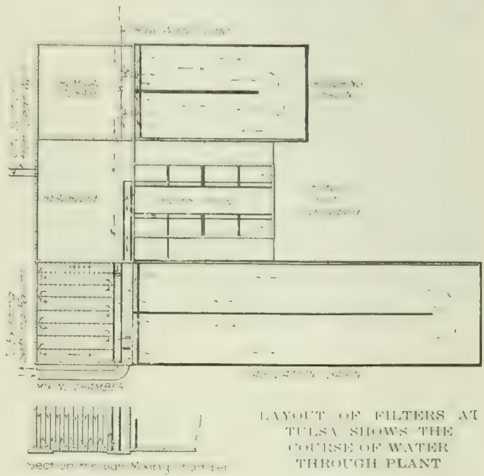
Salient features compelling attention in this plant are a new type of venturi meter with a short curved approach and recovery or modified vena contracta, dry-feed chemical machines controlled by this meter, a mixing chamber with up-and-down baffles and weighted swing gates on the under baffles to equalize the resistance causing loss of head under changing velocities, and meters of the same equal-pressure diaphragm type controlling the filter to meet the varying consumption.

As a source of supply, the Arkansas River at this point is exceeded in difficulty of treatment, for hardness as well as turbidity, by few other Southwestern rivers. Somewhat polluted by sewage and at each rise by a large quantity of waste from oil refineries and wells, the construction of the old intake, far from the main channel, at the end of a canal destroyed by each flood, is such as to skim much of this floating material and improve the average condition of the water flowing in the principal thread of the stream. Until a new intake can be built, the plant must handle the worst rather than the best water flowing in the river. As much as 4000 parts per million of sodium chloride, 265 of sulphates of lime and magnesia, and turbidities of 18,000, have been observed since the laboratory at the plant has been started. Bacilli coli are found in all c.c. river samples and total bacteria counts of 20,000 per c.c. at 37½° C. are not uncommon.

Situated near the existing pumping station, which formerly drew its supply from wells on the river bank, the new plant is fed by two centrifugal pumps, one of 4,000,000-gal. and one 8,000,000-gal. capacity, lifting the water 17 ft. to the roughing basins for two-hour storage. Thence it passes, as shown in the sketch, to the mixers for one hour and the coagulation basin for 11½ hours. Following the filtration, two hours' storage is provided under the filters, from which the existing high-pressure pumps take their supply and discharge it into the city mains.

All the water entering the purification plant passes by a 30-in. pipe to an equal-pressure diaphragm meter, which has an approach 30 in. long, a throat 10 in. in diameter, and a total tube length slightly more than 50% of a standard tube. The pressure recovery is found to be a trifle better than that given by a standard tube.

Four multiple drillings of unusually large area connect the annular pressure chambers, around the approach and the throat, to the stream. The approach chamber is connected by an open pipe line to the bottom of a diaphragm situated so as to cause the approach pressure always to act on the diaphragm. Immediately adjacent to the throat pressure chamber is installed a standard orifice of small diameter, with its discharge side looking toward the throat. The throat pressure is always acting on the discharge side of this orifice. The approach side of the orifice, which is fed from a source of higher pressure, is connected to the discharge side of the valve of the diaphragm and always feels the pressure created by the valve, on the top of the diaphragm. This is always maintained just equal to the pressure on the bottom of the diaphragm, which is the pressure on the approach of the tube. Under

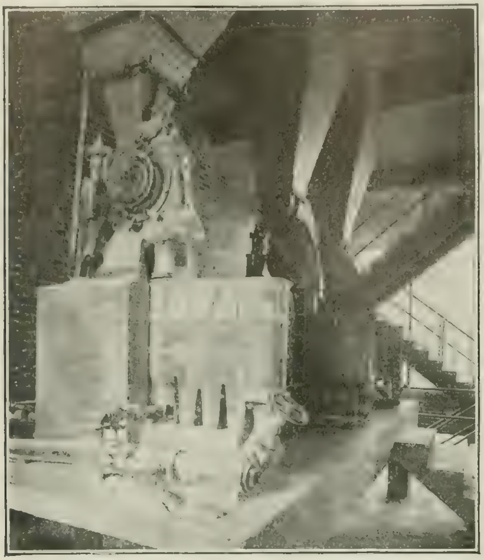


LAYOUT OF FILTERS AT TULSA SHOWS THE COURSE OF WATER THROUGH PLANT

these conditions, the flow through the small standard orifice and into the throat of the tube must always be proportional to the flow through the tube, and, therefore, if the small flow through the orifice be metered, the large flow through the large tube will also be metered. The gear train of a small meter is made to drive a pen which traces an ink record on a chart on a clock-driven drum. A cam forces the pen to rise to its high point, when it is released and instantly falls by gravity to its low point. Each rise and fall of the pen cuts a saw-toothed curve, the angle of the up-stroke being dependent on the volume of flow through the small meter.

Each saw-toothed curve represents a definite volume of flow through the small meter, and also a definite volume of flow, 100,000 gal., through the pressure-difference tube. The chart, of the seven-day type, has 10 subdivisions. This permits reading to within a 5000-gal. total of flow for any time period. The small metered flow is made to pass a small orifice. A mercury manometer, which feels the pressure on the two sides of this orifice, indicates the rate of flow at any moment and, reading against a graduated scale, indicates the total flow. Water entering the plant is thus metered by an integrating meter, indicated by a manometer and recorded on a self-planimetering chart.

Control of the three dry-feed machines for supplying sulphate of iron, lime and soda ash may be manual



DRY-FEED MACHINES ARE CONTROLLED BY WATER ENTERING THE PLANT

at a fixed rate or act automatically in proportion to the flow of water into the plant.

The small flow to the disk meter of the metering device is derived from a high-pressure main of ample capacity. It is first made to pass a small master standard orifice. The difference of pressure on the two sides of this orifice is functional to the flow through the orifice, and as this flow is the flow into the throat of the equal-pressure diaphragm meter, it is also functional to the flow of water into the plant.

Each chemical machine is provided with an individual orifice. The pressure on the approach of each of these is the same as that acting on the approach of the master orifice. Each chemical machine is also provided with a diaphragm which controls a valve. The pressure on the bottom of the diaphragm of all the chemical machines is the pressure also acting on the discharge side of the master orifice. The pressure on the top of the diaphragm is that created by its valve, and as the presure on the bottom of all the diaphragms is the pressure acting on the discharge side of the master orifice, while the pressure acting on top is the pressure acting on the discharge side of the individual orifice, we have all the orifices, both master and individual, with equal pressures on their discharge sides and equal pressures on their approaches. Hence, the discharge through both the master and the individual orifices must be proportional to their area.

The flow through the individual orifice is made to actuate the motor of a chemical machine. This motor is of the reciprocating type, and the piston stroke and area are the same for all. With an equal volume of flow through each motor, therefore, the speed of the motors will be equal. With the arrangement above described, it will be seen that as the flow through the master orifice is functional to the flow of water into the plant, and as it is also functional to the speed of the motors of each chemical machine, the machines move or stroke functionally to the flow of water into the plant.

The chemical machine consists of a wheel, having a milled surface, which is driven past an orifice. A ratchet wheel, set on the same shaft, drives the wheel forward past the orifice. The ratchet wheel has 48 teeth, with an adjustable guard so one or more teeth can be engaged. Each stroke of the motor can be made to throw from one to 12 teeth on the stroke. Thus each stroke can be made to cause from $\frac{1}{48}$ to $\frac{1}{4}$ of a revolution of the milled wheel. This amounts to a peripheral movement of from 0.78 in. to 9.4 in. The height of the orifice can be varied between zero and $1\frac{3}{4}$ in. and from $\frac{1}{8}$ to 3 in. in width. The minimum practical dosage is about 0.25 cu.in. of dry material per stroke of machine, while the maximum is about 50 cu.in., a variation of from 1 to 200. Above the chemical machine is a hopper, of inverted-pyramidal shape, holding a day's supply. From this the chemical wheel takes its supply of dry chemical through the adjustable orifice.

The water discharge from the motor and the dry chemical from the wheel are brought together in a small chamber, which can also be supplied with a secondary water flow to dissolve or carry away the chemical to the point of application. Each up baffle in the mixing chamber extends to the bottom of the mixing chamber and is provided with a swinging gate, kept closed in normal operation by a concrete weight fastened to it in such manner as to hold it closed except

MIXING CHAMBER PROVIDED WITH AMPLE BAFFLE SLOTS FOR VARIATIONS

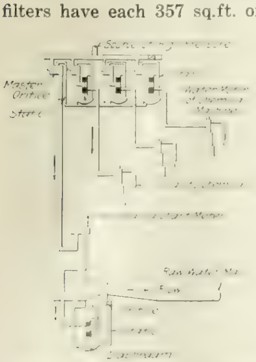
when the basin is being drained or filled. Each down baffle extends above the water line and is raised or clear of the bottom for $6\frac{1}{2}$ in. Above this is another swing gate intended to hang vertically when low flows are in use, and to swing out in the direction of flow with larger flows, thus affording a larger cross-section and reduced resistance over what would obtain with a fixed-bottom clearance. The purpose was to maintain about the same resistance and loss of head through the mixing chamber on all volumes of flow through it.

The calculated loss of head at the time the gates were weighted and baffles extended was within 3 in. of the observed loss of head after the baffles were changed. At a 4,000,000-gal. rate, the calculated loss was 42 in. and the actual loss 39 in. Variations of from 1,750,000

to 7,000,000-gal. rates have been handled with no difficulty by this mixing chamber, in its present arrangement. While the weighting of the gates is approximately correct for high rates, it is realized that, with the data now available, a better arrangement of the weighting can be effected and a closer control can be obtained of the velocities at the under-turn at low rates. The mixing chamber is 50 x 49 ft. and 20 ft. deep. The up-and-down mean velocity is about 0.7 ft. per second, and the velocity at the under-turn is approximately 2 ft. per second. The results that are obtained from the use of this mixing chamber are all that were expected or could be desired. Samples taken at various points through the mixing chamber under varying conditions of raw water, chemical treatment and volume of flow have shown a consistently improving quality of coagulation up to the point of discharge into the settling basins. Regardless of the type or quantity of the turbidity, the coagulation has been uniformly satisfactory, and when the water has entered the settling basins precipitation has been rapid and complete. The view shows this action very clearly. At the lower edge, a little to the left of center, the lens worked through from 3 to 4 ft. of clear water.

LIGHT CLOUDY PORTION IS COAGULANT QUICKLY CLEARING TO DARK PORTION

Each filter is equipped with a combined meter and controller similar in principle to the main supply meter, except that it is of straight-line design. The eight filters have each 357 sq.ft. of sand area, and the rates can be controlled from zero to 175,000,000 gal. per acre per day. One of the innovations of this plant is a master meter which measures the composite flow of all the filters and makes a sawtooth record on a chart, indicating 100,000 gal. per tooth. In addition to fixed- and variable-rate controllers is a master controller which is responsive to the level of the water in the clear well. The plant has been in service only a short time and the data so far available are rather scanty and not as reliable as they will be when all the possible seasonal variations shall have been encountered. The hardness of the raw water has been as high as 380 parts per million and was reduced to 44 parts per million. Bacterial reductions amount to about 98%, obtained without the use of chlorine. There is a virtual absence of bacilli coli in the filtered water. The plant is equipped, however, with dry chlorine apparatus. The percentage of wash water does not exceed 0.7% and will probably average less than 0.5%. The filtered water is free from color and brilliantly clear and sparkling.



PROPORTIONAL FLOW METER AND REGULATOR

The cost of the plant to date has been approximately $200,000. It was built during the term of office of C. S. Younkman, water commissioner, by the Fogel Construction Co., Kansas City, Mo., general contractors, and the equipment was furnished by the Pittsburgh Filter Manufacturing Co. The consulting engineers were Stevens & Stiles, Kansas City, and C. Arthur Brown acted as supervisory engineer for the city on the plans and specifications. The plant is in charge of W. R. Holway, superintendent of filtration.

Women Employed as Tar Sprayers in England

Women have been employed, for some time past to spray tar upon the highways of Westminster, England, according to a report in the London *Surveyor*. J. W. Dugdale-Bradley, city engineer, reports that, generally speaking, their work has been quite satisfactory. They work 50 hours per week, and the rate of wages in American money is 26c. per hour, rising to 30c. per hour on satisfactory service. Women who manipulate brushes for spraying tar receive an additional 4c. per hour. They wear uniforms, consisting of clogs, caps and gloves, which are supplied by the city. Portable mess rooms and lavatories are also provided for the women workers.

Highway Carries Twelve Times as Much Local Freight as Railroad

Shipments by Baltimore Road Increase 480% in Year, Saving Railways 39,923 Ton-Miles—Pennsylvania Road Shows Considerable Gain in Time of Shipment Over Railway

THAT twelve times as much freight was carried by motor trucks over the highway between Baltimore and Belair, Md., as was carried in the same period by the parallel railroad, is shown by a census of the Maryland State Roads Commission for the year that ended May 31 last. The motor-truck freight traffic increased 480% in this period, and the average gross tonnage carried was 2644 per 12-hour day. The average number of vehicles using the road exceeded 1000 per 12-hour day. Another traffic census of the Lincoln Highway, between Chambersburg and Bedford, Pa., taken by the Pennsylvania Highway Department, shows an actual saving of 39,923 ton-miles a day.

The first census, shown in one of the tables, covers a stretch of road 14 miles long from Baltimore to Belair. Two miles are paved with tar macadam, six miles with bituminous macadam on a concrete base, and six miles with oiled waterbound macadam. The road is standing up well under the heavy traffic, but constant maintenance is required to keep it in condition.

Farmers' Association Uses Road

A considerable amount of the increase in traffic during the early part of this year was caused by the use of the road by the trucks of the Harford County Farmers' Coöperative Association. This association holds the state franchise for operating a motor express line over this road, in accordance with a recent law enacted by the state Legislature. Stations are established at various points to collect milk and other produce of the farms, which the trucks pick up and transport to the city, returning with the empty milk cans, merchandise, materials and implements needed by the patrons. This association started one of the first motor express routes, which is said to have been very successful.

The period included in the table covers the year which ended May 31, 1918. According to its custom, the roads commission had observations taken one day each month, being careful to use a different day of the week in each succeeding month. It was thought that by this method a general average would be obtained for the entire year. The hours of observation were from 7 a.m. to 7 p.m. The data collected were complete, including every kind of vehicle which uses the road from a one-horse cart to a 5-ton motor truck.

How Tabulation Was Done

The gross weight in tons, shown in the second column of the table, was determined by weighing a large number of vehicles as they passed over the roads. When a sufficient number of weights of all types of conveyances to give a fair average had been collected, they were separated into the various classes and a standard weight was determined for each class. The dead weights of the various makes of automobiles and trucks were also compiled, and it was found that the average live-load for each class was practically one-half the gross weight. Thus, one-half of any tonnage figure shown in the census table should be the actual amount of freight represented by that item. The tonnage for each class of traffic is summed up in the table, and the grand totals of each day and for the 12 days are shown. In the last two lines, the monthly and yearly tonnage of both the highway and the railroad are tabulated. The monthly highway tonnage was computed on the assumption that there are 26 working days per month. The monthly motor truck tonnage is that of the four classes of trucks only; no account being taken of horse-drawn or passenger vehicles. The railroad tonnage was taken from the forwarding sheets of the company and includes all shipments forwarded from Baltimore to Belair and vice versa. Considerable of the railroad freight did not originate at the forwarding points, but was in carload lots to and from foreign roads. The railroad figures for May could not be ascertained, and they were supplied by using the figures for August, the largest previous month.

Referring to the tabulation, it will be seen that the net tonnage of the four classes of motor trucks was 213,564 for the year. This is the sum of the total gross tons transported per day, divided by 2 and multiplied by 12 and 26, according to the assumption mentioned above. The actual amount of freight carried by the railroad for the year was 17,568 tons. On the average, as much freight was carried over the highway in one month as the railroad carried in a whole year. This, of course, refers only to local business between the two points.

War Traffic Over Highway

The increase in strictly freight tonnage during the year as compared with the total tonnage is very marked. The total amount of tonnage June 1, 1917, for all vehicles was 1926, while the amount for May 14, 1918, was 4801 tons, or an increase of 149%. The gross total of strictly freight traffic increased from 524 tons to 3030 tons, a gain of 480%. Beside the local traffic, this road has served as a route for a large number of United States Army motor trucks, going through loaded with quartermaster supplies and truck parts on their way from the factories to the battlefields in France.

The total number of vehicles using the road on the 12 days of observation was 12,865 or 1072 per day. Of these, 1290 were horse-drawn, gross weight 1965 tons, 7530 were passenger auto traffic, gross weight 11,786 tons, and 4045 were motor-truck and motor-bus traffic, gross weight 17,980 tons. The total tonnage for the 12 days was 31,731, or 2644 tons per day. This shows what a small part the horse plays on the modern highway, hauling little over 6% of the loads. Taking 27.1 tons as the average load per freight car,

TRAFFIC CENSUS OF BALTIMORE-BELAIR HIGHWAY FOR THE YEAR ENDING MAY 21, AND THE RAILROAD TONNAGE, PER MONTH, FOR THE SAME PERIOD

Description	Gross Weight in Tons	June 2, 1917 No.	June 2, 1917 Tons	July 1, 1917 No.	July 1, 1917 Tons	Aug. 2, 1917 No.	Aug. 2, 1917 Tons	Sept. 17, 1917 No.	Sept. 17, 1917 Tons	Oct. 1, 1917 No.	Oct. 1, 1917 Tons	Nov. 1, 1917 No.	Nov. 1, 1917 Tons
One Horse: Runabouts, open and top buggies	0.362	12	4.3	13	4.7	15	5.4	15	5.4	18	6.5	28	10.1
One Horse: Open spring wagons and covered delivery wagons	1.00	20	20.0	3	3.0	19	19.0	21	21.0	11	11.0	11	11.0
Two Horse: Family carriages and hacks	0.562	7	3.9			3	1.7			4	2.2	8	4.5
Two Horse: Delivery wagons, vans, farm wagons and dump wagons	2.50	10	25.0			6	15.0	7	17.5	23	57.5		.....
Three Horse: Farm wagons, trucks and vans	3.50	5	17.5			4	14.0						...
Four Horse: Farm wagons and vans	3.75	8	30.0			2	7.5						
Horse-drawn totals		62	100.7	16	7.7	49	62.6	43	43.9	56	77.2	47	25.6
Motorcycles	0.225	20	4.5	140	31.5	31	7.0	42	9.4	25	5.6	15	3.4
2 Passenger Automobiles: Light weight machines	0.900	70	63.0	55	49.5	39	35.1	57	51.3	60	54.0	32	28.8
2 Passenger Automobiles: Machines of medium and heavy weight	1.75	55	96.2	50	87.5	30	52.5	50	87.5	48	84.0	25	43.8
5 Passenger Automobiles: Light-weight machines	1.125	180	202.5	595	669.4	145	163.1	275	309.4	180	202.5	185	208.1
5 and 7 Passenger Automobiles: Medium and heavy weight machines	2.25	195	438.8	510	1,147.5	108	243.0	291	654.8	145	326.2	200	450.0
3 and 4 Passenger Enclosed Automobiles: Like taxi-cabs	2.00	100	200.0	104	208.0	130	260.0	22	44.0	27	54.0	58	116.0
Passenger vehicle totals		620	1,005.0	1,454	2,193.4	483	760.7	737	1,156.4	485	726.3	515	850.1
Store Delivery Automobiles: Light weight machines with tops	1.125	40	0			30	33.8	38	42.8	60	67.5	60	67.5
Store Delivery Automobiles: Medium and heavy weight machines with tops	2.25	20	45.0			18	40.5	6	13.5	12	27.0	11	24.8
¾, 1, 1½ and 2-ton Hauling Trucks	3.20	30	96.0			20	64.0	12	38.4	23	73.6	13	41.6
3½, 4 and 5-ton Hauling Trucks: Heavy vans, freight and stone trucks	7.50	45	337.5	22	165.0	55	412.5	103	772.5	85	637.5	94	705.0
Passenger Auto Busses: Light-weight machines	1.15	102	117.3	95	109.3	65	74.8	75	86.2	60	69.0	60	69.0
Passenger Auto Busses: Machines of medium weight	3.00	23	69.0	32	96.0	16	48.0	10	30.0	16	48.0	5	15.0
Passenger Auto Busses: Heavy machines	4.25	26	110.5	12	51.0	6	25.5	15	63.8			15	63.8
Freight vehicle totals		286	820.3	161	421.3	210	699.1	259	1,047.2	256	922.6	258	986.7
Grand totals		968	1,926.0	1,631	2,622.4	742	1,522.4	1,039	2,247.5	797	1,726.1	820	1,862.4
Net tonnage of trucks per month and year			6,786		2,132		7,150		11,258		10,452		10,894
Actual tonnage by railroad per month and year			1,885		1,481		2,246		1,874		1,884		1,199

Description	Dec. 1, 1917 No.	Dec. 1, 1917 Tons	Jan. 26, 1918 No.	Jan. 26, 1918 Tons	Feb. 7, 1918 No.	Feb. 7, 1918 Tons	Mar. 2, 1918 No.	Mar. 2, 1918 Tons	Apr. 21, 1918 No.	Apr. 21, 1918 Tons	May 14, 1918 No.	May 14, 1918 Tons	Total No.	Total Tons
One Horse: Runabouts, open and top buggies	17	6.2	15	5.4	11	4.0	47	17.0	23	8.3	28	10.1	242	87.4
One Horse: Open spring wagons and covered delivery wagons	12	12.0	44	44.0	78	78.0	96	96.0	87	87.0	45	45.0	447	447.0
Two Horse: Family carriages and hacks	7	3.9			27	15.1	30	16.9	8	4.5			94	52.7
Two Horse: Delivery wagons, vans, farm wagons and dump wagons	5	12.5	49	122.5	77	192.5	63	157.5	78	195.0	89	222.5	407	1,017.5
Three Horse: Farm wagons, trucks and vans	.		2	7.0	14	49.0	17	59.5	7	24.5	9	31.5	58	203.0
Four Horse: Farm wagons and vans	2	7.5	10	37.5	9	33.8	4	15.0			7	26.2	42	157.5
Horse-drawn totals	43	42.1	[illegible]	[illegible]	215	372.4	257	361.9	203	319.3	178	335.3	1,290	1,965.1
Motorcycles	22	5.0	2	0.5	3	0.7	38	8.6	36	8.1	31	7.0	405	91.3
2 Passenger Automobiles: Light weight machines	28	25.2	10	9.0	26	23.4	40	36.0	63	56.7	30	27.0	510	459.0
2 Passenger Automobiles: Machines of medium and heavy weight	30	52.5	28	49.0	58	101.5	82	143.5	78	136.5	57	99.8	[illegible]	1,034.3
5 Passenger Automobiles: Light-weight machines	150	168.8	127	142.9	104	117.0	234	263.2	357	401.6	335	[illegible]	2,867	3,225.4
5 and 7 Passenger Automobiles: Medium and heavy weight machines	162	364.5	110	247.5	127	285.8	215	483.8	268	603.0	316	711.0	2,647	5,955.9
3 and 4 Passenger Enclosed Automobiles: Like taxi-cabs	27	54.0					4	8.0			38	76.0	510	1,020.0
Passenger vehicle totals	419	670.0	277	448.9	318	528.4	613	943.1	802	[illegible]	807	1,297.7	7,550	11,785.9
Store Delivery Automobiles: Light weight machines with tops	40	45.0	10	11.2	22	24.8	18	20.2	29	32.6	18	20.2	365	410.6
Store Delivery Automobiles: Medium and heavy weight machines with tops	6	13.5	22	49.5	28	63.0	30	67.5	38	85.5	23	51.8	214	481.6
¾, 1, 1½ and 2-ton Hauling Trucks	15	48.0	121	387.2	149	476.8	204	652.8	240	768.0	282	902.4	1,109	3,548.8
3½, 4 and 5-ton Hauling Trucks: Heavy vans, freight and stone trucks	115	862.5	133	997.5	133	997.5	268	2,010.0	273	2,047.5	274	2,055.0	1,600	12,000.0
Passenger Auto Busses: Light-weight machines					7	8.0					2	2.3	466	535.9
Passenger Auto Busses: Machines of medium weight	31	93.0	14	42.0	16	48.0			4	12.0	20	60.0	187	561.0
Passenger Auto Busses: Heavy machines			12	51.0							18	76.5	104	442.1
Freight vehicle totals	207	1,062.0	312	1,538.4	355	1,618.1	520	2,750.5	584	2,945.6	637	3,168.2	4,045	17,980.0
Grand totals	669	1,774.1	709	2,203.7	889	2,518.9	1,390	4,055.5	1,589	4,470.8	1,622	4,801.2	12,865	31,731.0
Net tonnage of trucks per month and year		12,584		18,772		20,306		35,750		38,116		39,364	213,564	
Actual tonnage by railroad per month and year		979		593		794		1,086		1,301		2,246	17,568	

213,564 net tons would be equivalent to 7880 carloads of freight, which transportation capacity can now be utilized to help overcome the shortage in freight-handling facilities.

The census on the Lincoln Highway, which is also

TRAFFIC CENSUS OF CHAMBERSBURG-BEDFORD HIGHWAY TAKEN MARCH 22, 1918

Description	Direction of Traffic: Eastward No.	Eastward Tons	Westward No.	Westward Tons	Totals No.	Totals Tons
Horsedrawn						
One horse	55	0	60	0	115	0
Two horse	19	30	17	10	36	40
Three and four horse	1	2	1	1	2	3
Automobiles						
Roadsters	33	0	17	0	50	0
Touring cars	159	0	76	0	235	0
Motor Trucks						
1-3 ton	51	153	19	30	70	183
5-6 ton	20	100	0	0	20	100
1.5-3 ton	66	198	0	0	66	198
Motorcycles	3	0	3	0	6	0
Totals	407	483	193	41	600	524
Through tonnage						481

tabulated, shows how a highway is aiding in the solution of the transportation problem by eliminating the long haul. The record was taken by the Pennsylvania State Highway Department. The distance between Chambersburg and Bedford is 57 miles, while the shortest railroad route is 140 miles. In computing the tonnages, it was assumed that the east-bound traffic was all loaded while the west-bound traffic was one-half loaded. Only the motor trucks were considered as carrying through loads, and the total through freight per day was found to be 481 tons. As the number of miles by highway is 57, the number of ton-miles would be 27,417. In the same manner, the railroad ton-miles would be 67,340 and the saving by the highway route would be 39,923 ton-miles.

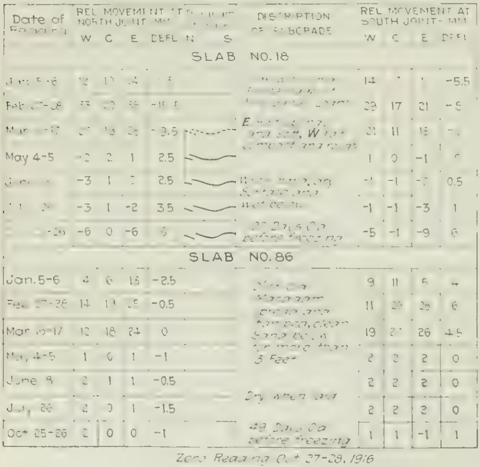
The use of motor trucks for transportation saves two handlings of the freight, which proceeds directly from the producer to the consumer. It saves transportation capacity for war uses, and on the basis of the above figures, where the hauls are short, it saves time.

The Maryland census was taken under the direction of Frank H. Zouck, chairman, and J. N. Mackall, chief engineer of the State Roads Commission, and George H. Biles is acting chief engineer of the Pennsylvania State Highway Department, which made the second tabulation.

Impervious Bituminous Wall Suggested To Prevent Seepage Under Paving

Extensive Study Made of Vertical Movements of Pavements with Reference to Frost Action—Distribution of Moisture in Clay and Loam Subgrades and Effect of Walling Off Shown by Charts

PLACING an impervious wall made of sheets of bituminous material ⅜-in. thick and extending from top of curb to 4 ft. below the bottom of the concrete base, is the novel suggestion made for controlling the water content under pavements. The suggestion was made in a paper presented before the recent convention of the American Concrete Institute, by John W. Lowell, division engineer of the Universal Portland Cement Co. The paper describes a study of the vertical movements of pavements, and the relation of frost action to longitudinal cracking, and was based upon an investigation of Sheridan Road, Kenilworth, Ill., extending over a period of one year. During the period of study, 12,528 level readings were taken on 3325 lin.ft. of concrete pavement. All deflections over $\frac{7}{16}$ in. were found to cause cracks, while those under $\frac{11}{32}$ in. caused no cracks. An abstract of the paper follows.



VERTICAL MOVEMENT OF TYPICAL SLABS, ITS EFFECT, AND NATURE OF SUBGRADE COMPILED

What it is worth to the public to eliminate cracks depends largely upon their objection to them. To the engineer a problem in economy is presented which may have as many solutions as there are engineers. These solutions must be based largely on assumptions, as no exact knowledge is available.

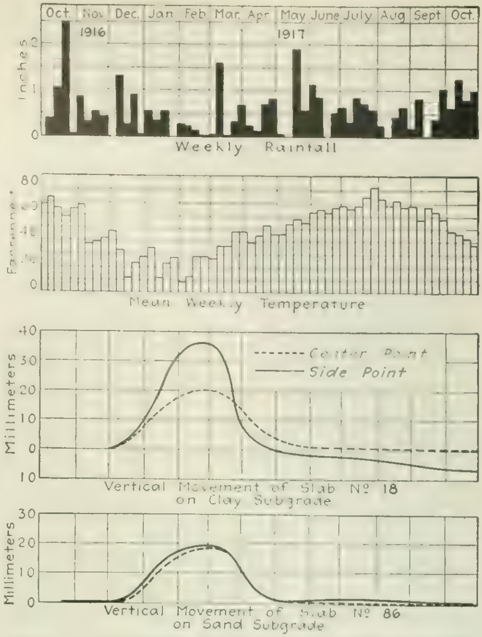
Before starting to eliminate cracks, it is pertinent to know the extent to which they exist and their cause. In climates where freezing occurs, it has been found from general observation of pavement slabs less than 60 ft. in length, that the following is true: (1) Transverse cracks do not occur as frequently as longitudinal cracks; (2) for width over 18 ft., frequency of longitudinal cracks is apparently unaffected by width of pavement; (3) cracks seldom occur in pavements lying on sand or well-drained porous subgrades; (4) on clay or heavy loam soils longitudinal cracks are of frequent occurrence; (5) the more compact the subgrade soil, the more frequently cracks occur; (6) cracking of pavements on clay or heavy loam soils cannot be entirely prevented by artificial drainage.

Desiring more definite information, the Universal Portland Cement Co. selected the stretch of newly built pavement mentioned above and made a complete study of its vertical movements. The pavement is of first-class design, being 7 in. thick at the sides and 10 in. thick at the center and of two-course construction. The base was 1:2½:4 pebble concrete, and the wearing surface was 1:1:1½ concrete. Reinforcement consisting of No. 27 triangle mesh wire fabric weighing 41 lb. per 100 sq.ft. was placed between the base and the wearing course.

The pavement was completed before it was decided to make the investigation, and it was impossible to determine the character of the subgrade by means of borings. However, the engineer of construction had observed the character of the subsoil, and his description was supplemented by scattered borings taken outside the curb. From slab 1 to 38, the subgrade may be described as spongy, tough, compact clay; from 39 to 45, sand loam with spongy under-stratum and compact crust; from 56 to 70, clay and loam with some fine sand, the ground being spongy with sand below; and from 79 to 86, the south end of the pavement, sand of more than 3 ft. depth.

As soon as the pavement was completed a series of precise levels at three points on each side of every expansion joint were taken. The points were situated 4 ft. from each curb and at the center and permanently located by small holes drilled in the steel expansion plates. The initial reading on each joint was accurate to 0.1 mm. and was taken on Oct. 27 and 28, 1916. Subsequent readings were not taken at definite intervals, but when weather conditions indicated that change might be taking place in the subgrade. Eight readings were taken during the 12 months, the last on Oct. 25 and 26, 1917. Coincident with each reading a survey was made of the surface, and all cracks were plotted.

Data on the temperature and rainfall were collected from the United States Weather Bureau station at Chicago, which was nearby. After collecting this mass of data, there being 4176 elevations taken, each requiring three rod readings, much work was necessary to put it in shape that would permit of study. Out of 86 slabs, 56 cracked. Thirty-eight which cracked deflected at one or both points more than $\frac{7}{16}$ in. in the 32-ft. width between outside points, 18 deflected less than $\frac{7}{16}$ in., and of these deflections eight were between $\frac{3}{8}$ in. and $\frac{7}{16}$ in., while four slabs having as great deflection failed to crack. Six of the ten remaining slabs which cracked, having maximum deflection of from $\frac{3}{8}$ to $\frac{3}{16}$ in., evidently cracked from abnormal settlement of a portion of the subgrade below the original level. The cracking of four slabs, with maximum deflections between $\frac{3}{16}$ in. and $\frac{5}{16}$ in., is hard to explain unless the deflection had been greater at some period between readings. Every slab reaching a deflection of more than $\frac{7}{16}$ in. cracked. Therefore, it is safe to assume that such deflection in 32 ft. of width is sufficient to crack any pavement built in accordance with present specifications. It is also evident that even greater deflection than $\frac{7}{16}$ in. can be expected when the subgrade is clay or loam with no other protection than underdraining. From study of the data collected it was shown that practically no longitudinal cracks occurred where the deflection was less than $\frac{11}{32}$ in., and that where the subgrade has a uniform moisture content the deflection would probably never reach this figure, which conclusion is substantiated by those slabs which were over the sand subgrade.

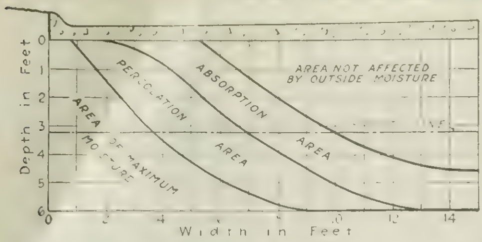


VERTICAL MOVEMENT OF SLABS COMPARED WITH REFERENCE TO RAINFALL AND TEMPERATURE

Thirteen consecutive slabs at the extreme south end of the pavement and on a sand subgrade acted quite differently and more uniformly than the others. The average upward movement was $\frac{7}{16}$ in. on the west side and $1\frac{1}{16}$ in. on the east side, while the center rose $\frac{31}{32}$ in. However, the movements were so uniform that the greatest deflection was $\frac{1}{8}$ in. and no cracking occurred. Unlike the other slabs, there was practically no settlement below the initial reading, the greatest settlement recorded being $\frac{3}{32}$ inch.

The movements of two typical slabs, together with the rainfall and temperature, are shown on the charts. Upon freezing, the sides and centers of these slabs at first began moving up uniformly. During the cold weather considerable snow fell, and then in the first week of January a thaw occurred followed by extremely low temperature for the next eight weeks. In this period, the sides of slab 18 on clay subgrade rose more rapidly than the center until a maximum deflection of $\frac{5}{8}$ in. occurred, while slab 86 on sand subgrade rose only $\frac{6}{10}$ as high, there being practically no deflection. These concrete slabs were exactly alike and precipitation and temperature were the same, the only difference being in the character of the ground on which they lay.

Since the subgrade is of inert material of similar nature, the only difference is in the size of the soil grains. Without going into details, the relation of moisture in soils to their volume depends upon the relative size of these grains. It is permissible to state that the finer



DISTRIBUTION OF MOISTURE PREVAILING IN UNPROTECTED CLAY AND LOAM SUBGRADES

the grains the greater the resistance to passage of water by gravity, the greater the change in volume for a given percentage of water contained and the greater the expansion of the mass due to freezing. This statement is borne out by the movements of slabs 18 and 86 which are shown on the charts, slab 18 being on fine grain material and slab 86 on coarse grain material.

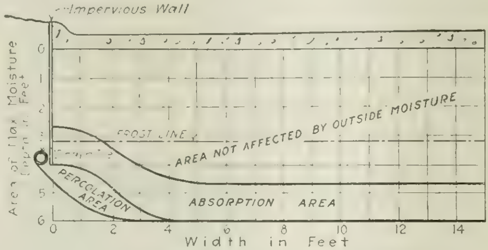
Having the facts, their bearing upon the problem was next considered. The moisture content below the central portion of a pavement will probably never be much less than when the pavement is laid because there is no surface from which it can be evaporated. Since surface water from each side seeps under the pavement, both from static head and the capillary attraction of the soil, the moisture content will vary from an almost uniform degree throughout to a maximum at the sides. Should the soil be compact a uniform condition is not probable at any time, while in sand, which is more porous, the water has less resistance to overcome and reaches a uniform condition quite rapidly. A study of moisture distribution under pavements is shown in an illustration.

Upon freezing, the soil expands in proportion to the moisture contained, and the greater the difference in moisture between the sides and the center, the greater the distortion of the pavement slabs. When a thaw occurs, if the soil is not fully saturated the water sinks and spreads out under the pavement as far as it can go by virtue of head and capillary power. This moisture settles in until it freezes in the voids at some depth where the temperature is still below freezing. In this way an impervious stratum is formed through which the water will not pass. The later seepage is retained above this stratum, and the soil rapidly becomes more water soaked. With the return of colder weather and subsequent freezing of all moisture this subsoil expands, and, being restrained laterally, the pavement is heaved. Naturally, the vertical movement or heaving is greatest at the sides where moisture is at a maximum.

If cracks in pavements are to be eliminated, there are but two general solutions of the problem. One is to overcome by slab design the conditions as they exist; the other to eliminate the condition by controlling the moisture content. The first scheme could no doubt be carried out in several ways, all of which would undoubtedly be expensive. An interesting and possibly less expensive solution is suggested by these experiments.

Variation in moisture can be eliminated by keeping water from percolating under the pavement. Although this is not a new idea, the result desired has not been attained up to the present. Much money has been spent in vain attempts to keep down the water content by the use of drain tile. This has failed simply because the tile do not prevent the water from getting under the pavement, either by pressure or capillary action. If results are to be expected, there must be an impervious underground wall along each side of the pavement, extending down below frost level, and where ground water is present at least 1 ft. lower, to keep capillary water below the frost line. The nearest we have yet come to this type of construction is the old-style 36-in. depth curbing with drain tile laid outside.

A construction that might be as effective and cost less would be a ⅜-in. thickness of continuous jointed or lop-jointed sheets of bituminous material such as is used for pavement joints. This would form an underground wall 4 or 5 ft. deep along each side of the pavement. With 6-in. drain tile laid on a good grade just outside the base, the results that can reasonably be expected in clay or loam are illustrated with this article. The results shown may be compared with those on the other chart, showing the probable conditions of moisture where no impervious wall exists. It is estimated that this wall construction would cost less than $1.25 per lineal foot, and even this might be counterbalanced by decreasing the thickness of the slab and the elimination of reinforcement, which would now be allowable. However, even if the thickness of slab is not decreased, cracks require maintenance, and it is only reasonable to assume that maintenance will increase as pavements become older. If the elimination of cracks would add a small additional life to the pavement, this would represent a saving. If the reduced cost of maintenance and the increased life, when capitalized, should equal or exceed the cost of an impervious wall with tile drain, then such construction is worthy of consideration.



EFFECT OF IMPERVIOUS WALL UPON DISTRIBUTION OF MOISTURE IN SUBGRADES

The investigation is still being conducted on the Kenilworth pavement by Prof. William H. Burger, of the civil engineering college at Northwestern University, who took all the levels mentioned above; also another investigation on Sheridan Road, Winnetka, Ill., and when these are complete further valuable information should be available.

Pennsylvania Railroad Employing More Women

A net gain of 1481 in the number of women employed on the various divisions of the Pennsylvania RR., Eastern lines, was made during the month of June. On May 31 a total of 6873 women were employed in the divisional offices, while on June 30 the figure had increased to 8354. This excludes the general offices in Philadelphia and Pittsburgh, with more than 1000.

Facing Leaky Rock Fill Dam with Timber Planks

After Dam Was Raised 25 Feet, Old Concrete Facing Leaked, So Three Rows of Creosoted Boards Were Placed on Face

BY GEORGE M. BULL
Consulting Civil Engineer, Denver, Colo.

EXTRA pressure on the Cucharas rock-fill dam in Colorado, due to raising the dam after original completion, caused serious leakage through the concrete upstream facing. After consideration of various remedial measures it was decided to pave this face with three layers of creosoted plank to form an impervious barrier. The work was successfully completed recently.

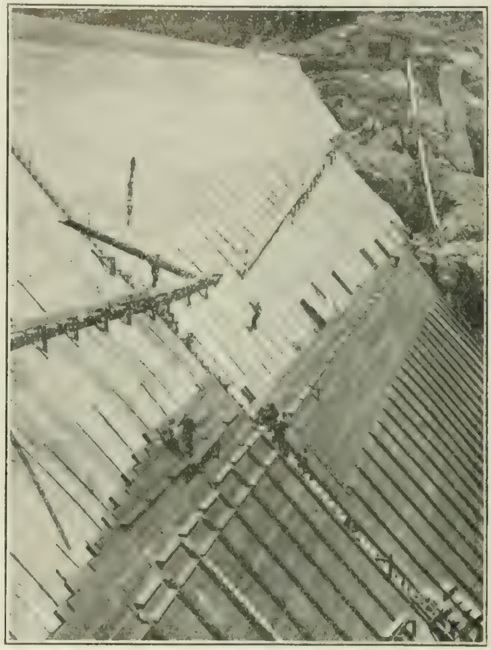
The Cucharas rock-fill dam impounds 44,000 acre-feet of water for irrigation purposes on the Cucharas River about 15 miles below Walsenburg, Colo. It is 125 ft. high, 600 ft. long on the crest and about 250 ft. long on its maximum section at the base. Construction was commenced in 1910 and continued until the structure had reached a height of 100 ft., when owing to the company's lack of funds work was discontinued.

The general type of dam as then constructed consisted of a rock fill, composed of sandstone from the two sides of the canyon, having an inner slope of 1 on 1 and an outer slope of 1 on 1.25. A substantial concrete cutoff wall about 15 ft. in depth was placed across the canyon at the base of the dam, tying the structure to the sandstone bedrock. The water-tight facing consisted of 18 in. of concrete placed in slabs about 8 ft. in width and 10 ft. in height, slightly reinforced by wire, the concrete being backed by about 4 ft. of hand-laid rock. This facing extended to within 5 ft. of the top of the structure as then built and made contact with the solid rock abutment walls on the sides of the canyon, where several thousand yards of waste was deposited over the junction of the concrete and the abutment walls. This facing was not anchored to the cutoff wall across the bottom of the dam except by extending the reinforcing wire into that wall. The solid rock excavation forming this embankment when placed in the fill consisted of about 30% of fine sand and 70% of fairly hard sand rock varying in size from a few inches in the longest dimension to several feet.

In its unfinished condition there was practically no spillway capacity to care for floods, which might reach a maximum of 35,000 sec.ft. for a short period. The outlet was constructed of three 48-in. cast-iron pipes with a concrete base about 1 ft. thick, and with the concrete extending around the pipes for half their height. The entire outlet structure was founded on shale. The controlling gates consisted of three 48-in. Ludlow valves placed on the lower side of the dam with three cast-iron emergency gates at the inlet end.

An examination of the structure by the receiver, after his appointment, showed conclusively that it would be necessary to raise the dam an additional 25 ft., or to a total height of 125 ft., and to construct a spillway to care for flood flow, and also to build a tunnel outlet to take the place of the old outlet so as to insure safe operation of the reservoir. It was not at that time anticipated that the rock fill with its concrete facing and cutoff would prove to be unsafe.

During 1913 the embankment was increased in height to 125 ft. with downstream slope of 1 on 1.5, and a spillway was constructed. The following year the new outlet was built. The first attempt at filling the reservoir demonstrated that the dam was unsafe until the facing had been entirely rebuilt up to the junction of the original facing and that placed above in heightening the dam. As soon as the gates were closed and the water level in the reservoir raised, seepage commenced



PLACING PLANKS ON FACE OF DAM—SLOPING TROUGHS CONVEY GROUT

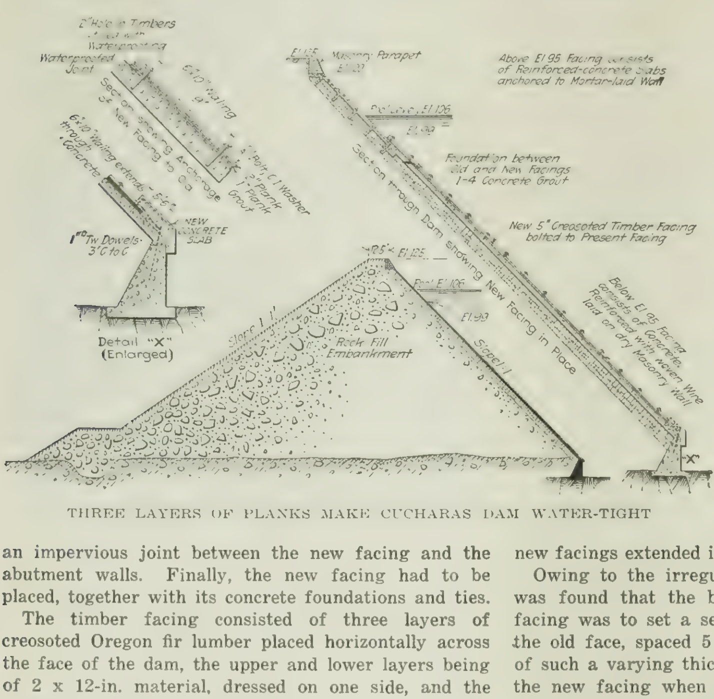
to appear at the lower toe of the dam and when the water surface reached the height of 70 ft. the seepage was 30 sec.ft. A large volume of sand was washed out of the embankment and the structure over the outlet pipes settled 2½ ft. Water was then withdrawn and the water level maintained at a height of not over 50 ft. While 10 or 12 sec.ft. of seepage occurred at that elevation, there was practically no further settlement of the structure.

The general conditions developed indicated that seepage occurred to a greater or less extent in three ways: (1) It was apparent that there was a considerable seepage along the toe of the concrete facing at its junction with the cutoff wall; (2) the various cracks throughout the concrete facing were causing a considerable loss of water; (3) the junction between the concrete facing and the abutment walls at the sides of the dam was not impervious.

Several schemes of reconstruction were considered, in all cases for the purpose of renewing the facing to an elevation of about 100 ft. above the base of the

dam, leaving the upper 25 ft. which was intact in its present condition. These consisted of: (1) A new reinforced-concrete face; (2) a combination of concrete and steel facing, and (3) creosoted timber facing. The high cost of materials during 1916 and 1917 led to the adoption of this latter type of facing.

The plans adopted required the excavation of the silt which had accumulated to a height of some 18 ft. above the base of the dam on the water face in order to expose the junction of the cutoff wall and the concrete facing so that the joint between the two might be repaired and a foundation formed for the timber facing; also the removal of several thousand yards of loose rock and earth at the juncture of the dam and abutment walls in order to expose the joint of the concrete facing and the side walls. Excavation had to be made into the solid rock abutment walls to form an impervious joint between the new facing and the abutment walls. Finally, the new facing had to be placed, together with its concrete foundations and ties.



THREE LAYERS OF PLANKS MAKE CUCHARAS DAM WATER-TIGHT

The timber facing consisted of three layers of creosoted Oregon fir lumber placed horizontally across the face of the dam, the upper and lower layers being of 2 x 12-in. material, dressed on one side, and the middle layer of 1 x 12 in., dressed on one side. All edges were dressed to give uniform widths of material. Between the old concrete facing and the lower layer was placed one thickness of felt waterproofing and between the lower 2-in. plank and the 1-in. plank above were placed two layers of felt waterproofing, treated with a heavy coating of hot bituminous cement between the layers. The planks were thoroughly spiked together and held in place by 6 x 10-in. waling pieces, also creosoted, spaced 9 ft. centers and bolted down every 9 ft. to the original concrete facing. The timber facing was brought to a solid bearing with the original work by grouting in the space between the timber work and the old concrete. In order to provide for the swelling of the lumber when wet ⅜-in. joints were left between the 2-in. planking, with the 1-in. plank laid tight.

Alternate methods were planned for founding and tying the new facing to the existing cutoff wall, the method used to be adopted upon determining the condition of the joint between the old facing and the old cutoff wall.

The placing of all tie bolts in the old facing, placing of the inner plank of the new facing, and grouting of the facing when in place, as well as all trenching in solid rock, was done by force account. The remainder of the work was done under unit prices.

The excavation of the material from the toe of the dam across the bottom for about 250 ft. consisted almost entirely of silt deposit and was excavated by the use of a steam pump delivering about 3 sec.ft. under a pressure that washed the material from place and carried it through the original outlet and down the river. The remainder of the excavation, which consisted of a mixture of rock and earth, was excavated by hand and deposited in spoil banks on the inner side of the dam. On the completion of the excavation exposing the junction of the cutoff wall and the base of the original facing it was found that the entire joint had broken between the two and that a space varying from ¼ in. to 3 in. had opened up along the entire joint. The cutoff wall itself was found to be intact. The joint was repaired by anchoring the new concrete slab into the old concrete of the slab and cutoff wall and thoroughly capping the break between the two. On exposing the joint between the abutment walls and the facing, additional cutoff trenches some 10 ft. deep were excavated and the old and new facings extended into the additional tie.

Owing to the irregularity of the original facing it was found that the best way of placing the timber facing was to set a series of vertical guide planks on the old face, spaced 5 ft. apart, about 4 in. wide and of such a varying thickness as was necessary to bring the new facing when placed to a fairly even surface horizontally, and with such slight changes in slope as were necessary vertically to bring the vertical breaks in slope at the junction of the waling pieces. These guide planks made the average thickness of the grouting between the new and old face not more than 3 in. The bottom layer of felt was placed on this foundation in horizontal strips and the lower planking laid and lightly nailed in place with the expansion joint for swelling. The bottom layer of planking was entirely completed across the dam for a height of 18 ft. on the slope (that is, the length of one waling piece) before the remaining planking was placed.

This work was then followed up by the laying of the remaining waterproofing and two upper layers of planking, during which period the next lift of 18 ft. of lower planking was placed. On the completion of

the three layers of plank for an 18-ft. lift a set of walings was placed across the entire structure and bolted down. The grouting, consisting of one part cement and four parts sand, was then run under the finished planking of an 18-ft. lift. It usually required two separate runs in two days to complete the entire grouting, as it was found that only about 9 ft. could be run without danger of straining the walings.

The placing of the grouting was accomplished by the use of two concrete mixers, one on each side of the dam, with conveying flumes from each side meeting at the center. These flumes were tapped at the required point and the grouting allowed to flow down the face of the dam to place. All timber work used was framed at the end of the dam and delivered by a carrier that operated by gravity and was tripped from the loading point. The average facing placed per day of ten hours was about 2500 ft., board measure, including the loss of time in grouting, changing flumes and doing preparatory work on the face.

The lumber used was No. 1 common Oregon fir, treated with 8 lb. of creosote per cu.ft. The field tests made as to the swelling of this material when thoroughly wet consisted in sawing test pieces from the planking about 8 in. in length and submerging them for several weeks in water which was constantly heated. The greatest swelling that was recorded for 12-in. dressed planking was ⅜ in., varying from that measurement to one-fourth of an inch.

Within three weeks after the completion of the facing the water level in the reservoir stood at 71 ft., which was practically the height of water at which 30 sec.ft. seeped through the original facing. There was practically no seepage that could be measured through the new lumber facing, and the entire flow through the surrounding abutment walls, as near as could be measured, was ¾ sec.ft. The entire cost of the reconstruction was about $42,000. The unit price for timber work was equivalent to $20 per thousand in place; concrete, including cement, $10 per cubic yard; excavation of dry earth, 60c. per cu.yd.; solid rock, $1.50 per cu.yd.; wet excavation, either rock or earth, $3 per cu.yd.; the total amount of force account work, including preparation of the facing and trenching, was about $6000, of which some $3000 was spent on the facing. The total timber used in the face was about 230,000 feet board measure.

The contractors were Smith & McDowell, of Pueblo, Colo.; Thomas Murphy, superintendent. For the company, Charles Barwick, of Denver, was engineering inspector. The writer prepared the plans and supervised the construction, and was indebted to H. T. Cory, consulting engineer, of San Francisco, for many helpful suggestions in connection with the work.

Mexican Labor May Be Imported

Importation of unskilled labor from Mexico, to meet the present shortage, is facilitated, it is believed, by an order from the Secretary of Labor which removes temporarily the head tax, literacy test and contract-labor regulations imposed under the immigration act. This applies only to labor for railway maintenance, farming and mining work. No aliens will be admitted under this new ruling unless arrangements for their employment have been made.

Equivalent Uniform Loads for Indeterminate Structures

Method Worked Out for Ordinary Trusses Applied To Curved Influence Lines—Wheel-Load Complications Avoided

BY D. B. STEINMAN
New York City

WHEN live-load stresses in arches, continuous bridges or suspension structures are calculated by use of equivalent uniform loads, an undetermined error is involved if the same load values are employed as for simple truss bridges. In several practical cases this error has been found to be negligible, but this fact does not give assurance against large error in other cases.

The writer therefore has made a special study of the matter, and finds that the error is rarely greater than 2%, and where it does pass this limit a correction factor is easily applied. The results of this study are given below in condensed form.

For simple, determinate structures, all influence lines are rectilinear, and the influence area for any particular stress is usually a simple triangle (Fig. 1). In such case the equivalent uniform load (for a given locomotive loading) depends only upon the horizontal lengths, l_1 and l_2, of the two segments of the influence triangle. This principle constituted the basis of the chart of equivalent uniform loads published in *Engineering News* of Apr. 22, 1915, p. 780.

Typical influence diagrams for arches and continuous bridges (Figs. 2 and 3) show influence areas of two kinds—the segment type, Fig. 4, and the combination type, combining segment and triangle elements, Fig. 5. In each case the curved segment may with sufficient accuracy for the following discussion be assumed a parabolic curve.

LOAD-POSITION FOR PARABOLIC INFLUENCE LINES

For maximum stress where the influence line is a parabola, it is easily proved that the center of gravity (R) of the loading must come directly over the middle ordinate of the curve (Fig. 7). Accordingly, in the case of the conventional (Cooper's) engine loading, it is found that the load-position for maximum stress is given by advancing the train until the head of the uniform load is at

$$u = l_1 + 142 + 3800 \div l_1^2 \qquad (1)$$

from the left end of the span. This formula cannot be used for values of l_1 less than 57 ft., as in such case the uniform load does not enter the span. A simplified substitute for the above formula, giving correct results if l_1 is greater than 80 ft., is

$$u = 142 + 1800 / l_1$$

In the case of a triangular influence area, of sufficient length to admit the head of the uniform load, the value of u for maximum stress is always 142 ft. Hence the second term in the preceding equation shows the additional distance the entire train load must be advanced because of the curvature of the influence line.

LIVE-LOAD STRESS WITH PARABOLIC INFLUENCE LINE

A train of concentrations produces the stress $S = \Sigma P y$, where y is the ordinate of the influence diagram under each concentration P. If the influence line is

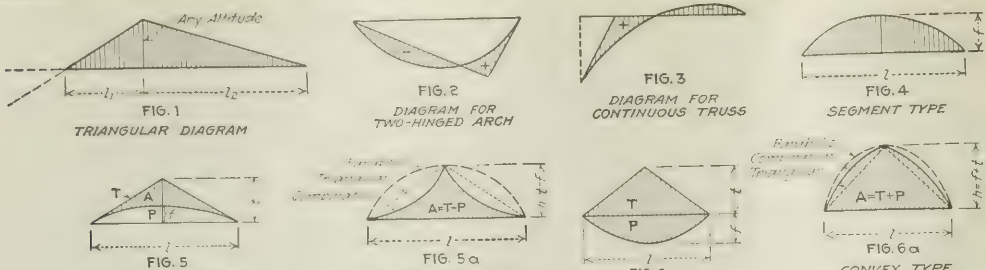


FIG. 1 TRIANGULAR DIAGRAM

FIG. 2 DIAGRAM FOR TWO-HINGED ARCH

FIG. 3 DIAGRAM FOR CONTINUOUS TRUSS

FIG. 4 SEGMENT TYPE

FIG. 5 COMBINATION TYPE

FIG. 5a COMBINATION TYPE RE-PLOTTED

FIG. 6 CONVEX TYPE

FIG. 6a CONVEX TYPE RE-PLOTTED

DIFFERENT FORMS OF INFLUENCE AREA FOR WHICH EQUIVALENT UNIFORM LOADS DIFFER

straight, the loads may be replaced by their resultant R, and the stress will be $S = RY$, where Y is the ordinate under R, *i.e.*, under the center of gravity of the applied loads.

In the case of the curved influence line, the loading may likewise be replaced by its resultant, R, provided a proper correction term is deducted. This correction term depends upon the deviation of the curve from the tangent at R. If the influence line is a parabola (Fig. 7), we thus obtain the following expression for the stress:

$$S = \Sigma Py = RY - \frac{4f}{l^2}\Sigma Pa^2$$

where a is the respective distance of each concentration (or load element) P from the resultant R. The less scattered the loads, the less will be the resulting reduction of stress represented by the last term in the above expression.

It should be noted that this correction term is a constant for varying positions of the train of concentrations, so that the stress S will vary only with the term RY. Consequently S will be a maximum when Y has its maximum value f. When this occurs, the equation reduces to

$$\text{Maximum } S = f\,(R - 4\,\Sigma Pa^2/l^2)$$

Equivalent Uniform Loads for Parabolic Influence Lines

Dividing this expression for maximum stress by the area of the parabolic influence segment, $\frac{2}{3}\,f\,l$, we obtain a general expression for the equivalent uniform load:

$$q = \frac{3}{2l}\left(R - \frac{4}{l^2}\Sigma Pa^2\right) \qquad (2)$$

Applying Cooper's E 60 loading in the position prescribed by eq. (1), and substituting the resulting values of R and $\Sigma\,P\,a^2$ in eq. (2), there results the following formula for equivalent load:

$$q = 3000 + \left(\frac{1920}{l}\right)^2 + 24{,}000\left(\frac{m}{l}\right)^2$$

where $m = \sqrt{3800 + l_1^2}$ and $l = 2\,l_1$. This expression is exact for any value of l greater than 114 ft. ($l_1 > 57$).

Although the above formulas for q have been derived on the assumption that the curve is a parabola, there will be no sensible error in applying them to any other segmental influence lines; any minor variations in curvature are automatically taken care of in multiplying q by the included area.

The figures of Table 1 show that for any length exceeding 90 ft. the maximum difference between the equivalent uniform loads for triangular and segmental influence lines is 2%. Above 225 ft. the maximum difference is less than 1%. That the differences are very small is still better shown by the graphs of the equivalent-load formulas, Fig. 8.

TABLE I. EQUIVALENT UNIFORM LOADS FOR E60 LOADING

Length	Pounds per Track: Segmental Influence Area	Triangular Influence Area	Ratio
20	12,390	12,390	100%
40	9,250	9,850	94
60	8,130	8,660	94
80	7,780	8,100	96
90	7,660	7,920	98
100	7,790	7,650	102 0
110	7,810	7,660	101 9
120	7,780	7,680	101 1
130	7,650	7,650	100.0
140	7,530	7,590	99.4
160	7,320	7,460	98 1
200	7,025	7,140	98.5
300	6,530	6,510	100 3
400	6,340	6,290	100 9
600	6,150	6,128	100 4
800	6,090	6,072	100.3
1,000	6,050	6,046	100 1

The small magnitude of the differences suggests the desirability of the following method for treating curved influence lines: Use the equivalent uniform load given (by chart or formula) for ordinary triangular influence lines, and apply a small percentage correction to be obtained by interpolation from the foregoing comparison table or diagram. Thus, for $l = 500$ the ordinary value of q is 6185; adding a correction of 0.65%, as

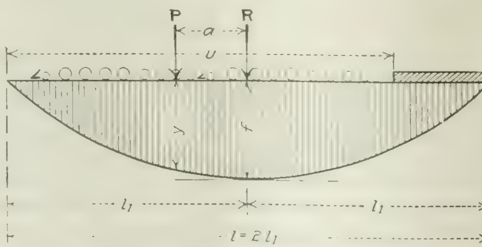


FIG. 7 TRAIN LOAD AND PARABOLIC INFLUENCE AREA

read from the table, we obtain 6225 as the equivalent uniform load for a segmental influence line.

It should be noted that the length l does not necessarily represent the span, but merely the horizontal length of the particular influence area under consideration.

A combination influence area (Fig. 5) may be re-

garded as the difference between a triangle of altitude t and a parabola of height f. If the ordinates are replotted on a straight-line base, there results a diagram of the form shown in Fig. 5a. Since the sides in this case are concave, instead of convex as in the parabolic influence line, the variation from the standard triangular influence diagram is reversed in direction, and the percentage corrections to be applied to the standard values of q are consequently changed in sign. This

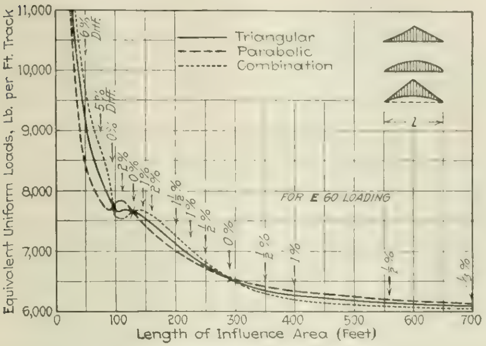


FIG. 8. EQUIVALENT UNIFORM LOADS FOR THREE TYPES OF INFLUENCE AREA

reversed relationship is indicated by the relative positions of the two dotted graphs in Fig. 8, representing combination and parabolic influence lines, respectively.

If we denote the parabolic percentage correction by p, and the corresponding correction for the combination influence line by c, it may be shown that the correction c is equal to minus p multiplied by the ratio of the parabolic area (P) to the combination area (A). The following values of c result for different values of the height-ratio (Fig. 5): For $f = \frac{1}{8}t$, $c = -\frac{1}{3}p$; $f = \frac{1}{4}t$, $c = -\frac{1}{2}p$; $f = \frac{3}{8}t$, $c = -p$; $f = \frac{1}{2}t$, $c = -2p$.

The last ratio is the limiting case, so that the departure from the basic equivalent uniform load can never exceed twice the amount of the percentage correction (p) determined above for segmental influence lines.

With the relations just established, we may construct the tabulation (Table II) to give, by interpolation, the percentage correction to q for any parabolic or combination influence diagram.

Another form of combination diagram, usually occurring in connection with the influence lines for web members of indeterminate structures, is represented in Fig. 6. Replotted on a straight-line base, Fig. 6a, it is seen to be intermediate between the triangle and the parabola.

For this case it may be shown, by the same reasoning as before, that, for $f = \frac{1}{8}t$, $c = \frac{1}{7}p$; $f = \frac{1}{4}t$, $c = \frac{1}{4}p$; $f = \frac{3}{8}t$, $c = \frac{1}{3}p$; $f = \frac{1}{2}t$, $c = \frac{2}{3}p$. These fractions of p represent corrections so small that they may, as a rule, be safely neglected. If desired, however, a table of corrections similar to Table II may be constructed.

The foregoing discussion and results indicate that it is usually safe to ignore the curvature of influence diagrams, and simply to apply the equivalent uniform load values established for straight influence lines. The

TABLE II. PERCENTAGE CORRECTIONS TO EQUIVALENT UNIFORM LOADS

Corrections to be added to equivalent uniform loads established for triangular influence lines in order that they may apply to segmental and combination influence diagrams

Length	Segmental Diagram	Combination Diagrams $f = \frac{1}{8}t$	$f = \frac{1}{4}t$	$f = \frac{3}{8}t$	$f = \frac{1}{2}t$
95					
100	+2.0	-0.4	1.0	—2.0	—4.0
120	+1.1	—0.2	—0.6	—1.1	—2.2
130					
160	—1.9	+0.4	+0.9	+1.9	+3.8
200	—1.5	+0.3	+0.8	+1.5	+3.0
250	0.6	+0.1	+0.3	+0.6	+1.2
300	+0.3	—0.1	—0.1	—0.3	—0.6
350	+0.6	—0.1	—0.3	—0.6	—1.2
400	+0.9	—0.2	—0.5	—0.9	—1.8
500	+0.6	—0.1	—0.3	—0.6	—1.2
600	+0.4	—0.1	—0.2	—0.4	—0.8
800	+0.3	—0.1	—0.1	—0.3	0.6
1000	+0.1	—0.0	—0.0	—0.1	—0.2

resulting errors in the stresses will generally be less than 2%. In special cases, however, the error may be considerably greater, especially for lengths under 100 ft., where it may amount to as much as 12 per cent.

Where it is desired to eliminate all uncertainty from the results, the method of correction percentages given in this article will enable the exact stresses to be obtained within a small fraction of 1%, while retaining the advantages of employing equivalent uniform loads.

Limit Truck Capacity or Build Better Roads

Discussion in "Public Roads" by State Highway Officials Shows Present Construction Inadequate for Traffic

THAT the demand of motor traffic has exceeded the carrying capacity of our present roads, and that immediate means must be taken to limit loads, if the investment in our highways is to be saved, is the consensus of opinion of several highway officials as expressed in the June issue of *Public Roads*. The various means suggested for controlling traffic are divided between directly limiting the load and making license fees so high for the larger trucks that the same result will be accomplished. The following is a summary of the views of Edwin Duffey, commissioner of highways of New York State; J. N. Mackall, chief engineer of the Maryland State Roads Commission; William D. Sohier, chairman of the Massachusetts State Highway Commission; C. J. Bennett, highway commissioner of Connecticut; Charles M. Upham, state highway engineer of Delaware; and W. G. Thompson, state highway engineer of New Jersey.

Experience of Highway Departments with Motor Traffic

That the experience of the various highway departments with motor traffic has been painful was shown by numerous illustrations, picturing roads in practically impassable condition. These were roads which had been built during the past ten years at considerable expense, and whose designers had never contemplated the possibility of their carrying the tremendous loads to which they have now been subjected. Roads in New York State, built ten years ago for from $10,000 to

$11,000 per mile, having been subjected to a traffic of thirty 7-ton trucks per day can be repaired only at a cost of from $20,000 to $30,000 per mile at present prices. Roads in Maryland, where the quality of construction has been constantly improved for the past ten years, until 6-in. concrete pavements are being used, show serious damage; even the higher concrete types are suffering. Massachusetts has 2600 miles of main roads, including state, municipal and town roads, which in 1908 cost $100 a mile to maintain. In 1910, due to motor traffic, the maintenance had increased to $300 a mile per year; and now with $2,000,000, or $770 per mile per year, to spend, the state found it necessary during the past year to expend $1,250,000 extra for resurfacing. Indications for the present year point to repair costs from 50 to 100% greater than normal, and if through routes are to be used for heavy motor freight traffic, 100% will be a low estimate.

Most Trouble in the Spring

The greatest trouble due to the motor traffic occurs in the spring, according to reports from Connecticut. One water-bound macadam road, surfaced with 7 in. of trap rock and treated with coal oil, was shown to be practically ruined. The increase in motor truck traffic upon this route in three years was from zero to 200 five-ton trucks per day. Roads of this character are not built for such heavy traffic. When it occurs, particularly in the spring, they are rapidly destroyed. The damage that can be done by only one truck was shown by an experience in Delaware. The state has many miles of water-bound macadam roads which were partly worn out and which were resurfaced with bituminous material. The base of these roads, due to the previous wear, is light and easily destroyed by heavy load concentrations. The instance referred to was one in which a manufacturer in the neighborhood of Wilmington purchased a 5-ton truck for transportation between his plant and the city. This truck, having a gross load of about 11 tons, and making regular trips, very soon broke through the more direct road into the city and changed its route to a parallel road. The parallel road was of light construction but had given good results for several years. A single trip of this truck in the spring of the year put the road in such bad condition that it was impassable for ordinary traffic.

The experience of New Jersey was stated by Mr. Thompson in the following words: "When it is said that New Jersey highways suffered greater damage during the past eight months than during the preceding two years, the statement is hardly exaggerated, as roads which for several years presented very good surfaces became almost impassable under the unprecedented weather and traffic conditions last winter."

The great investment in the highway system of the country is in danger of being partially if not wholly lost, unless immediate steps are taken to remedy the present conditions. Mr. Duffey pointed out that New York State has $140,000,000 invested in highways, and he insisted that this "must be preserved for the many and not destroyed by the few." Even with the present traffic, large amounts of this original investment are being lost, to say nothing about the tremendous economic loss to the state, due to having these roads closed for resurfacing and, in many cases, for reconstruction. That these conditions are considerably aggravated by the difficulty in obtaining bituminous and other materials for repairs, was brought out by Mr. Sohier. Furthermore, the lack of bituminous road oils is having an indirect effect because of dust damage to the crops, particularly the hay crop. The general situation was summed up by Mr. Upham when he said, "The passenger autos demanded that the roads be improved; the trucks are demanding not only improved roads, but pavements of tremendous strength. This means that thousands of miles of the present roads are not strong enough to withstand the heavy auto trucks, and a large part of the vast amount invested in roads today will be lost unless conditions are modified."

An Equitable Solution Desired

What can be done, equitably, to meet the repair bills and insure highways capable of carrying the growing burden, was the evident question in the minds of all the writers. There was a desire to be fair to the motor truck, but at the same time to safeguard the interests of the public. "It is hardly reasonable," said Mr. Mackall, "to expect that a very few individuals, who profit by the use of large heavy trucks, should be permitted to destroy the roads which would ordinarily be used by an infinitely greater number of truck and pleasure vehicle owners, who desire and have a right to use the roads." However, as was pointed out by Mr. Upham, the motor truck, which has been developed during abnormal times, has solved an economic problem, and this solution assures us that not only for the period of the war, but afterward, the use of heavy trucks for transporting freight and express will continue to expand. It was Mr. Thompson's opinion that the weight and dimensions of trucks should be regulated to a point consistent with the ability of the several states to provide highways and bridges strong enough to accommodate them, but at the same time he emphasized the necessity of meeting the present transportation crisis from a patriotic standpoint.

Remedies Proposed to Control the Situation

"There are two remedies for this ill; first, the restriction of the weight of trucks and the stopping of truck traffic when the damage is greatest; and second, the construction of roads sufficiently strong to carry reasonable loads." These are the alternatives as expressed by Mr. Bennett, and the ideas of those who favor the limiting of capacity were expressed by Mr. Duffey when he stated that a reasonable limit upon a properly distributed total load must be placed, and that there should be, if possible, a limit that would remain unchanged for a number of years. It is essential, if highway building is to proceed along scientific and rational lines, that highway engineers be furnished with the total maximum load and the kind of load which must be provided for during the useful life of the construction. It is safe to say that roads already constructed will carry 3-ton trucks. With heavy expenditure, which still would not be beyond control, they could be placed in condition to carry 5-ton trucks. Many believe that the 3-ton truck would answer every requirement of modern traffic, and it would seem, if the Government's war re-

quirements can be met by the 5-ton truck, that this capacity should be ample for use in times of peace.

The impossibility of collecting fees large enough to pay for the damage done to macadam roads by the heavy trucks was brought out by some of the writers. Experience in England, as well as in our own country, has shown conclusively that the cost of maintaining water-bound macadam roads, even when the surface has had a bituminous treatment, has always been ½c. per ton mile, and quite often it has been 1½c. per ton mile. At the average rate of one cent, even a 1-ton truck, making 60 miles per day, for 300 days in the year, would wear the pavement to the extent of $180. A 5-ton truck, at the same rate, would wear the pavement to the extent of $900. The impossibility of collecting such fees from trucks is asserted as being beyond argument.

Of those states which favor restricting the size of truck by large fees, the State of Maryland is the most striking example. This state has a regularly graduated scale, starting with pleasure vehicles at 60c. per horsepower; 1-, 2- and 3-ton trucks, $20 per ton, per year; 4-ton trucks, $100 per year; 5-ton trucks $150 per year; 6-ton trucks, $300 per year; and 7-ton trucks, $500 per year. It is not known whether this scale is too high or too low; it was tried to determine the proper charges by experiment. Massachusetts charges a license fee of $5 for the first ton and $3 for each additional ton. Connecticut restricts the sizes of loads to 25,000 lb. on four wheels.

In Delaware, previous to 1915, license fees for 20-ton trucks would have been the same as for motorcycles; but recently a law has been passed which makes the license fee proportional to the tonnage. It was pointed out, however, that the tonnage is not the proper basis, inasmuch as a 20-ton truck would do infinitely more damage than 20 one-ton trucks. Among the states represented New Jersey allows the heaviest load. Its law limits the maximum width over all to 90 in., the maximum height to 12 ft. 2 in., the maximum length to 26½ ft. and maximum weight to 30,000 lb. Only one trailer is allowed for each motor truck. There was general agreement that some limit should be placed upon the size of trucks, 5 tons capacity being favored by most as the upper limit.

Miles Acid Process May Require Aeration of Effluent

New Haven Experiments Show That Sulphur Dioxide in Effluent Deoxygenates Several Volumes of Diluting Water

By F. W. Mohlman

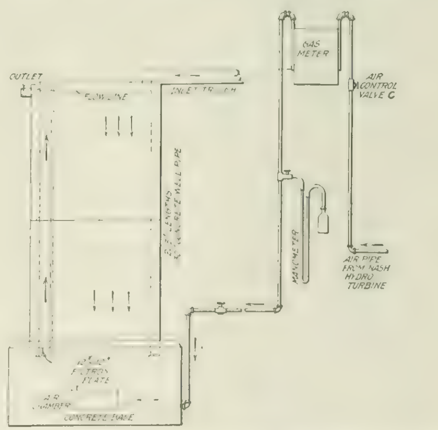
With Engineering Division, Connecticut State Board of Health, New Haven, Conn.; formerly connected with experiments here described

EXPERIMENTS with the Miles acid process of sewage treatment were conducted at the New Haven sewage experiment station, under the direction of Prof. C.-E. A. Winslow, from June 1, 1917, until May 1, 1918, in comparison with three other processes which have been considered for New Haven conditions. (*Engineering News-Record* of Nov. 1, 1917, p. 829.) Some very interesting facts regarding this process were established during this work. The most notable of these are that the effluent from the process has a large deoxygenating effect and that this may be overcome by a moderate amount of aeration.

The Miles patent (No. 134,280) asserts that the Miles process "1, consists in introducing . . . an inorganic acid as the sole effective agent" . . . and "3, consists in introducing sulphurous acid into the sewage."

Sulphurous acid seems to have a selective toxic action on bacteria which is more intense than is obtained with the same hydrogen-ion concentration of sulphuric acid. The effect of the sulphurous acid is augmented by the germicidal power of the bisulphites formed from the bicarbonates. Therefore, from the standpoint of effective disinfection, sulphurous acid is preferable to sulphuric. It also has the decided advantage of being cheaper, when made as needed by burning sulphur or pyrites, and conducting the gas into a part of the sewage, which can then be used for acidifying the remaining sewage.

We have applied compressed sulphur dioxide to the sewage as it flowed into a settling tank through a galvanized-iron pipe about 20 ft. long. The settling tank was 16 ft. long, 4 ft. wide and 4 ft. deep. The detention period was four hours when 10,000 gal. of sewage per day were treated. After acidification the sewage contains bisulphites and some free sulphurous acid. It also contains lime and magnesium soaps, which are attacked by the acid, liberating the free fatty acids. As the sewage passes through the tank, part of the bi-



EFFLUENT FROM MILES PROCESS WAS AERATED IN TANK

sulphites and sulphurous acid are oxidized to bisulphates and sulphuric acid. The oxidation may easily be followed by determining total SO_2 in both bisulphates and sulphurous acid by titration with thiosulphate against an excess of iodine solution.

Preliminary tests made on Feb. 14, 1918, showed a total content of 118 p.p.m. of sulphur dioxide in the effluent. In order to determine whether this sulphur dioxide would use up the dissolved oxygen in the dilut-

ing water if it were discharged into New Haven harbor, various mixtures of the effluent with sea water from New Haven harbor were made. No especial care was taken to exclude atmospheric oxygen during the mixing. As soon as possible after dilution, dissolved oxygen and sulphur dioxide were determined in the mixtures. The results shown in Table I were obtained.

TABLE I. MIXTURE OF SEA WATER AND MILES EFFLUENT

	Effluent	Sea Water	1 Eff. to 2 Water	1 Eff. to 4 Water	1 Eff. to 9 Water	1 Eff. to 19 Water
Dissolved oxygen	0.8	12.0	1.0	5.0	8.8	11.0
Sulphur dioxide	118	0	8	[illegible]	6	0

A great decrease in the dissolved oxygen took place in the dilutions containing 20% or more of the effluent. Further experiments showed that one part of oxygen would be required for four parts of sulphur dioxide in the effluent, according to the reaction $SO_2 + O = SO_3$.

The Miles effluent in our experiments usually contained from 80 to 120 p.p.m. of sulphur dioxide. The alkalinity of the sewage treated was unusually low, averaging but 50 p.p.m., so that a relatively small quantity of sulphur dioxide was required. But even with this small amount of SO_2, averaging 100 p.p.m., 25 p.p.m. of dissolved oxygen will be reduced, or, in terms of dilutions at summer temperatures, one volume of effluent will immediately reduce *all* of the oxygen in 3 to 4 volumes of sea water. The average sewage would require probably twice as much SO_2 as the sewage which we treated, and the effluent would deaërate twice as much water, or 6 to 8 volumes. It is not improbable that there might be a distinct zone of deaërated water at the outfall of the effluent from the Miles process.

In order to determine whether the sulphur dioxide might be oxidized before the effluent is discharged, an aërating tank (see drawing) was constructed by Harold G. Wynne, of the city engineer's office, who assisted in the experimental work. The tank was used both on the fill-and-draw and continuous plan. When used intermittently it was filled with effluent and the air started, samples being withdrawn at intervals and analyzed for sulphur dioxide, the quantity of air being measured at the time each sample was withdrawn. Results of an average experiment of this kind are given in Table II.

TABLE II. AËRATION OF MILES EFFLUENT, MARCH 4, 1918

Quantity of effluent 220 gallons
Quantity of air 21.0 cu.ft. at 6.4 in. mercury
Quantity of free air 25.5 cu.ft.

Time, Min.	SO_2, P.P.M.	Reduction, %	Air per Gal., Cu.Ft.
0	78.1		
10	71.7	8	0.029
20	53.8	31	0.058
30	23.0	70	0.087
40	10.2	87	0.116

Effluent mixed with sea water, before and after aëration, dissolved oxygen determined immediately

Sample	Dissolved Oxygen Before Aëration	Dissolved Oxygen After Aëration
Effluent	1.4	5.8
Sea water	14.2	
1 effluent to 2 sea water	4.4	11.8
1 effluent to 4 sea water	7.4	11.8

The results of this experiment have been substantiated by various other experiments on the fill-and-draw plan. The tank was next used as an aërator on the continuous-flow plan. The effluent from the Miles tank was passed through the tank as shown in the cut, having a detention period of 31 min. Samples of the influent were taken at 3 and 9 a.m. and p.m., and of the effluent 30 min. later. The average results of these experiments are shown in Table III.

TABLE III. CONTINUOUS AERATION OF MILES EFFLUENT

Date	Sulphur Dioxide, P.P.M. Influent	Sulphur Dioxide, P.P.M. Effluent	Reduction, %	Air per Gal. Cu.Ft.
March 6, '18	99.1	44.9	54	0.10
March 7, '18	70.4	14.4	79	0.10
March 8, '18	72.3	14.4	80	0.11
March 9, '18	69.1	5.2	92	0.10
March 10, '18	81.3	46.4	43	0.10
March 11, '18	80.9	36.1	55	0.06
March 31, '18	53.8	10.2	81	0.10
Apr. 1, '18	108.5	37.4	65	0.10
Apr. 2, '18	90.9	26.5	71	0.10
Apr. 3, '18	71.0	19.8	72	0.10
Apr. 4, '18	92.2	4.5	95	0.10
Average	78.1	23.6	70	0.097

These results are quite similar to those obtained on the fill-and-draw plan, with 30 min. aëration, except that slightly more air is necessary. The close agreement in SO_2 content in the effluent is accidental. In each method 70% of the SO_2 was removed in 30 min. aëration, but with 97,000 cu.ft. of free air per 1,000,000 gal. of effluent when operating continuously, as compared with 87,000 cu.ft. on the fill-and-draw plan.

The aërated effluents did not deaërate the diluting water to an appreciable amount at any time, and thus could be discharged into the harbor with safety. Bacterial counts made by W. S. Sturges before and after the aëration showed that there was practically no change in the bacterial content.

Division of Air Affects Oxidation

Laboratory experiments in which wood plates were used for diffusing the air indicated that the amount of air required could be reduced considerably by diffusing the air very finely. This experience is similar to that found in the activated-sludge experiments at Milwaukee, but it is probable that this oxidation, which is purely chemical, is even more affected by the fineness of division of the air than is the oxidation in the activated-sludge process, which is biological. The quantities of air used in the experiments with the filtros diffusor were from one-fifteenth to one-twentieth of those used in the aëration of the same sewage with activated sludge, so it is probable that the cost of this aëration would be low. The tank used for the aëration was too shallow to be very efficient, and it is believed that the results obtained in these experiments could be greatly improved by further work. While this aëration would make a Miles plant more complicated and the process more costly, it does not necessarily condemn the process, as the aëration period is very short and the amounts of air necessary but a small fraction of those required in the activated-sludge process.

Conclusions

(1) The Miles acid effluent contains unoxidized sulphur dioxide. (2) This sulphur dioxide is oxidized at the expense of the dissolved oxygen in the water in which the effluent is diluted. (3) The sulphur dioxide may be oxidized before dilution by aëration for a short time with relatively small quantities of air. After this aëration the effluent will not deaërate large volumes of diluting water.

Water Company Wins Imperial Valley Seepage Case

Court Holds Raising of Water Table and Damage to Land Adjoining Canal in Sand Not Chargeable to Irrigation Company

A DECISION recently handed down by Judge Franklin J. Cole of the county superior court in Imperial Valley, California, which is considered of great importance to irrigation interests throughout the west, held that an operating company was not responsible for damage through alleged raising of the ground water by seepage from its canal. Noted authorities have been retained in the case, and much evidence of a highly technical character on the subject of ground water flow has been submitted. The high degree of interest attaches to it because this has been a test case and, had a contrary decision been rendered, and sustained by higher courts, hundreds of similar claims would have been filed. The damages involved in such procedure would reach a total sufficient to require assessments on a large portion of the irrigated lands in the valley.

Canal Sole Source of Supply

The test case was brought by land holders on the extreme eastern frontier of cultivation in the valley, against the mutual water companies operating the East High Line Canal. This canal is the sole source of supply in this district, and it was by means of it that the plaintiffs' land was reclaimed from its original desert condition. Plaintiffs asserted that the canal in question was built through a sandy territory of the native soil, and with a grade that kept its channel scoured, thereby forfeiting the protection of the impervious silt deposit which forms the lining of many of the valley canals and acts as an inner seal. As proof of these claims the plaintiffs presented to the court the results of experimental test holes in the damaged land, and near the canal which adjoined it. These results showed that the water in the test holes reflected the rise and fall of water level in the canal, and within a very few hours afterward. To support further their contentions that the scouring of the canal channel increased the rate of seepage, the plaintiffs gave results obtained from experiments with soil samples taken from the inner banks of the East High Line Canal and from other canals where it was agreed that seepage did not occur. Based on these samples effort was made to show that water would seep much more readily from the East High Line Canal than from other canals of the valley.

The burden of proof upon the defendants was heavy, for the plaintiffs' land is undoubtedly water-logged, and its immediate proximity to a canal constructed through sandy soil would at first glance win over a casual observer. The defendants, however, endeavored to establish:

First, that before the canal was built, and while adjoining land was still arid desert, there were occasions when heavy rains in the nearby highlands to the east and north caused large damp areas in the lower lands. This was caused, it was asserted, by the natural ground water escaping to the west, and the existence of large alkali patches, it being a well established fact that the presence of alkali in soil results in a capillary attraction which brings ground water nearer the surface.

Second, that the canal in question was constructed according to the best engineering practice as to location, grade and section, and that it would be impracticable to construct it of any material other than the natural soil. While it was admitted that silt did not deposit in the canal to the extent that it did in other canals, still the seepage through the sandy banks would soon seal them, defendants said. To substantiate this contention, evidence was introduced showing that the same water, even when partially settled, as in the case of the water filtration plant of the City of Calexico, would seal the sand in a slow sand filter if the sand were not cleaned often enough and to sufficient depth.

Third, that excessive irrigation, without systems of drainage canals, was rapidly raising the original ground water table under the land in question as well as in many other parts of the valley, and it was the ground water which was directly the cause of the damage.

Authorities on the flow of ground water were quoted to show that if the water level in the canal had any direct bearing on the depth of water in the test holes, the time required for the canal fluctuations to register in the test holes would be days and weeks, instead of hours as asserted by the plaintiffs. It was contended that a flow of ground water as rapid as the plaintiffs' experiments indicated would result in a veritable flooding of the country. Experiments were also performed by the defendants to show that samples could be so picked from the inner banks of various canals that almost any result could be obtained.

As a mainstay of the defense the theory was advanced that the only value which the land in question ever had was to be credited to the present situation of the canal. Without the canal the land would still be arid desert. Building the canal of other material than the natural soil was prohibitive. If the land was so situated and contained, as it did, certain inherent salts, then if the only feasible canal had destroyed the value the canal itself had created it was incumbent upon the land to suffer the damage.

Irrigation Service by Mutual Companies

The 500,000 acres under canals of this irrigation system are divided into several sections, each served by a mutual water company. These companies own and maintain their own distributing canals and retail the water to the ranchers. A land owner in any section is a stockholder in the water company, to which he pays a prescribed amount for water, plus a periodical assessment to pay the cost of maintining the mutual water company's properties and retailing the water. These companies buy water from the parent concern, the Imperial Irrigation District, a municipal corporation organized along the lines of the county government. It maintains the main canal system and flood protection levees. Thus, a suit against a mutual company is not an action against a public service corporation but is a suit against a community of ranchers taken collectively.

The question of liability of an organization such as a mutual water company in the case of damage to desert lands whose value was created by the construc-

tion of the canal causing the alleged damage is believed to be new. If the plaintiffs win in higher courts it is believed to mean that all lands in the Imperial Valley suffering from rising ground water, whether caused by alkali, insufficient drainage or canal seepage, may demand of the other lands the cash difference in value between them.

Engineering Salaries Adjusted to Cost of Living

Monthly Bonuses Paid in Cuyahoga County, Ohio, in Accordance with Variations in Six Groups of Family Expenses

By W. A. Stinchcomb
Engineer of Cuyahoga County, Cleveland, Ohio

Employees of the engineering department of Cuyahoga County, Ohio, who are on the monthly payroll now receive a bonus which is fixed as nearly as we can determine it in accordance with fluctuations in the living expenses of the ordinary family, grouped under (1) food; (2) clothing, including shoes; (3) fuel and light; (4) rent; (5) miscellaneous; (6) savings.

In our department the salaried employees range in wages from about \$1000 to \$3600 per year. It was quite apparent that it would not be fair to pay bonuses on the same index to all the men, for it was easily seen that in the case of the employee with a small salary the percentage which he would spend for food would be greatly in excess of that which the higher salaried man would expend for the same commodity. Accordingly, a questionnaire was prepared, and each employee was asked to state anonymously the percentage of his income which he spent for the before-mentioned items. Employees were grouped in three classes (see table).

TABLE I. PERCENTAGE DISTRIBUTION OF LIVING EXPENSES AND SAVINGS FOR THREE CLASSES OF SALARIES

	Class A Less than \$1,600	Class B \$1,600 to \$2,400	Class C Above \$2,400
Food	38%	37%	24%
Clothing and shoes	15%	14%	12%
Fuel and light	5%	6%	3%
Rent	21%	21%	14%
Miscellaneous	13%	12%	27%
Savings	8%	10%	20%

The apparent discrepancies in Class C are attributed to the small number in that class.

Having determined approximately the percentages of income which were being spent under the various headings, the next difficulty arose in attempting to find some authentic information which would give comparative prices, from month to month, which might be grouped under the various commodity headings. The Department of Labor gathers statistics along this line, but its publications are given out too long after the current month to make useful the application of the information. Accordingly, I went to Bradstreets, and we are using Bradstreet prices, modified to a certain extent, as a basis.

We are making our comparison as of Jan. 1, 1917. In the cases of fuel and light, corrections had to be made in order to fit local conditions, because in this city a great deal of heat used is obtained from natural gas, and there has been no variation in price during the period covered. So, as with light, a fixed price is maintained for illuminating service. It was necessary again to divide the item of average fuel and light into two classes: gas and electricity, and coal. Information with reference to the average increase in rents was obtained from the Real Estate Board of this city. In order to determine "Miscellaneous" certain classifications in Bradstreets were used; namely, metals, building material, drugs, chemicals and miscellaneous. An investigation disclosed the fact that under the heading "Miscellaneous" the employees had certain fixed expenses which present economic conditions had not changed, among which might be mentioned insurance, both life and fire, forming in some cases a considerable portion of a miscellaneeous item. Also transportation, which until the past month or so has not been affected. It was found that these constants amounted to about 50% of the miscellaneous items, and so the index shown by the use of the above commodities from Bradstreets was divided by two in order to get the index for "Miscellaneous," as we used it.

During the past two years this department has in a way attempted to keep abreast of or at least to follow along with the upward trend of prices by a readjustment of salaries about twice a year. Inasmuch as we were about to install a system which made its base that of January, 1917, the base salary had to be adjusted to fit that condition. This was done.

Table II shows the way the bonus has varied during the past three months.

TABLE II. CLEVELAND COMMODITY PRICES IN 1918 COMPARED WITH JAN. 1, 1917, AS BASE; AND "H. C. L." SALARY INDEX

	Jan. 1918	Feb., 1918	Mar., 1918	April, 1918
Food	1.334	1.36	1.33	1.33
Clothing and shoes	1.22	1.225	1.244	1.294
Gas and electricity	1.00	1.00	1.000	1.000
Coal	0.834	0.835	0.833	0.825
Rent	1.125	1.125	1.125	1.125
Miscellaneous		1.19	1.185	1.184

"H.C.L." Salary Index, Percentages

	Class A	Class B	Class C
Feb., 1918	21.7	21.2	17.9
Mar., 1918	20.9	20.0	17.5
Apr., 1918	21.66	20.71	18.08

Mine Concrete Designed by Empirical Methods

Cut-and-try measures have been used in designing underground concrete structures on the iron ranges in Minnesota, for it is quite impossible to determine pressures. Ore beds frequently move without warning and exert tremendous crushing effect. Details of geological formation are frequently unknown in advance. If the strata are horizontal side pressures may be negligible, but with inclined strata the pressures may be enormous. Since the compelling reason for the use of concrete is its resistance to fire which might shut down a mine indefinitely, the tendency is to make the shaft sections err on the side of strength. The additional cost of concrete is of little consequence, but the space taken up becomes a factor, particularly in relining work. When concrete timbers were first used they were made the same size as the wood timbers which had been used for many years. The 3-in. precast slabs have proved uniformly successful. Dimensions of the monolithic construction are somewhat different from the ordinary timber dimensions, but in general an 8-in. wall is recommended by the iron range engineers as a minimum.

Further Commendation of American Society's Development Committee

Leading Engineers Look for Much Good to Come of Move to Broaden Society's Activities—General Black Inclined to Believe Time Allowed Committee Is Too Short

A number of prominent engineers were asked by "Engineering News-Record" to comment on the creation of a development committee by the American Society of Civil Engineers, as set forth in the issue of June 27, p. 1209. A number of the replies were published July 18, p. 135. Further opinions, given below, are from Major General William M. Black, chief of engineers, United States Army; A. P. Davis, director and chief engineer, United States Reclamation Service; J. F. Coleman, member of the board of direction of the society; J. A. Ockerson, past president of the society; M. M. O'Shaughnessy, city engineer of San Francisco; Sidney J. Jennings, president of the American Institute of Mining Engineers, and George H. Burgess, chairman of the valuation committee of the Delaware & Hudson Company.

J. F. Coleman Holds Development Can Result Only in Good to the Society and to the Profession

I regard the appointment of the committee on development by the board of direction of the American Society of Civil Engineers as most hopeful of far-reaching and beneficial results to all concerned. The appointment of the committee on development in the manner provided by the resolution cannot result otherwise than in benefit to the society and to the profession. The researches and deliberations of the committee must surely disclose ways and means of so broadening and enlarging the scope and the functions of the American Society of Civil Engineers as to render it a more potent factor in affairs than it has yet been. I am in most hearty accord with the resolution.

J. A. Ockerson Sees in Move a Means of Increasing Society's Efficiency—Must Have Hearty Co-operation of Members

It is gratifying to find *Engineering News-Record* fully in accord with the preamble and resolutions recently adopted by the board of direction of the American Society of Civil Engineers, appointing a committee on development. The action of the board, seeking the general uplift of the society in its relations to the public and within its own ranks, is admirable from all points of view and will doubtless result in a fuller understanding of the privileges and responsibilities of membership, and with it a wider sphere of influence and efficiency.

While all of this is true, the fact should not be overlooked that this is not the first step taken by the board of direction and the society looking to similar ends through active participation in the current questions of the day touching the engineer, his activities and his influence.

The American Society of Civil Engineers has been the pioneer in many matters of importance to the profession and the general public. Having been a member of the board of direction for some eight years, and seven years a member of the nominating committee, the writer has a pardonable pride in the achievements of the society thus far. The advancement of the society, the interests of its members, and the relation of both to the public, have been constant themes of discussion in the board, and substantial progress has been made, which is evidenced by the enviable standing of the society today in its relations to the Federal Government and the public at large. It has taken a leading part in the international engineering congresses held at St. Louis and at San Francisco, in the inventory of our manufacturing resources, in the organization of the Naval Consulting Board, in the classification of engineers according to qualifications for service in war activities, in proclaiming its loyalty and desire to aid our country in every practicable way, and in efforts to obtain just legislation relating to the practice of engineering.

In a material way, the reports of its committees on cement, reinforced concrete, standard rail sections, columns and struts, and numerous other important subjects, show earnest, careful work and the conclusions have been adopted as standard practice.

In later years the board of direction has encouraged research work in the appointment of committees and the allotment of funds therefor.

It has endeavored to increase the interest of the members in the society, by authorizing and encouraging local associations of members, by defending members wrongfully accused and bringing to justice those who are guilty of wrongdoing, by providing for meetings of the society at places other than New York, by fixing the time and place of the annual conventions through automatic rotation by geographical districts, by providing representation of the districts in the board of direction. So it will be seen from the partial list of things accomplished that the society has by no means been idle, but has kept pace fairly well with the growth of the profession—but progress can only be realized by sustained, persistent effort.

Throughout all its efforts the board of direction has frequently had occasion to regret the lack of interest shown by the members of the society. A ballot on the most vital questions rarely brings out a response from more than one-third of the voting members. So the statement of the preamble that "a readjustment can be accomplished successfully only with the aid of the membership throughout the country" is the crux of the whole matter.

With more than 8000 engineers in the Officers' Reserve Corps who are making good at the front and elsewhere, which brings them into the limelight of public scrutiny, with the economic conditions and industrial activities rapidly changing, with new problems to come with the close of the war, the time is most opportune for the society to redouble its efforts to

increase its usefulness to the public and to its members, by leading and guiding as far as practicable in the solution of the great economic and social problems which will confront us for years to come until normal conditions are again restored. To this end a committee such as proposed can and will render valuable service which will result in greater efficiency, but it must have the hearty coöperation of the members of the society in order to achieve the results hoped for. No half-way measures of encouragement will suffice.

It has been well said that "there is something in the soul and spirit of man which is mightier than the appeal of personal gain." If this feeling among the members can be evoked the success of this movement is assured. Let us all put our shoulders to the wheel and "do our bit" toward aiding the committee in this important work.

Major General William M. Black Believes With Others That More Time Should Be Allowed for Investigation

An important step like that contemplated by the board of direction of the American Society of Civil Engineers is one that should be taken only after very careful consideration, which, doubtless, the board of direction has given the matter. Therefore, criticism or comment should be made with equal care.

I do not feel sure that I grasp fully the intent of the resolutions, nor am I sure that I understand just how the American Society of Civil Engineers could act in order to further the cause which the board of direction has in mind. It seems to me that engineers are bound to take a leading place in the community life of our nation, just as soon as the individuals themselves are found worthy to take it. Perhaps the society might be able to help in the necessary broadening of the views and sympathies of the engineers. I believe that the exercise of the profession itself tends to fit its men to perform civic duties of all kinds eminently well.

I am inclined to agree with some of the members whose comments I have read in thinking that too short a time is allowed for the formation of a proper committee and for the preparation of a report of value. With the short time allowed there is too much of a chance for a small group having clearly defined aims to impress their will on the larger number who have not yet thought the matter out with care. The society has such a high value as an aid toward higher aims and greater achievements for our nation that no hastily prepared changes in its objects or methods should be permitted. I hope that this step will prove one beneficial to the profession at large.

M. M. O'Shaughnessy Hopes Move Will Enable Engineers To Play Part in Economic Reconstruction, and Urges Prompt Action

The proposed project of the American Society of Civil Engineers aims at stimulating and concentrating the energy of this great organization into a direction which will improve, control, and direct sociological and economic conditions, now in a state of flux.

Before the advent of war social and economic problems and controversies were speeding along with unprecedented violence, which indicated an early conflict of class selfishness. The activities of the war have temporarily postponed the climax. The railroads and other utilities are now receiving guaranteed incomes. The labor elements are practically obtaining all the compensation they request, which, during the period of the war, with the increased price of foodstuffs and other commodities, is only a just distribution of burdens and awards. At the cessation of the war this state of affairs will stop and the country will be confronted with new problems which will need all the enlightened direction and skill of not only engineering organizations but the other bodies that have to do with and direct labor and capital.

No other class of men comes into such intimate contact with both factions as the engineers, who have heretofore been unduly modest in making suggestions of value which their great experience and powers of observation qualify them to do. Generally, with undue modesty, they suppress their views and permit noisy demagogues and blatant politicians to direct functions that properly belong to the engineering body.

I trust fruit will be borne from the new move of the American Society and that more results will be obtained than are usually accomplished by the formation of committees which proverbially write verbose reports and which generally so delay the production that the problems are passed before the discussions are closed.

First Step to Important Development in Society's Activities, Says A. P. Davis, But Patience and Courage Are Needed

The resolution of June 18 adopted by the board of direction of the American Society of Civil Engineers without serious opposition is the first step to an important development in the policy of the society which I believe will greatly add to its usefulness. Similar tendencies are shown by a number of other committees appointed recently, so that the development foreshadowed by this resolution is really already begun. There is a growing feeling that the society should take a more active part in the control of public policies where they depend upon, or touch upon, engineering matters.

As an illustration, a recent recommendation of the Engineering Council concerning the bonus system in connection with contracts is an important example of the potential usefulness of the society if this and similar matters are followed up and carried through to fruition. Years ago the Navy Department offered a premium for speed on contract requirements in connection with war vessels. This practice was abolished by Congress with much elocution indicating that a great abuse had been abolished. It is impossible to calculate what this blunder may cost the United States in lives and property and it might, perhaps, have been prevented by vigorous and aggressive action when the question was pending. A common tendency of laymen is to underrate the importance of preliminary investigations of engineering works. Had it not been for a treaty prohibition, it is probable that the Nicaragua Canal would have been taken up for construction in the early 90's under the impression that it could be built for about $60,000,000. As it was, it required a hard fight on the part of Messrs. Ludlow, Noble and Endicott to prevent such as disaster and they probably

could not have prevented it had it not been for the French disaster of Panama which stood as a warning before the country.

The conservative policy of the past concerning public measures has not been due entirely to a spirit of conservatism, but probably in some measure to a dread of antagonism and dissension in the society itself, and the policy now foreshadowed, if consistently and courageously followed to an extent adequate to make the society feel its great usefulness, is bound to be beset by pitfalls and difficulties which should not be underestimated. Patience as well as courage is necessary. The society should confine its advocacy to general principles and policies and the measures necessary to carry them out rather than to engineering details which must be determined by members of the profession, employed for the purpose, who can give it the necessary time, and to which it would not be wise to commit the society as a whole. Even confined to these broad and general functions, abundant opportunities for usefulness will present themselves to the society.

President Jennings of Mining Engineers Calls Action Excellent Preliminary Step — Says It Will Be Brought to Attention of Executive Committee of His Society

The question of the future development of the national scientific societies of the United States thus brought prominently to the front by the civil engineers is one that has exercised the thoughts of the directors of these various societies ever since the United States entered this world war. In the upheaval that has been brought about, various forces with indefinite influence will come to the front, and it seems to me a part of the function of the national engineering societies to consider these forces and to give them direction and consequent effectiveness. The action taken by the civil engineer in appointing a committee to report on this question seems to me an excellent preliminary step. This action will be brought to the attention of the executive committee of the Mining Engineers and, if they approve, a similar committee will be appointed. It is hoped that these committees of the national societies will coöperate with the Engineering Council of the United Engineering Society so that the engineering profession will be organized as a whole in the United States to render the maximum amount of service of which its membership is capable. In all times of the world, and under all circumstances, the engineer has proven himself to be "The Man Who Can," and everywhere and at all times "The Man Who Can" always will.

Should Commend Itself to All Members, Writes George H. Burgess—Much Responsibility Will Lie Upon the Committee

The creation of a Committee on Development of the American Society of Civil Engineers is a step that should commend itself to all members, many of whom have been convinced for some time that the society is not occupying that position to which its large and widely distributed membership entitles it.

The objects of this society should be such as to confer the greatest possible benefits to (a) its members; (b) the engineering profession; (c) the nation. These beneficiaries are not necessarily named in order of importance, though it is obvious that the most successful organization is the one conferring the greatest benefit upon its members, and upon the strength of the organization depends the ability of that organization to confer its benefits upon others. That the society has not accomplished any of the results of that degree to which its size and importance entitle it is well recognized by many of its older members, who undoubtedly will welcome this important step. Much responsibility rests upon the members who will be appointed to this committee and it is to be hoped they will be men of broad vision, keenly alive to their responsibilities, and who may be able to devote a very considerable amount of time to the service of their society and profession.

With the period of readjustment and reconstruction of physical, political and social structures of the world rapidly approaching, the society should so equip itself as to become an important factor in such changes as are certain to arise from this readjustment.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Crystallize Council Action

Activity of the Engineers' Club of Columbus, Ohio, in furnishing a forum for the presentation of views on the seriousness of the water-supply situation, has led to favorable action on this matter by the City Council. Prof. E. F. Coddington, chairman of a committee on water-supply, indicated June 28 from charted studies of daily rainfall records for 20 years and gage readings at the storage reservoir for nine years that the city would now be without water under the present demand in case dry weather conditions obtained such as have been experienced during at least five years of the past twenty. The engineers did not hide themselves, their meeting nor their report. On July 19 Jerry O'Shaughnessy, superintendent of water, appeared before the council with the same unpleasant information. Authorization was granted for the employment of an engineer to make necessary surveys.

In Chicago universal water metering is up for consideration by the city council (see editorial in *Engineering News-Record* of July 18, p. 111). Although starting late the American Association of Engineers has been able since the editorial was written to get into the newspapers eight news items urging the adoption of meters. The last move was to wire the Federal fuel administrator asking him to urge the measure because of the fact that Chicago wastes half the water it pumps, hence half the coal burned, amounting to 100,000 tons a year. With every other industry reduced to short coal rations the association could see no reason why flagrant waste of this kind should continue without the first step being taken toward its reduction. The question of holding mass meetings in the wards of doubtful aldermen to explain the situation is under consideration, since the proposed metering ordinance has been put on file until autumn.

HINTS FOR THE CONTRACTOR

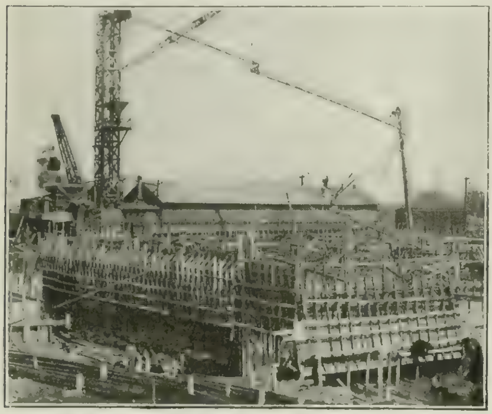
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Forty-Five-Hundred-Yard Concrete Boiler Room Mat Laid Continuously

By H. S. Hunt

Fargo Engineering Co., Jackson, Mich

THE placing of 4500 cu.yd. of concrete was accomplished in a continuous run at a large power plant in Detroit, Mich.; the concrete formed a foundation mat for the boiler room and covered an area of 115 x 150 ft. and was 7 ft. thick. On account of the great amount of reinforcing steel required for use as shear bars at



CENTRAL POLE AND REVOLVING SPOUT SYSTEM ARRANGED FOR CONTINUOUS CONCRETING

each location of boiler room columns it was not considered advisable to use the trestle system for placing the concrete. The method shown in the photograph,

[illegible] STEEL BEING LAID IN ONE SECTION WHILE CONCRETING IS DONE IN OTHER SECTIONS

which is similar to that described in the article on "Sink 7700-Ton Drop Shafts to Exact Line and Grade by Dredging," in *Engineering News-Record* of Sept. 27, 1917, p. 593, was finally adopted and found entirely successful.

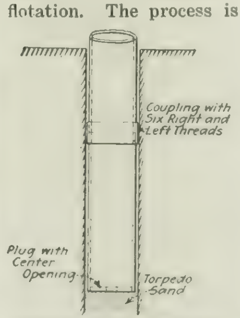
The layout consisted of the usual concrete tower and a wooden pole erected at the center of the mat and guyed by nine $\frac{3}{4}$-in. steel cables. A set of $\frac{1}{2}$-in. rope falls was fastened to each guy at a uniform distance from the top of the pole. The main spout from the concrete tower was fastened to the top of the pole and discharged into a movable spout, having the upper end attached to the spouting system near the pole, while the lower end was supported by the rope falls. A second swiveling spout was provided at the lower end of the movable spout, so that all points of the mat could be reached.

The process of concreting was carried on continuously, the spout being moved about the pole as a center by attaching the two adjacent set of falls, and pulling in on one while slacking off on the other. In this way the spout could be moved over practically a complete circle, the concrete being placed to a uniform depth throughout the movement. This circular movement was continued until the full depth of 7 in. had been concreted.

Three 8-hour shifts worked on the job, and on account of the method adopted there were no delays occasioned by changing trestles, etc. As shown in the illustration, the method allowed the placing of the shear reinforcement steel in one section while concreting was being done in others.

Sixteen-Inch Cast-Iron Well Casing Sunk by Floating

MORE than 500 ft. of $16\frac{1}{2}$-in. cast-iron well casing was successfully sunk at the Chicago stockyards plant of Miller & Hart, Inc., by plugging the bottom and lowering in a water-filled hole to reduce the weight by flotation. The process is a modification of a process for cast-iron casing deep wells developed by the Whitney Well Co., Chicago, contractors for well drilling, and is being used when longer strings of casing have to be sunk. This process consists, as shown by the sketch, of filling the drilled hole with torpedo sand or similar material, resting the pipe, plugged with a perforated disk, on the sand, and pumping the sand out to let the casing settle gradually.



PERFORATED DISK ~~[illegible]~~TED IN PIPE

Cast-iron casing, with cast couplings of semi-steel, of the size used at the stockyards well, weighs about 120 lb. per foot. Its advantage is its resistance to corrosion as compared to steel casing, and its disadvantage is its greater weight. This great weight has been regarded in the past as an insuperable obstacle to its general use, so that the examples here noted of successful sinking record an important advance in deep-well work. Cast pipe requires a straight hole since, unlike steel casing, it will not flex and follow a hole out of true. The stockyards work, therefore, was unique in the perfection of the drilling as well as in the use of cast pipe of large diameter.

The sinking was done with a standard oil-well rig. Through the surface, about 60 ft., a 24-in. hole was used, then a 19-in. hole through limestone and shale to 557 ft. This was the portion cased with the 16½-in. cast pipe. Between 990 ft. and 1040 ft. a soft layer was cased with 12-in. pipe. The remainder of the 1621 ft. of the well was uncased.

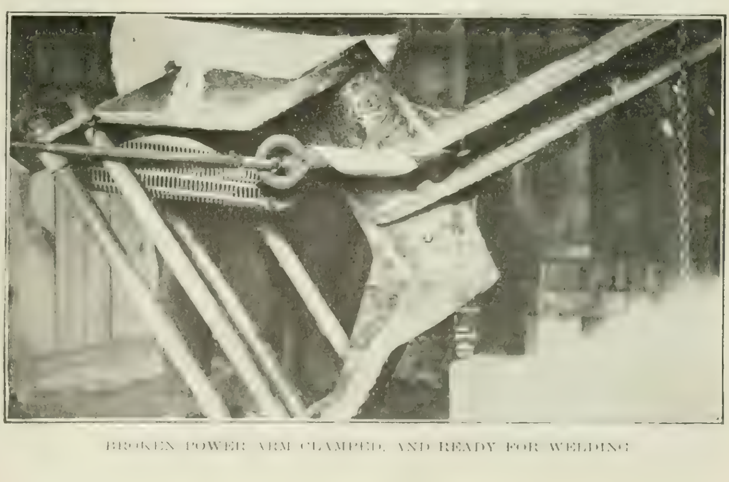
Broken Power Arm of Clamshell Dredge Bucket Welded on Job

By G. W. McAlpin
Point Pleasant, W. Va

A DIFFICULT weld of a break in a cast-steel power arm of a clamshell dredging bucket was recently made by use of the oxyacetylene welding apparatus. The work was done by the blacksmith at Dam No. 25 on the Ohio River, now under construction by the National Contract Company.

The power arm was broken during the winter, while the bucket was receiving very severe usage. Owing to possible delay in getting a new arm, it was decided to weld the old arm at the job. The edges of the break were trimmed back with a cold chisel to an angle of about 45°, forming a V-shaped trough, and were brought together by the rig as shown in the photograph. One-inch bolts, passing through pipe spreaders, and a clamp held the broken parts together. A metal basket, made from sheet iron suspended under the break, held a charcoal fire for heating, and air pressure from the blacksmith forge blower was applied through a section of pipe.

When the edges of the break had reached the proper temperature, the fire was cleaned away from the top and the addition of material started by the fuse of the welding apparatus. New material was added until the entire trough space containing 29 cu.in. was filled. As soon as the weld was completed a small charcoal fire was placed around it, and the whole was covered with several sheets of asbestos and allowed to cool gradually.

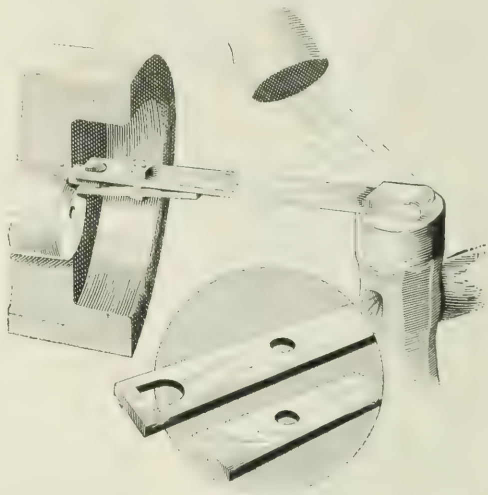


BROKEN POWER ARM CLAMPED, AND READY FOR WELDING

The welded arm has now been in use for some time and has proved entirely satisfactory. Besides the great saving in time and freight, it is estimated that at least 50% of the cost of a new arm was saved by welding on the job.

Use Extension Clamp to Draw Shaft Keys

AN EXTENSION clamp, designed to loosen and draw pulley keys from inaccessible locations, described by W. A. Cooil in a recent issue of *Power*, is shown



KEYS EASILY LOOSENED WITH EXTENSION CLAMP

in this drawing. The device extends the gib-head to a working position. The clamp as described and illustrated is easy to make and use.

In the particular instance described, the extension bar and clamp were made of ¼ x 2½-in. material. Holes were

punched for the gib-head and clamping bolt, and the outer end bent over to form a driving head. Three sharp blows with a 10-lb. hammer removed the key.

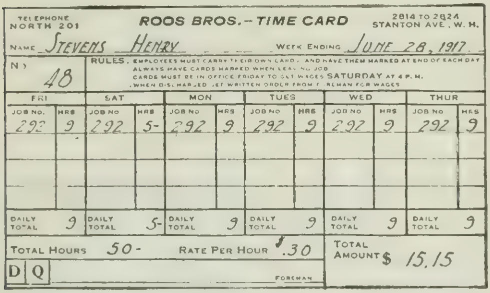
Pass-Time Card Prevents Disputes Over Time Shortage

BY JOHN T. SULLIVAN
Covington, Ky.

A TIME card handed in every morning and received back every night by each workman on the East Side High School work at Cincinnati regulated tardiness and made arbitration of time shortage claims a simple problem. One card, which is printed on stiff paper, served each man for a week.

The hour was noted when each man handed his card to the timekeeper each morning. Tardiness was thus observed and regulated without opportunity for debate. When the workman quit at night he took back his card, on which the timekeeper had entered the hours worked. If any question of shortage of time arose it was arbitrated at once. This eliminated disputes, which, under systems where the workman does not keep his own card, arise on Saturday over shortages of time charged for perhaps the previous Monday or Tuesday. Substantially, the workman received each night a rectified credit for the hours of labor that was performed during the day.

Provision was also made for handling cases of men discharged or quitting work. Two small squares lettered D and Q were printed in the lower left-hand corner of


TELEPHONE NORTH 201 — ROOS BROS.—TIME CARD — 2814 TO 2824 STANTON AVE., W. H.

NAME STEVENS HENRY — WEEK ENDING JUNE 28, 1917.

NO. 48

RULES. EMPLOYEES MUST CARRY THEIR OWN CARDS AND HAVE THEM MARKED AT END OF EACH DAY. ALWAYS HAVE CARDS MARKED WHEN LEAVING JOB. CARDS MUST BE IN OFFICE FRIDAY TO GET WAGES SATURDAY AT 4 P. M. WHEN DISCHARGED GET WRITTEN ORDER FROM FOREMAN FOR WAGES

FRI		SAT		MON		TUES		WED		THUR	
JOB NO.	HRS	JOB NO.	HRS	JOB NO.	HRS	JOB NO.	HRS	JOB NO.	HRS	JOB NO.	HRS
292	9	292	5-	292	9	292	9	292	9	292	9
DAILY TOTAL	9	DAILY TOTAL	5-	DAILY TOTAL	9	DAILY TOTAL	9	DAILY TOTAL	9	DAILY TOTAL	9

TOTAL HOURS 50- RATE PER HOUR $.30 — TOTAL AMOUNT $ 15.15

D Q — FOREMAN

PASS CARD DESIGNED TO ELIMINATE DISPUTES

each card. If the workman quit, the timekeeper would cut out the square lettered Q, file the card, and hold the man's wages until the following Saturday. In case, however, the man was discharged he went to the timekeeper and received his card, then returned to the foreman, who cut out the D-square and signed the card, which thus became an order for payment, which was made immediately.

On Thursday of each week new cards for the following week, which began on Friday, were given to the men. The old cards were held by the timekeeper and the time on them figured for the Saturday payroll. The contractors for the East Side High School were Roos Bros., Cincinnati.

Excavator Erects Structural Steel With False Boom

BY H. S. HUNT
Fargo Engineering Company, Jackson, Mich.

A DRAG-LINE excavator equipped with an auxiliary boom, as shown in the illustration, was used to erect the structural steel for a steam power plant at Battle Creek, Mich. When the erection of the structural steel was started, consideration was given to the best


EXCAVATORLIFTING STEEL TRUSS INTO POSITION

method of handling this work without interference with concreting operations within the power house walls, and the method shown was finally adopted for placing the steel work on the interior walls.

A 60-ft. cedar pole was rigged up as an auxiliary boom, the load line running from the end of the pole over the pulleys at the end of the steel boom and thence to the hoisting engine. The location of the pole with reference to the steel boom could be changed by means of a second line rigged as shown. Through the use of this arrangement it was found possible to reach all the steel work on the division walls, thus making it unnecessary to use a gin pole. The steel columns on the outside walls and the steel roof trusses were placed as the excavator backed away.

Irrigation In Imperial Valley, 1913-17

Irrigation by Imperial Water Co. No. 1 in the Imperial Valley, California, during 1917, covered 113,503 acres. The acreage of various crops, the total and average volumes of water used and the duties in acre-feet for the years 1913-17, as given in the annual report of Ray S. Carberry, superintendent, follow:

	1913	1914	1915	1916	1917
Total acreage of crops	101,796	105,902	108,224	105,100	113,503
Alfalfa	59,279	57,396	51,797	44,702	35,790
Barley	19,257	17,514	20,363	12,400	9,834
Corn	12,933	10,948	22,145	18,864	27,360
Cotton	4,741	12,114	5,179	20,162	25,765
Miscellaneous	1,190	2,636	1,677	1,334	3,660
Melons	3,125	4,025	4,480	4,702	7,440
Vineyards	910	908	903	939	954
Asparagus	361	361	332	514	424
Trees			967	1,209	1,491
Beans			381	274	348
Wheat					437
Water delivered, acre-feet	337,349	358,579	336,435	350,582	364,578
Duty of water, acre-feet	3,314	3,386	3,109	3,335	3,212
Cost of water, total	$198,948	$191,266	$179,185	$170,349	$193,395
Per acre-foot, cents	58.9	[illegible]	[illegible]	48.6	55.0

Labor costs in 1917 were $148,162, as compared with $132,949 in 1916, although only one more man was employed—175 men in 1917 and 174 in 1916, based on a 300-day year.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Quota of Engineer Officers Not Yet Complete

Still Ample Chance for Qualified Engineers to Become Captains or Lieutenants

Engineers between the ages of 32 and 42, qualified physically and mentally to take up the arduous duties of a pioneer engineer officer in the field, are still wanted for captains and first lieutenants in the regiments of the United States Army. Since the primary call for these men, which was given in detail in *Engineering News-Record* of June 13, p. 1150, applications for commissions have been reaching the Chief of Engineers in great numbers. The quota of selected men is not yet full, however, and engineers who are in a position to accept such commissions are being urged to offer themselves to the Government.

HOW TO APPLY

The qualifications are an acceptable engineering training and experience, and a physical condition satisfactory to the medical officers of the Army. Applicants should write to the Chief of Engineers, United States Army, Washington, for blanks to be filled out. If accepted for examination they will be notified when to appear before a traveling examining board, which is now making a tour of the country.

The first call stated that men between the ages of 32 and 36 would be accepted as first lieutenants, and between the ages of 36 and 42 as captains. It is now announced that there is an undue proportion of applications for the rank of captain, so the Office of the Chief of Engineers has allotted the limited number of vacancies in that grade to the various sections of the country, roughly on a population basis. It is stated, however, that while most of the existing vacancies are in the grade of first lieutenant, the organization of a great number of additional regiments is contemplated in the immediate future, and by the time candidates accepted now finish their training camp course a considerable number of additional vacancies in the grade of captain will be available for the promotion of those first lieutenants who make the best showing at the training camp.

Men whose applications are accepted by the examining board will be immediately commissioned as captains, or first lieutenants, as the case may be, in the United States Army, and will be detailed to the Engineer Officers' Training Camp at Camp A. A. Humphreys, on the Potomac River below Washington.

(Concluded on p. 247)

Contractors Take Steps To Create National Association

Progress Since Atlantic City Meeting Recorded in Formation of Committee Containing Many Big Construction Men

Action looking to creation of a national federation of contracting interests has followed fast on the informal meeting of contractors (noted editorially on p. 157 of this journal last week) who attended the convention of building industries at Atlantic City July 15 and 16 last. An executive committee representing many of the strongest firms and organizations of contractors in the country has been formed, and is expected to meet in the near future to develop completed plans for the immediate establishment of a national association of general contractors.

The meeting in Atlantic City, at which were present about 25 contractors, representing as many contractors' organizations ranging from New England to the Pacific coast, appointed a temporary executive committee to investigate the possibility of a national organization and take steps looking to its formation. Funds were provided for the activities of the committee, and its chairman was empowered to enlarge the body by inviting the participation of prominent firms and organizations which were not represented at the Atlantic City meeting.

The committee, including those originally appointed and those invited to join, is organized as follows: Chairman, D. A. Garber, New York; secretary, H. D. Hammond, managing editor of *Engineering News-Record;* members, Noble F. Hoggson, Hoggson Bros., New York; T. T. Flagler, the Flagler Co., Atlanta; J. W. Cowper, the John W. Cowper Co., Buffalo; Norman H. Mayo, the Aberthaw Construction Co., Boston; M. D. Smith, A. J. Smith Construction Co., Detroit; E. J. Thomas, D. D. Thomas & Son, Memphis; George Watson, the Watson Co., Dallas; C. P. Massard, Central States Association of Building Contractors; C. W. Gompertz, president General Contractors' Association, San Francisco; Leland H. Ross, P. Sanford Ross, Jersey City; W. A. Rogers, Bates & Rogers Construction Co., Chicago; S. L. May, National Contract Co., Evansville, Ind.; Ronald Taylor, president Building Trades Employers' Association, New York; A. P. Greensfelder, Fruin-Colnon Construction Co., St. Louis; F. L. Cranford, president General Contractors' Association, New York; George A. Glover, New Orleans; Edward A. Steele, William Steele & Sons Co., Philadelphia; Dewitt D. Barlow, Atlantic, Gulf & Pacific Co., New York; and John R. MacArthur, president River and Harbor Contractors' Association, New York.

With the men named, it is believed this committee will include representatives of most of the existing organizations of contractors, in addition to which a number of strong local associations which sent delegates to Atlantic City, notably those in Pittsburgh and Cleveland, are already interested in the movement.

As a basis of discussion at the meeting of the committee to be called early this month, a tentative plan has been submitted to its members which proposes that the membership of the national association shall be composed of existing contractors' organizations of a regional, sectional or local character, and that individual firms shall be admitted to membership only where there is no organization at present in the territory. It is tentatively proposed that a national convention shall be called at which permanent officers and an executive committee shall be elected. When permanent organization is perfected, those interested in the movement contemplate opening an office in Washington and putting forth every effort to gather information, organize the contracting field to assist the Government, and to solve pressing problems that will confront contractors after the war.

Railroad Administration to Protect Short Lines

The Director General of Railroads has created a short line railroad section under the supervision of the director of the Division of Public Service and Accounting. E. C. Niles, chairman of the New Hampshire Public Service Commission, and president of the National Association of Railway and Utilities Commissioners, has been appointed manager of the new section. This section will be charged with the duty of securing to the short line railroads not under Federal control fair divisions of joint rates with roads under Federal control, a reasonable car supply and protection against any undue disturbance in the routing of traffic.

War Department Centralizes Purchasing Control

Each Branch of Army to Have Separate Jurisdiction Over Purchase of Designated Supplies

Organization of the centralized purchasing scheme whereby the General Staff controls the buying of all commodities and supervises all contracts for the Army is rapidly progressing. Already assignment of purchases of a number of commodities has been made to the several branches of the War Department, and boards of review are passing on all contracts in order to insure uniformity of contract control and provisions. The general administration of the scheme is under the direction of Brig. Gen. Hugh S. Johnson, head of the purchase and supply branch of the division of purchase, storage and traffic of the General Staff of the Army.

QUARTER-MASTER	CONSTRUCTION	ORDNANCE	ENGINEERS	SIGNAL	AIRCRAFT PRODUCTION	MEDICAL	CHEMICAL AND WAR GAS
Automobile Drive Chain	Reinforcing Bars	Chrome and Ferro-Manganese Alloys	Arc Search Lights	Electric Wire	Aeroplane Cloth	Surgical Dressings	Elastic Tape
Ice Boxes	:Cement	Ammonium Nitrate	Chain	Radio Equipment	Brass and Copper Tubing	Surgical Needles	Horse Masks
Burlap	Clay Products	Artillery Chain	Paint Containers	Telephone and Telegraph Equipment	Electric Wire and Cable	Medical Thermometers	
Non-Skid Chains	Electrical Equipment and Supplies	Barometers	Gantry Cranes		Clocks		
Cotton Cloth	Electric Wire for Heavy Power	Dry Batteries	Locomotive Cranes		Aviators' Clothing		
Cotton Goods	Refrigerating Equipment	Blast Furnace and Steel Mill Products	Paint Driers		Compasses		
Cotton Rope	Sand and Gravel	Cartridge Cloth	Electric Gas Generator Sets		Wood Distillates		
Silk Fabric	Rough Hardware	Coal Gas Products	Enamels		Gages, Oil, Air and Gasoline		
Rubber Goods	Heaters, Room	Coal Tar Products	Gas Engines		Steel Hangars		
Woolen Rubber Goods	Heating Equipment and Supplies	Cotton Linters	Mechanical Rubber Goods		Linen Fabric for Balloons and Aircraft		
Jutes	Plumbing Equipment and Supplies	Forging Equipment	Japans		Thermometers		
Leather	Roofing Material	Hull Fiber	Lacquers		Spar Varnish		
Linen	Sprinkler Systems	Flash Lights, Dry Cell	Mineral Spirits				
Manila Rope	Ventilating Equipment	Lanterns	Paint				
Needles	Water Supply Equipment and Fixtures	Nitrates	Steam Shovels				
Woolen Goods	Structural Steel	Tin	Turpentine				
		Pig Tin	Varnishes				
		Plate Tin	Linseed Oil				
		Platinum	Railway Equipment				
		Sodium Nitrate					
		Stop Watches					

In the past the various branches of the department have been buying their respective commodities through their own purchasing agencies, often bidding against one another for the same goods and frequently paying several different prices for the same article. The General Staff brought together a committee of representatives of the various purchasing agencies, and this committee is now engaged in standardizing the commodities needed and assigning to one branch of the department the purchase of each commodity. This standardization has progressed to the point indicated in the accompanying table, which shows the name of the branch intrusted with the purchase of about 150 items so far agreed upon. Others are being added to the list each day.

Thus, reinforcing bars, regardless of their use or of the branch that uses them, are purchased by the Construction Division according to specifications laid down by that division. Any other branch requiring reinforcing bars makes a requisition on the Construction Division for the required amount. More than 70 per cent. of the articles bought by the department are now being purchased under this system.

A further extension of purchasing is the establishment of boards of review which have to pass on all contracts before they become valid Boards of review have been established in each of the eight purchasing bureaus; that is, quartermaster, construction, ordnance, engineers, signal, aircraft production, medical and chemical and war gas. Each board consists of men representing purchasing, finance, production and contracts. This board passes first on all contracts more than $5000, second on all cost-plus contracts and third on all formal competitive bidding contracts where the contract is not awarded to lowest bidder by the local officer. It sits every day and goes over each contract—those from remote points by telegraph if necessary—and approves only those which are in accordance with the rules laid down by the main committee on purchases or which seem to be at prices in accordance with the state of the market.

In addition to these departmental boards there is a superior board of review, consisting of General Johnson, a representative of each minor board and Max Thelen, who is surveyor of contracts. This superior board passes on large questions of purchase and contract, lays down the general rules of purchase and acts as a court of appeals from the lower boards. In general, any dissatisfied prospective contractor has the right of appeal to the superior board.

In standardizing the work of purchasing, this superior board is making a number of reforms. For instance, it is preparing a card index of all purchases made by the War Department, according to a punch card system, whereby the prices and contract requirements can be told for all previous purchases at a glance. Thus, the board can keep tab on the contracts submitted, as to price, quality, delivery, etc. The superior board, too, is deep in the study of contract forms, so as to standardize the various specifications and contracts and to protect the Government as to price, terms and conditions. The cost-plus form of contract is particularly under scrutiny just now and will probably be standardized in the near future.

More than 3000 separate purchase transactions are now passing through the War Department each day, to say nothing of the construction contracts that also come under the jurisdiction of the boards of review. The perfecting of the present system is expected not only to insure more efficient purchasing on the part of the Government, reducing as it does the multiplicity of purchasing and inspecting effort, but also will be of material advantage to the manufacturers, who for any one product or group of products will have to deal with only one agency in the War Department.

Signal Corps Wants Men for Photographic Work

The Signal Corps announces an urgent need for a large number of men to engage in the compilation of a pictorial history of the war. About 60 more lieutenants and as many sergeants, first class, are to be selected for this work; and for a short time, until the immediate needs are met, some commissions will be given to men direct from civil life whose experience is ample to justify this procedure. Other men will be sent temporarily to the Signal Corps School of Photography at Columbia University, New York City, where they will be taught, not how to take pictures, but rather what kind of pictures to take. Many of the men commissioned will become staff officers of army divisions and as such will be in charge of the work of making a pictorial history of the activities of that division from the time of its organization through its active war service.

The successful newspaper photographer represents most nearly the type of man needed. That is to say, he must have a "nose for news" in addition to being able properly to set and expose his camera. A military photographer must possess a generous amount of initiative and originality, for he will have to act as his own director and dig up the type of picture that really tells the story.

The Signal Corps states that appointment will depend almost entirely on a man's previous experience. Application for service can be made and full particulars obtained by addressing the Office of the Chief Signal Officer, Photographic Section, Arcade Building, Washington.

Quota of Engineer Officers Not Yet Complete

(Concluded from page 245)

While there they will receive the pay and allowances of their grade, although, of course, as in all officers' training camps, they will be considered as privates and be classed with all the other student officers. They will be required only to provide themselves with the uniforms of their ranks, but while at camp will be provided by the Government with working uniforms.

Allowances for Officers in Camp

Since April of this year the commutation of quarters, fuel and light has been extended to all officers serving abroad and to all officers serving in this country in the field who maintain separate abodes for dependent wives, minor children, etc. This includes officers at training camps, cantonments and those occupying temporary quarters on permanent reservations or at Army posts. According to this ruling, a major receives $60 per month commutation of quarters and a fuel and light allowance of from $6 to $20 per month, depending on location, climate and amount of space occupied. This, of course, is in addition to his salary. A captain similarly receives $48 and from $5 to $18 fuel and light allowance; a first lieutenant $36 and from $5 to $15; a second lieutenant $24 and from $4 to $12. This brings the salary of a married captain to about $3000 per year, and of a married first lieutenant to about $2500 a year.

Opportunity for Engineers in Artillery School

Artillery officers are needed in the United States Army, and a field artillery central officers' training school for civilians between 20 years and 8 months and 40 years of age, and for enlisted men of the army, has been established at Camp Zachary Taylor, about six miles southeast of Louisville, Ky. Engineers are peculiarly well qualified for modern artillery service, and it is hoped that a number of them will become candidates for the school.

Civilians wishing to enter the school will make application for a blank for entrance to the field artillery central officers' training school. After the form is filled out, designation to a medical officer will be made and if the applicant passes the examination he will be notified of his acceptance and ordered to the camp. While at the camp he rereceives the pay of a private, first class, $33 a month, and upon graduation will either be commissioned as second lieutenant or will be appointed to the grade of sergeant and designated officer-candidate. He will then be sent to replacement depots and commissioned as soon as vacancies occur. While at camp a man with a wife must allot not less than $15 a month to her, to which the Government adds $15 if she is childless, $25 if there is one child, $32 if there are two children, and $5 a month for each additional child. The Government pays all expenses of the man while at camp.

The department particularly wishes to get older men of mature judgment, and states that such men need not hesitate to enter the school because on graduation they cannot be commissioned above second lieutenant, as promotion will be by selection and should be rapid if they demonstrate ability.

The call for candidates says that the field artillery is in need of officers who have scientific and technical education, but this is by no means a prerequisite to the selection of a candidate. It is essential, however, that every candidate should now have or be in a position to readily recall a thorough understanding and working knowledge of arithmetic, algebra and plane geometry. A knowledge of trigonometry is desirable.

All applications should be addressed to Field Artillery Central Officers' Training School, Camp Zachary Taylor, Louisville, Ky.

Flushing Bay Yard Launches First Concrete Barge

On July 27, the first concrete barge built by the Fougner Concrete Shipbuilding Co. was launched at the company's yard, Flushing Bay, New York City. It is a bulk-oil carrier, the "Socony 200," built for the Standard Oil Co. of New York. The vessel is 98 ft. long, 32 ft. broad by 9 ft. 9 in. deep amidships and 10 ft. 3 in. deep at the ends, drawing 3 ft. 10 in. light and 9 ft. with a cargo of 370 tons.

Special interest attaches to the event because it was the first successful end launching of a concrete vessel in this country. Furthermore, the "Socony 200" is the first concrete bulk-oil carrier built in America.

The company started work early in March. At present six ways for barges are in operation. A second yard, near the first, was started later, and here ways have been completed for a 3500-ton concrete vessel for the Emergency Fleet Corporation. Four ways will be built, capable of taking vessels of 7500 tons dead-weight carrying capacity.

Herman Fougner is president of the company. H. A. Hyman is superintendent of construction, in charge of operations at the Flushing Bay Yard.

Training Schools For Military Instructors In Colleges

The War Department has obtained the services of Dr. R. C. McLaurin, president of the Massachusetts Institute of Technology, as educational director for the new army training corps, which is being created under the auspices of the department's committee on education and special training. This announcement is made in Washington coincident with the statement that the work of the corps is now in full swing, and that three summer camps were opened July 18 for professors and advanced students in colleges who will take part in the student training corps next fall. Also, the committee has called three conferences, to formulate detailed regulations, under which the army training corps shall be administered.

The three summer camps are established at Plattsburg, N. Y., Fort Sheridan, Ill., and Presidio, Cal. Three thousand men have been enrolled in each for a period of 60 days, the purpose being to instruct members of faculties and students so they may be able to assist in giving military instruction at colleges. The camps are being operated under the direction of the commanders of the different military divisions in which they are located. The schools have been asked to furnish one instructor for each 200 students and one student out of each fifteen. The schools are reporting direct to the commanders of the military divisions of the Army. The camps are reported to be well on the way to having full quotas. The students and professors are on active duty as privates enrolled in the army under a special 60-day enlistment, with the pay of privates. The expenses for traveling are paid, although it is stated that the schools are at liberty to pay their instructors out of their own funds, and do so in many cases

The conferences called by the committee to formulate detailed regulations under which the army training corps shall be administered will bring together a large number of college men, as the guests of the committee. One conference is to be held at Presidio, Cal., Aug. 23, another to be held at Fort Sheridan, Aug. 30, and the other to be held at Plattsburg, Sept. 3.

Spring Valley Wins Right to Collect Meter Rates

The Railroad Commission of California has given the Spring Valley Co. of San Francisco authority to collect meter rates on all metered services. This relieves what is believed to be the unparalleled situation of a water company having meters in service without being allowed to base charges on meter readings. The commission has stated its belief that metering is the only means of conserving the present supply, and is to issue an order covering rates as soon as the company engineers can confer with the commission and agree thereon.

Allen Hazen stated in the course of the hearing before the commission that the company is now selling more water than its sources are capable of producing. During the past year the rainfall has been only 41% of normal, and Mr. Hazen pointed out that should a third dry year follow the water reserves of the company would be exhausted. At the present rate of consumption, he said, the company has only a 330-day supply in storage. The domestic consumption registered by meters is approximately 11,000,000 gal. per day, but as flat rates only are collected Mr. Hazen estimates that approximately 2,000,000 gal. per day are wasted.

The schedule of rates as proposed by the water company and accepted by

the city was worked out with the intention of bringing the company the same revenue as is produced by the present flat rates. The proposed rates are in the form adopted by the New England Water-Works Association, graded as follows:

Kind of Service	Rate Per 100 Cu.Ft.	Quantity Per Month, Cu. Ft.
Domestic	24	Up to 33,000
Intermediate	20	3300 to 33,000
Manufacturing	16	Over 33,000

The meter charge, in addition to the foregoing, would range from 75c. per month upward, varying with the size of the meter. It is believed that under the proposed rates 10% of the consumers, designated as water wasters, would be hit hard, 40% would be affected by a slight increase, and the other 50% would get lower rates. In the event that these rates produce more revenue than the flat rates, the excess is to be disposed of by order of the railroad commission.

Selling water by meter measurement in San Francisco was temporarily suspended early in 1917 by order of the State Railroad Commission, on the ground that the rates then being collected had no legal status because they had been fixed by the city authorities after jurisdiction had passed to the commission. (See *Engineering Record* of Jan. 20, 1917, p. 125; *Engineering News* of Feb. 15, 1917, p. 273.)

Seattle Asks $5,500,000 Power Development

Asserts Shortage by End of Year Will Be 58,000 Horsepower Unless Present Units Are Increased

Seattle has petitioned the Capital Issues Committee for approval of an issue of $5,500,000 light and power bonds for the construction of a hydro-electric power plant on the Skagit River, which, it is stated by the petitioning committee, is necessary at this time because there is no surplus power available in the Seattle district, regardless of place or manner of generation, and the actual condition of the city's present hydro-electric plant is such that there is likelihood of failure. The petitioning committee, composed of Ole Hanson, mayor of Seattle; C. B. Fitzgerald, chairman of the finance committee; Hugh M. Caldwell, corporation counsel, and R. H. Thomson, formerly city engineer for Seattle, appeared in person before the Capital Issues Committee for the purpose of pointing out that the construction of additional power facilities at this time is essential to insure an adequate and continuous supply of electrical power to Seattle, due to the greatly increased power demands of the district, the depreciation of the present hydro-electric plant at Cedar Falls on the Cedar River and the possibility of the failure of Cedar Lake Dam, which would endanger the city's water supply from Cedar Lake.

The report of the petitioning committee points out that the maximum usable power from hydro-electric sources, including the White River plant, the Snoqualmie plant, the Electron plant and the Cedar Falls plant, is approximately 96,000 hp. and that the maximum usable power from steam which can be produced under present conditions in the Seattle district is approximately 41,000 hp., making a total of available usable energy of 137,000 hp., as against a total maximum demand during 1917 of approximately 128,000 hp., leaving a theoretical surplus of only 9000 hp. Since this time and up to July 1, 1918, additional demands for power have been made upon the municipal plant and contracts signed for 17,000 hp. and notification has been given to the management that an additional supply of 44,000 hp. will be required in the near future. To furnish this amount of current to customers, it is stated that an additional installation to develop approximately 67,000 hp. will be required, and that if this is not done there will be a power shortage at the end of the year amounting to 58,000 horsepower.

"Faith" Starts for the Atlantic

The concrete freighter "Faith" recently left San Francisco with a cargo of lumber, bound for the west coast of South America. There she is to take on a load of nitrate and go via the canal to a northern Atlantic port.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS: 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 704 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The Engineers' Club of Mobile, Ala., was organized at a meeting of members of the profession held July 23. L. W. Duffee, special engineer for the Gulf, Mobile & Northern R.R., was chosen as the first president of the society. Other officers chosen were: vice-president, Wright Smith, city engineer of Mobile; secretary, R. H. Pitard, assistant chief draftsman, Mobile Shipbuilding Co.; treasurer, Walter W. Toxey, also of the Mobile Shipbuilding Co. Many members of the profession attended the organization meeting of the society, membership in which is open to professional engineers in the civil, mechanical, electrical and architectural branches. As stated by Mr. Duffee at the meeting, the coming of the shipbuilding industry to Mobile has brought with it a large number of members of the engineering profession, leading to the organizing of a local engineering society.

The San Francisco Sections of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the American Chemical Society held a joint meeting at the San Franscisco Engineers' Club July 23 to hear A. D. Flinn, secretary of the Engineering Council. Mr. Flinn described the work of the various joint organizations, centering in the Engineering Societies Building in New York City, particularly war-time activities, in which he asked for the aid of Western engineers. A resolution that there be formed in San Francisco a joint council, to coördinate the activities of the five national engineering society sections in that city, was unanimously adopted.

The Northwestern Society of Highway Engineers, the Oregon Society of Engineers, and the Portland Association of Members of the American Society of Civil Engineers held a joint meeting in Portland July 13. Following the business session a banquet was held at the Benson Hotel in the evening. The address of welcome was delivered by Herbert Nunn, president of the highway engineering society. R. H. Thompson of Seattle discussed the importance of enacting legislation for the registration of professional engineers.

The Cleveland Engineering Society will hold its first regular meeting for the coming season on Sept. 10, which will be addressed by Alfred D. Flinn, secretary, Engineering Council, New York City, and by W. H. Finley, president American Association of Engineers, Chicago.

Personal Notes

W. C. CUSHING, chief engineer maintenance of way, Pennsylvania Lines West of Pittsburgh, has been appointed engineer maintenance for the Pittsburgh, Cincinnati, Chicago & St. Louis Ry., the Cincinnati, Lebanon & Northern Ry., and the Lorain, Ashland & Southern R.R., as well as the Pennsylvania Lines West, under the new organization of Federal management.

L. L. BEALL, chief engineer of the Atlanta, Birmingham & Atlantic Ry., has been appointed chief engineer for the Georgia R.R., the Atlanta & West Point R.R., the Western Ry. of Alabama, the Charleston & Western

Carolina Ry. and the St. Louis-San Francisco lines east of the Mississippi River under the new organization of Federal management.

F. W. BALLARD, consulting engineer, Cleveland, who has been commissioner of lighting for the city of Cleveland and who had charge of the city's municipally owned electric light plant, has been appointed special assistant to the vice-president of the Emergency Fleet Corporation, with headquarters in Philadelphia.

W. H. VANCE, engineer maintenance of way, St. Louis Southwestern Ry., has also become engineer maintenance of way for the Louisiana & Arkansas Ry. and the Illinois division of the Missouri Pacific R.R. under the new organization of the Federal management.

M. N. WATSON, road engineer for the State Highway Commission of Kansas, has assumed the duties of W. S. Gearhart, state highway engineer for the commission, during his leave of absence for the duration of the war as captain in the Engineer Officers' Reserve Corps, noted in last week's issue.

R. G. JENCKES, JR., has resigned as assistant engineer for the Indianapolis Water Co. to become associated with the Pitometer Co., of New York City, with headquarters at Wheeling, W. Va.

BERTRAND E. GRANT, division engineer, Board of Local Improvements, Chicago, and past president of the Western Society of Engineers, has been granted leave of absence to enter the service of the Emergency Fleet Corporation at the Hog Island shipyard.

MISS FLORENCE HOLMES, Portland, Ore., who has been appointed to a position in the town planning and housing work at the Puget Sound Navy Yard at Bremerton, Wash., is attached to the office of E. T. Mische, of Seattle, who is at the head of the town-planning division of this project, as noted in *Engineering News-Record* of last week, p. 197. It is said that Miss Holmes is the first woman in the country to receive such an appointment. As a student at Oregon Agricultural College she majored in landscape architecture, her course including surveying and elements of civil engineering. Since her graduation she has designed a memorial gateway that was erected on the Oregon Agricultural College campus as the gift of the senior class.

P. D. FITZPATRICK, valuation engineer and general road master, Central Vermont Ry., has been appointed chief engineer. Mr. Fitzpatrick was appointed valuation engineer in January, 1916, with headquarters at St. Albans. In July of the same year his duties were expanded to include those of general road master as well as valuation engineer.

HERBERT E. HUDSON, division engineer, Board of Local Improvements, Chicago, has been granted leave of absence to become division engineer for the Construction division of the Quartermaster's Department at the Aberdeen proving grounds, north of Baltimore.

A. B. TRUMAN has been appointed division engineer of the New Mexico division, Atchison, Topeka & Santa Fe Ry., with headquarters at Las Vegas, N. Mex., succeeding J. A. Roach, who has entered military service.

L. H. SALTER has been appointed chief of the Bureau of Sanitary Engineering of the new organization created by coördinating the sanitary and health departments of Jefferson County, Alabama, including the city of Birmingham.

LEROY F. WERTZ, for the past seven years assistant engineer for the Board of Park Commissioners of Indianapolis, has been appointed assistant engineer to the Indianapolis Water Company.

RALPH W. EATON, engineer for the Shore Line Electric Ry. system, Norwich, Conn., has been appointed public service engineer of Providence, R. I., succeeding Robert L. Brunet.

M. R. SUMNER, resident engineer for the Jessup & Moore Paper Co., Philadelphia, with headquarters at Wilmington, Del., is to become associated with Fred T. Ley & Co., Inc., contractors and engineers.

R. L. ROWLEY, assistant engineer for the Board of Fire Underwriters of the Pacific, San Francisco, has become engineer for the insurance department of the Emergency Fleet Corporation, United States Shipping Board, at 369 Pine St., San Francisco.

ALLEN G. LINCOLN, division engineer for the Victor American Fuel Co.'s mine at Chandler, Colo., has been appointed assistant district engineer in the Denver district, United States Forest Service. Mr. Lincoln will assume his duties as assistant district engineer Aug. 10.

FRANKLIN THOMAS, professor of civil engineering and chairman of the faculty executive committee of Throop College, Pasadena, Cal., has been appointed assistant engineer under Capt. Charles T. Leads, Los Angeles division engineer for the U. S. Army Corps of Engineers, who is in charge of army construction work along the coast of Southern California and flood control work along the Colorado River.

ARCHIBALD H. ROWAN, assistant to the vice-president, traffic department, New York Central Lines, has been commissioned a major in the Engineer Officers' Reserve Corps.

DAVID C. MORROW, city engineer of Washington, Penn., has resigned to accept a commission as captain in the sanitary department of the United States Engineer Corps.

OBITUARY

ISAAC SHONE, inventor of the sewage ejector which bears his name, died in England June 19. He was born at Brymbo, Wales, near Wrexham, in 1856. For many years he maintained engineering offices under the name of Shone & Ault at Wrexham and in London. He was mayor of Wrexham in 1878. His firm coöperated with Dr. Owen Travis in developing the Travis hydrolytic tank, the intermediate stage between the Cameron and the Imhoff tank for the treatment of sewage.

CHARLES ALLEN GOODNOW, vice-president of the Chicago, Milwaukee & St. Paul Ry., since July, 1917, died July 26, after a brief illness in Seattle. Entering railroad service in 1868 with the Vermont & Massachusetts R.R., Mr. Goodnow became superintendent of the New Haven & Northampton R.R. in 1881, and in 1886 was appointed superintendent of construction with the Chicago, Milwaukee & St. Paul Ry., being promoted in 1888 to division superintendent, with headquarters at Dubuque. In 1902 he was appointed general manager of the Chicago, Rock Island & Pacific Ry., and in November, 1903, became general manager of the Chicago & Alton R.R. In 1913 he became assistant to the president of the Chicago, Milwaukee & St. Paul Ry., and had under his charge the electrification of that road from Freeport, Mont., to Deer Lodge, which work was considered remarkable for the rapid progress made and the results achieved in but three years of work. Mr. Goodnow also constructed the Gallatin Valley Ry., a subsidiary of the St. Paul, and was president of that line. Many interesting innovations were made by Mr. Goodnow, such as the use of interlocking plants, English staff machines, the perfection of the manual block system as now in use on the St. Paul, and the introduction of the floating system of handling freight on Puget Sound.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Intensive Campaign in Progress To Recruit and Apportion Labor for War Industries

Will Resemble Liberty Loan Drive and Will Show Labor Shortage and Emphasize Need for Maximum Production

On July 29, the Department of Labor launched a nation-wide advertising campaign to lay before the public the plans and methods of the United States Labor Bureau for the recruiting and distribution of unskilled labor. The drive is patterned after the Liberty Loan drives and will emphasize the labor shortage and the necessity for maximum production by every industry throughout the entire nation. A preliminary outline of the employment program of the Government was given in *Engineering News-Record* of June 27, p. 1245.

A survey of the labor requirements and supply is in progress, and the results show the extent of the labor crisis throughout the country. Very few sections, so far reported, have any surplus from which labor may be drawn. When the survey of requirements is finished and the aggregate demand is found, to each state will be assigned a quota representing the common labor to be drawn from among men engaged in nonessential industries in that state. The quotas will be distributed among localities in which employers in nonwar work, including those who are only partially in war work, will distribute the local quotas from time to time among themselves.

The term "indirect war work" does not extend to those plants making supplies which may ultimately be used in war work but which are not being delivered directly to firms producing direct war materials, and such firms will not at present come under this ruling. There has been no attempt to define "unskilled" labor, since it is well understood, but where there is uncertainty in this, as well as in the matter of essential or nonessential war work, the question may be referred to the labor boards for decisions and an appeal from these decisions, if not satisfactory, may be made to the War Labor Policies Board at Washington. All recruiting for labor must be done through the United States Employment Service. Exceptions are made in the case of railroads, nonwar industries and those hiring less than 100 men, but the recruiting in these cases must not interfere with the activities of the official labor recruiting boards, by offering superior inducements, or preventing the transfer of workers urgently needed for war production, or in any way attempting to compete with the Government for labor.

The program will be extended to the skilled classes as soon as the need becomes acute, but strict prohibitions are put upon solicitation to draw skilled labor from one war industry to another or to nonwar work. No restrictions are put upon the hiring of labor that presents itself wholly unsolicited either directly or indirectly, and no cards of dismissal are needed at present.

Employers may make their wants known on blanks that are being distributed through the War, Navy and Labor Departments, the Shipping Board and the fuel administration. These blanks have been sent out, but if they have not been received application should be made to state directors. After filing the application the employer should receive a notice from the employment service informing him of the office or agent especially charged with the filling of his order.

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German Lumber Company Will Help Contractor Build Ships

With the letting of a contract by the United States Shipping Board to the Bates & Rogers Construction Co., Chicago, for eight 2500-ton schooner barges an end comes to an obvious and insidious plan of the Germans to control the Gulf of Mexico from a harbor on the south Florida coast, through the medium of the \$3,000,000 German-American Lumber Co. Since 1917 this company owned 150,000 acres of land surrounding St. Andrews Bay and strategically located directly south of the Alabama iron and steel district, but development had been suppressed and the two sawmills were operated only in a desultory manner supplying lumber for export. The only railroad to the bay was forced to condemn all land for right of way.

Since its taking over by the United States alien property custodian, the property and funds have been made available to finance a shipyard of four ways which will require a thousand men to build and as many to operate.

From the headquarters of the company, which was fitted out in fine style for the German directors, masses of propaganda material were taken when the officials were interned.

Business Conditions To Be Compiled and Indexed

Complete Statistics To Be Collected, Correlated and Published by Reserve Board

An index of industrial, business and economic conditions throughout the country, for publication in its monthly bulletin, is the purpose of the Federal Reserve Board announced recently in Washington. Business progress, economic changes and the financial and banking situations throughout the country will be correlated, and a series of indexes inaugurated for the use and guidance of the industries and business.

The board expects to obtain its material from trade journals and commercial organizations, as well as from Federal Reserve agents, state and municipal sources. The information will cover the production, consumption, transportation and prices of commodities and other factors. Changes occurring in the economic and business conditions of the country may be followed. They will include market movements, receipts and shipments of stocks in hand and the prices of leading commodities. From such data an index will be computed to show the changes in volumes of trade, stocks, consumption, etc.

The scope of the undertaking will cover the following topics:

1. Retail and wholesale prices indexed with reference to a specified base. This will include a series of indexes computed by private investigators, such as Dun's, Bradstreet's, the Bureau of Labor Statistics, etc. These have been the subject of a study made by W. C. Mitchell recently published by the United States Bureau of Labor Statistics; the figures will be correlated to compare changes in price, with production and the movement of commodities.

2. Production reports, gathered from reports of various industries, especially the basic industries, such as iron, coal, steel, copper, mining, etc. These will be a basis for producing factors for the correlation of information regarding the quantities of products on hand, in storage or at points of shipment, and the assembling and distributing of output.

3. Railroad data compiled from the reports of the railway administration as to the changes in movement and character of freight, and showing the activity of industries by indicating the extent to which such materials were being demanded and moved in order to supply consumption.

(Concluded on next page)

Labor Recruiting

(Concluded from previous page)

Local quotas will be drawn upon first. Where this is not adequate, other states will be drawn upon, but movements from state to state will be effected with the greatest economy in distance traveled. The distribution from these quotas will be arranged between the state directors, subject to supervision from Washington. The transportation will be paid by the employment service from its "revolving fund" and later collected from the industries for whose benefit it has been advanced.

All the men before leaving their home sections will be examined as to skill and physical condition. Local public health boards will conduct physical tests and all requirements as to vaccination, etc., will be announced and complied with in advance.

The employment service is established throughout the nation and divided into state organizations which in turn are subdivided so as to cover every community.

Rocker End-Dump Truck Operated from Driver's Seat

A 1½-ton end dump body in which the weight of the material supplies the energy for operating it, the control being from the driver's seat, is shown in the accompanying illustration. The operation is accomplished without the addition of power from either the engine or the operator.

The mechanical action is on the rocker principle, and lies in the design of the curvature in the supporting rockers. The employment of this mathematical curve makes the weight of the material in falling perform the work of tipping the body and storing sufficient potential energy to cause it to regain automatically the horizontal position after the load discharges.

The attachment is made for the Ford truck, and is manufactured by the Anthony Co., Inc., Streator, Ill.

Business Indexes

(Concluded from previous page)

4. Banking information such as clearings, deposits and reserves, together with commercial rates of interest and discounts on various loans, and information as to capital and credit, will be compiled. The information and statistics from the office of the Comptroller of the Currency and the Federal reserve system generally, as well as other banking data, will be indexed so that the industries may be able to obtain the information desired.

5. Under savings and investments, improvement on the information that has been so far available will be attempted, to show the relations between production and consumption as indicated by savings. This will supply the information regarding the money available for investments and the capacity of the country for the employment of labor.

6. The employment of labor, its extent and distribution at any given time in the various portions of the country will indicate the volume of industry and the purchasing and consuming power throughout the various industrial sections.

The Federal Reserve Board states that the establishment of these indexes is only a step in the eventual development of a complete service of business indexes relating to the condition of the chief industries.

Obituary

George Bancroft Adair, president of George B. Adair & Son Co., dealers in general machinery and electrical equipment, Seattle, died recently at his home in Seattle. Mr. Adair organized the Adair Co. in 1912, after having been engaged in the hardware business for many years. He was born at Romulus, N. Y., July 13, 1847.

LIGHT MOTOR TRUCK WITH AUTOMATIC DUMPING DEVICE

Business Notes

Joseph Tracy, formerly a racing motorist but later an engineer for various automotive interests, has been appointed consulting engineer to the bureau of oil conservation, United States fuel administration. He will supervise the testing of gasoline and other fuels and their consumption in all types of automobiles.

The Pioneer Asphalt Co. reports that its plant at Lawrenceville, Ill., was burned to the ground July 20. Under present conditions it may be difficult to secure a supply of material for resuming operations. H. B. Pullar is general manager.

W. H. Foster, president of the General Fireproofing Co., has been elected chairman of the Youngstown, Ohio, division of the War Industries Commission.

G. O. House, formerly superintendent of the St. Paul municipal water department, has been appointed manager of the Northern States Power Co., St. Paul, Minn., succeeding P. T. Glidden, deceased.

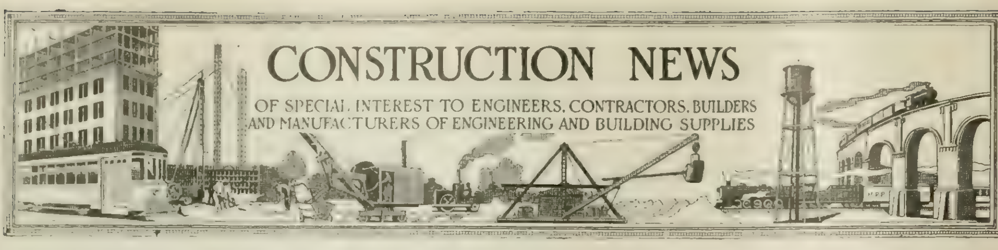
Trade Publications

The All-American Truck Co., Chicago, Ill., has issued a folder announcing the introduction to the automobile market of the All-American internal-gear-drive one-ton truck.

The Villadsen Bros., Salt Lake City and Ogden, Utah, engineers and contractors, have issued a booklet containing illustrations of the concrete buildings and industrial plants erected in Utah and adjoining territory by that company.

A catalog has been received entitled "Graphic Record Supplies," of specially prepared material sold by the Educational Exhibition Co., Providence, R. I. It illustrates graphic charts and supplies for use of executive sales managers, advertisers, draftsmen, educators, engineers, etc.

The Wellman-Seaver-Morgan Co., Cleveland, Ohio, has issued Bulletin No. 10, dated July, 1918, on the W-S-M Coke Oven Machinery. It has six pages of 8½ x 11 size, and describes and illustrates this class of heavy machinery.



Construction Material Prices Subject of Several Important Meetings and Conferences

Indications That Coal Production and Food Supplies Are Meeting the Crisis Will Probably React on Prices

Several important meetings and conferences on building materials have drawn marked attention to the problems of prices, supply and demand involved in the present situation.

The critical condition of the trade, owing to the sharp rise in prices of material of all lines and the restriction due to Government action were the reasons for the recent meeting of representatives of building trades at Atlantic City, called by the United States Chamber of Commerce. The progress made by all Government war work has been so far beyond expectations that the demand on raw and other materials has exceeded the most farseeing estimates. This has produced advances in prices, where such advances were possible, and has brought pressure to bear on those prices already fixed by the Government. The report from the coal fields, however, that coal production will probably meet the shortage threatened for next winter, and the recent announcement by the food administrator that the food problem has been solved, will probably have a corresponding reaction on prices.

Prices May Be Higher

Prices will probably be forced to still higher levels by the recently announced housing program, provided for in a $110,000,000 appropriation, and the depleted stocks of nonferrous materials, especially cement. The fact that steel is strictly preëmpted by the Government for ship construction, shell and other war supplies, and that the Federal levies will continue to be high, will probably have a corresponding effect. The volume of building construction for this reason will probably not be more than $350,000,000 for the year exclusive of Government building operations, which, together with the housing problem, has created a situation such that manufacturers of the building commodities are calling for revisions and new rulings on these lines by Government officials. They are urging priority rulings that will make possible the production of these commodities in larger quantities. If such rulings are deferred they say a price reaction will be produced that will seriously affect even Government operations.

At the beginning of the month the Price Fixing Board, as the result of the urgent request of the copper producers, advanced the price of copper from 23½c. to 26c.

The ability of the country to produce shipyards and ships has gone so far beyond expectations and estimates that, although the steel producers are realizing the predicted maximum output, the demand on steel has become such that the probability of a surplus is entirely gone. Mr. Hurley and Mr. Schwab are urging steel producers to do all in their power to meet the demand but the representatives of steel industries say that a readjustment of prices by the War Industries Board is necessary. A conference will shortly be held by Mr. Replogle of the War Industries Board and steel manufacturers, for the purpose of fixing prices on steel rails, wire ropes, castings and other steel products. The current reports of the Bridge Builders' and Structural Society indicate that nearly two-thirds of the entire capacity of the bridge and structural shops has been contracted for. These demands are having such a large effect on the steel reserve that a revision of the Governmental estimates of steel for the rest of 1918 is considered necessary, the shipping board alone asking for a reserve of 1,250,000 tons.

Charges of Profiteering Answered

Charges of profiteering recently made by the Federal Trade Commission regarding Southern lumber caused a protest from President Charles S. Keith of the Southern Pine Association. He pointed out that the companies forming the association with capital amounting to $170,000,000 and which produced 2,500,000,000 ft. of lumber annually, made a margin of $3.53 per M. on their shipments last year. He also pointed out that, although various economic reports show that the increase in commodities in the year of 1918 over that of 1913 amounted to 100%, the inincrease in Southern pine lumber amounted to only 39% for the same period. $3.00 per M. however is the margin computed as reasonable by the Federal Trade Commission.

During July the price-fixing committee of the War Industries Board issued a new scale of maximum prices for long and short-leaf Virginia and Carolina pine. These prices are based on information submitted by the Federal Trade Commission and representatives of the industry throughout the country. With few exceptions, the prices are fixed on the same basis as the list published for Southern pine and the prices to the Government will be on the same increase as that of Southern pine, so that the price to the Government will be higher and to the public lower. A request by the wholesale lumber dealers to the War Industries Board for relief from the order forbidding manufacturers and dealers to accept orders for mill shipment above the maximum prices fixed in June was refused.

The price-fixing committee has allowed an increase of about $4 per M for New England spruce. This will advance the prices to about $38 to $60 per M according to size, length and finish. These prices will hold from July 19 to November 1, 1918, and will apply to the American Government; the Allies; railroads and other lumber customers for all mill shipments.

Changes in Priority Classification

Recent changes in the priority classifications made by the War Industries Board, in which Class C was changed to include items entitled to preference, the addition of Class D, to take those which are not entitled to preference, and the establishment of automatic ratings, will probably have some effect on prices. These changes are expected to proivde a wider distinction, so that production will be stimulated through the ability of some industries to obtain the necessary raw materials.

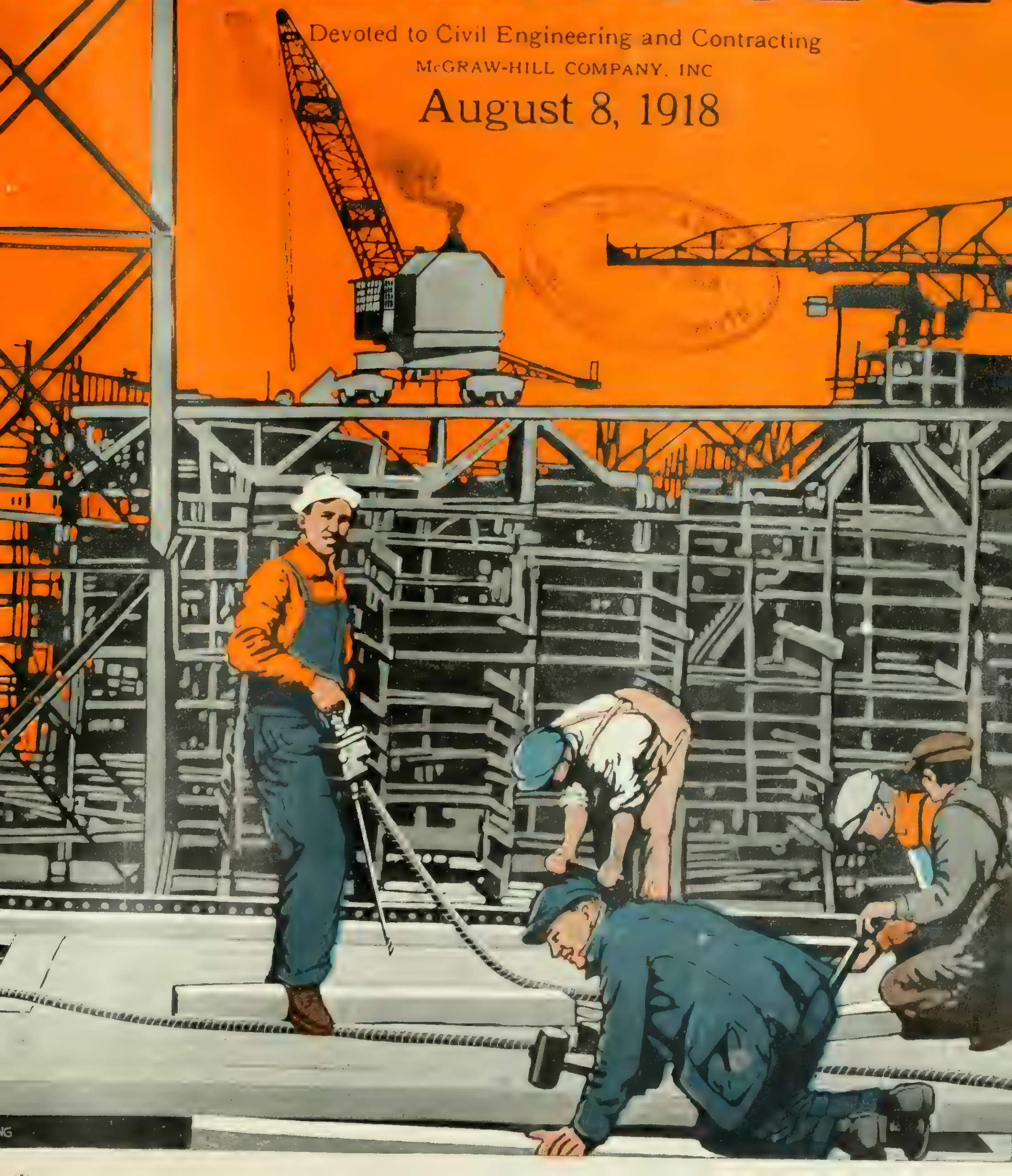
The price list shows no change in pig iron, railway supplies and steel and iron pipe, except one item in railway ties and some change in the discounts for steel products. The price of cast-iron pipe was advanced in San Francisco and Dallas, Tex., and clay drain tile has advanced in St. Louis. The current prices of sewer pipe in New York and St. Louis, Boston and St. Paul have advanced, but a slight decline is noted in Seattle, Wash. In road-paving and construction materials the prices are generally stationary, except a slight advance in asphaltum, wood paving block, lime and triangle mesh. Brick prices have advanced over last month in New York, St. Louis, Denver, Boston, St. Paul, Kansas City, Seattle, Cincinnati and in places in the South.

Engineering News-Record

Devoted to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC

August 8, 1918

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* CHARLES WHITING BAKER, *Consulting Editor*

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Two More Great Yards Now Producing Ships

SIXTY-TWO more shipways joined the company of producing yards during the week, when Bristol and Hog Island celebrated their first launchings. Agency yards both, they are constructing bridge-shop-fabricated vessels. Last year's all-summer battle over quantity ship production ended eleven months ago with the decision to build steel ships in agency yards, which is already justified by the event. The course taken put the full strength of the nation into shipbuilding. Figures published in *Engineering-News Record* of July 4, p. 40, reflected the tremendous ship output attained. With the two great yards that began to launch ships this week, we are closely approaching the maximum rate of production there forecast.

New Speed Records Show Increasing Efficiency

WHILE massing more resources on the work of building ships, we are progressing also in efficiency. Ever new marvels of achievement seem to be the order of the day. At Ecorse, in Michigan, they built a steel vesel of 3500 tons in fourteen working days from keel-laying to launching; the "Tuckahoe" record was far outdone by this performance. Yet within a few days afterwards, another yard set a much more wonderful mark of speed. Alameda launched a 12,000-ton ship after but twenty-four days of construction, or thirty calendar days. "Invincible" is the name of this remarkable vessel, launched on August 4. At the shipyard's present pace, the record is not likely to stand for long. Not a yard but is driving its work at top speed; and the top speed of today is not limited by what was considered possible yesterday.

Imperial Valley Seepage Case

ENGINEERS throughout the West have been waiting anxiously for the decision in the Imperial Valley seepage case reported on p. 237 of the last issue. The court found in favor of the canal company. The case will probably be carried to the higher courts, and should the decision there be reversed, the result would be a serious blow to irrigation properties, in California at least. It would force the lining of all canals that were in any considerable degree leaky, an expense that would in general be prohibitive. In districts wealthy enough to be able to meet the high cost of lining, the result would be that lands favorably located and not water-logged would have to pay for the drainage of those troubled with water. Further progress of the case will be waited with interest. Meanwhile one cannot but believe that cases of this sort serve to show the necessity for constant emphasis upon the ultimate need for drainage, even though the character of the drainage works cannot be determined when the project is planned. Were irrigationists taught from the start that irrigation necessarily implies drainage, cases of this sort would not arise.

Work for Every Cleveland Soldier When War Is Over

RECONSTRUCTION problems demand early attention by every city of the country, but few seem to be acting accordingly. Cleveland affords a marked exception. Following the general plan mentioned by City Engineer Robert Hoffmann on p. 36 of this journal for July 4, Mayor Davis of Cleveland has asked all his department heads to submit to him an outline of needed public improvements. These reports will be referred to the City Planning Commission for weighing and coördination. On approval all preliminary details can be worked out so construction may be started as soon as the war is over. By this means the city will provide work for all its returned soldiers and at the same time carry out the elements of a well conceived city plan. Other cities will do well to follow Cleveland's lead.

Efficiency, Like Charity, Should Begin at Home

EMPLOYING an efficiency engineer at city expense and placing him at the service of local industrial plants without charge to the latter is the novel proposition made by the Jersey City Commissioner of Finance and Revenue. In most cities of the country charity of this sort should begin at home. Relatively few American cities recognize the value of continuous expert engineering service and fewer yet are willing to pay for it and to leave the engineer who gives it free from the deadening influence of party politics.

Economical Size of Motor Truck Must Be Determined

REVIEWING the highway transportation problem, it appears to divide under three main heads. The first of these represents an established fact, the second propounds an interesting question, while the third deals with a most perplexing problem demanding immediate solution. That motor truck transportation over good roads is desirable for the short-haul up to fifty or sixty miles cannot longer be doubted. The large proportion of freight which, in any event, has to be loaded

upon motor trucks at one or both ends, and the economics of railway transportation which appears to demand a low mileage per car day, unite to make the use of trucks both convenient and economical. The question as to whether the truck will ultimately be found desirable for the long haul is interesting but more or less academic. Academic because it has no particular bearing upon the construction of the roads. If the road slab is put in condition to carry the short haul truck, the length of haul can be regulated at will. The problem demanding immediate solution, therefore, is, What is the heaviest economical size of truck? This must be settled before engineers can form any logical opinion as to the thickness of the road slab. The problem is one dependent upon the mechanical limitations of the truck, the economical size of load and the heaviest wheel loads for which it will pay to allow in designing highways. Truck manufacturers, truck users and highway engineers should get together and bend every effort to solve the problem.

Long Municipal Service Honored in England

APPRECIATION of long terms of municipal engineering service is more common in England than in the United States—partly because they are more frequent there than here. On the recent retirement of C. H. Cooper, borough engineer and surveyor of Wimbledon, after forty years service for the borough, the Municipal Council put upon its records its appreciation of Mr. Cooper's professional skill and devoted service, presented him with a piece of plate, conferred the freedom of the borough upon him, and appointed him consulting engineer and surveyor to the council at a salary of $500 a year. Acting further upon the principle of recognizing faithful service, the council promoted the assistant engineer and surveyor to the position held so long by Mr. Cooper, and advanced the chief architectural assistant and draftsman to the position of assistant engineer and surveyor. It would be a pleasure to *Engineering News-Record* to record oftener than it is able to do similar action on the part of American municipalities. Lest it be supposed that the conditions surrounding the municipal engineer in England are wholly ideal, attention may here be called to the brief abstract of the inaugural address of the president of the Institution of Municipal and County Engineers of Great Britain, printed on p. 274 of this issue. The status of the municipal engineer in this country deserves the careful attention of the municipal engineers themselves, the engineering societies, city councils and friends of good municipal government.

Is the Shipping Board Against Concrete Ships?

FOR some time vague rumors have credited the Shipping Board with an unexplained but quite definite opposition to the growing favor in which concrete ships are held by the experts of the Concrete Ship Department of the Emergency Fleet Corporation. Contracts for a number of such ships have been let and progress is being made in the five government yards, but the Board, like the prospective bridegroom in the old story, is reported to have "lost its enthusiasm." Those who have been slow to believe these rumors will begin to wonder if they are not true when they read of the interference of the Board in the War Department's concrete ship program, as outlined in the news pages of this issue. The Water Transport Branch of the Army has under contract and design only very small vessels, either engineless or of such low power as not to interfere with the engine requirements of the Shipping Board. The cement, aggregate and steel requirements are likewise small enough to be satisfied in local markets. While there is much to be said in favor of the concentration of the country's shipbuilding in one agency, the Shipping Board will be subjecting itself to a criticism of motives if it now raises objection to the War Department's proceeding with the concrete boats it has planned.

Water Waste Curtails Output of War Materials

VIGOROUS steps to prevent water waste at Philadelphia should be taken. On a recent day the consumption *and waste* broke all previous records, resulting in numerous complaints of low pressure and water shortage and curtailing the output of a number of plants working exclusively on emergency orders for war supplies. The daily pumpage reached 359,000,000 gal., or more than 200 per capita. Besides cutting down war supplies this means increased costs for pumping and filtration, increased fire risks, increased danger to health from overworked water filters and an unnecessary draft on the limited coal supply of the country. Engineers in the Bureau of Water realize the gravity of the situation and would have averted it long ago could they have had the backing of the City Council and the public. What is the Engineers' Club of Philadelphia doing to help stop the water waste for which Philadelphia has long been notorious?

New York's Dual Subway System Is Opened

WITH the formal initiation last Thursday of train service over the new trunk lines in Manhattan and the Bronx of its dual subway system, New York City has in operation the major portion of the greatest rapid transit system in the world. The new system, the present enlargement of which has cost more than the Panama Canal, and perhaps more than any other railroad or public utility yet built in the world, will transport annually 3,000,000,000 persons. It will have a total trackage of more than 600 miles, and several of the trips which can be made on it are far longer than the distance that may be traversed for a single fare on any other rapid transit system in existence. The construction of the lines under streets carrying the densest of vehicle traffic, through treacherous ground adjacent to heavy skyscrapers, beneath the East and Harlem Rivers and finally over outlying areas on steel and concrete elevated lines, presented an array of construction difficulties which can safely be said to have surpassed those of any other work ever undertaken. The conditions have called for well nigh every known type of construction, and in many cases have required the development of new methods, which have contributed greatly

to the science of construction. Those who conceived, designed and built the great system deserve the highest praise for the vision with which the work as a whole was planned, and for the skill with which it was executed. There may be details in which the system will require modification, but no work of this magnitude whose construction must occupy a long period of time, during which conditions are bound to change, can be carried out without minor alterations in plan. It is true that the system has been put in operation somewhat later than was intended, and that important work remains to be done in adjusting the construction contracts before the dual subway can be completed. War conditions, however, have intervened since the work was undertaken, and the completion by Aug. 1 of the most important trunk lines, under the present difficulties imposed upon construction work, is in itself a monument to the builders.

The Times Square Tangle Becomes a Reality

NO SOONER was the new "H" subway system in New York City opened than the public afforded a demonstration of the fact that accustomed ways are hard to change, and incidentally a foretaste of what many expect will happen at Times Square when the East River tunnels are completed and the new Broadway subway brings thousands of Brooklynites to that district during the rush hours. The crush at the Times Square and Grand Central stations which made it necessary to discontinue temporarily the 42nd Street shuttle service on the cross of the "H" between the two new lines until passageways could be improved and adequate signs posted for the direction of passengers was not due primarily to the planning of the new system. It was chargeable, in great part, to the fact that the opening took place in the middle of the week. Had the new service been inaugurated on Saturday night the public would have had a full holiday to become acquainted with its workings before the arrival of the next rush hour.

In any case there would have been many thousands arriving at the Grand Central Terminal and wishing to reach the upper West Side, and many residing in that section who wished to reach the district below the Grand Central Terminal, who would have attempted to use the 42nd Street shuttle until they learned that it was incapable of carrying the traffic. This was the strongest argument advanced for rearranging the layout at Times Square to provide for operating a small percentage of the trains on the upper Broadway line to the Grand Central. In time, however, those who wish to reach upper Broadway in the morning will move out of the district served by the New York Central R. R., and those who must reach the Grand Central district will move away from the upper Broadway line, so that the shuttle traffic under 42nd Street will be reduced to passengers other than commuters using the New York Central, and to non-rush-hour traffic, which it will be able to accommodate.

The more serious situation at Times Square is that presented by the arrangement of the Broadway Subway station, underneath that of the Interborough. This station as built is provided with 300-ft. express platforms having exits only at the ends. It is far below the street, and stairs and passageways are narrow and will undoubtedly prove wholly inadequate. As was described on page 452 of *Engineering Record* of March 22, 1917, this station was redesigned to meet the obvious needs of the traffic, and the new design was at one time actually adopted. It failed of execution and the inadequate station which was planned years ago without the advantage of present knowledge of subway traffic was built because certain officials took umbrage at the refusal of the contractor to install cast-iron columns for a price which the contractor stated to be less than the cost of the columns at the foundry. This deplorable incident, which is of a type that can never be excused in connection with important public work, was fully commented on by this journal on p. 819 of its issue of Nov. 1, 1917. As was pointed out at the conclusion of that editorial, it is to be expected that this station will have to be rebuilt at considerable expense before it is long in operation.

Does Commission Control Remove the Hazard of Investment?

AT a recent hearing upon the petition of one of the larger water companies of this country for increase in revenue to meet its abnormal increase in operating costs, the significant suggestion was made that the commissions themselves, rather than the corporations, were on trial in pending petitions for relief presented by public utility corporations to the public service commissions or other regulatory bodies all over the country. At the same hearing one of the commissioners expressed himself as not interested in the question of dividends, but as being very much interested in the maintenance of service by the company.

That substantial relief is urgently needed in many cases no fair-minded man would deny. It has been recognized clearly for several years by operators and students of economic problems that the number of examples of seriously declining service rendered by different public utilities was growing with dangerous rapidity, due to advances in labor, material and supply costs, and that the necessary relief, through increase in rates and revenue, was not being given by the regulating authorities. The country has been paying a very high price for this sort of public policy and lack of sound commercial sense toward the railroads for several years, and is now facing similar conditions in other fields.

This situation raises some interesting problems of public policy. Is the government bent upon extending its functions to the limit of general public ownership of the utilities—steam and electric railroads, telegraph, telephone, power, gas, electric light and water plants—or is the fundamental idea of regulation and control still the dominating one? Obviously, ownership and operation will involve enormously increased personnel over that of the regulatory bodies. Is it possible that the country can be ready for this additional step as a permanent measure?

In the more limited field of public regulation or control, too, the situation presents some vital questions of policy, one of which, of particular interest at this time, is suggested by the water works situation referred to above. For years the public service commissions have stood on the principle that commission con-

trol removed the hazard of investment and that public corporations thus protected must therefore be content with a smaller rate of return; while the commercial world and even the Supreme Court has held that the corporation should carry the hazard of the business and be compensated accordingly. It is fair to inquire, now that the war has enormously increased the hazard carried by the corporations and correspondingly reduced their ability to maintain a reasonable return, and in many cases to preserve the integrity of the properties themselves, whether the commissions are living up to their pronouncements—whether they are removing the hazards of business and granting the necessary relief. That the conditions are abnormal and most difficult is true. That some measure of relief has been accorded in many cases is also true. But is the principle being adhered to generally? To this there can be but one answer, and that a negative one. The most that can be claimed is that the regulatory authorities are trying to maintain credit. Perhaps their effort could more fairly be characterized as one to prevent bankruptcy.

The moral of the situation is clear. The facts should be faced fearlessly and fairly. The investing public also has rights and can in the long run dictate terms within the limits of economic laws. If the commissions and regulatory bodies of the Government or the State, from considerations of policy or lack of power or support, have abandoned, or through the compelling force of events have been forced to disregard, their intent to remove the hazard of investment, the public is entitled to a frank admission of the fact. The corporations should not now be denied full relief from their extraordinary burdens and later on in normal times be limited again to a return restricted by the doctrine that commission control removes the hazard element.

To urge that the war is alone responsible for the situation justifies the conclusion that the hazards will be removed to a degree only, inversely proportionate to their severity. A fairer interpretation of the cause of the railroads under commission control during the past five years would be that the cutting of values and rates is an easier task than their upbuilding. Destructive influences can readily be set in motion in a moment by individuals. Constructive measures, on the other hand, involve coöperative effort over long periods of time.

Is it not likely that the avowed attempt to remove the hazard of investment has involved a task economically and psychologically impossible of achievement? The commissions and other regulatory bodies are indeed on trial.

Construction Plans Should Anticipate Contingency of Winter Work

ENGINEERS and contractors need to determine and appraise the factors which frost introduces in construction problems. It is seldom, north of forty-two, that one can be sure that work planned and undertaken can be completed during the season of no frost. Plans miscarry.

An example of good calculations gone wrong is furnished by the Dead River Dam, the construction of which is described in this issue. Had normal market conditions prevailed, the connecting railway to the dam site would have been completed in early summer, and before frost the bulk of the dam building would have been accomplished. War intervened, and actual building was not begun until frost had set in. Most of the construction had to be prosecuted in severe winter weather. Winter construction is a contingency always to be kept in mind. The engineer may well design his structure so that the dangers of winter work, should it become necessary, are minimized. The contractor should plan his operations in such a manner as will enable him quickly and at least cost to adapt his plant and his organization to the requirements of winter work. Means of winter construction need to be studied and their possibilities in the way of risk to the quality and appearance of work need to be determined. Data on the excess cost of winter construction should be collected.

Structures like the Dead River Dam, where zero weather concreting was carried on successfully all last winter, and like the Junction Dam, where hydraulic fill was put in at all temperatures above fifteen degrees below frost, are distinctly noteworthy because of the assurance they furnish of the comparatively slight risk from construction in winter. Extra precaution and often additional appliances are necessary of course, and these increase cost. They must increase cost very greatly, however, to equal the loss in accumulated interest and foregone profits resulting from delaying work until the next season.

Local Society the Fighting Unit

LOCAL societies are the fighting units in engineering society organization. The close acquaintanceship possible in a small organization favors effectiveness, while the public problems taken up touch closely the life of each member. In consequence there is a latent—and in some cases a present—virility about the local that should be capitalized by making it contribute to a national organization of all engineering forces.

With the purpose of strengthening the locals, the Cleveland Engineering Society early this year proposed that membership in a local society be made a prerequisite for membership in a national. Moreover, as further evidence of the close relationship it holds should exist between national and local bodies, the society has concluded an arrangement with the American Association of Engineers by which there are combination dues and entrance fees for the two organizations. The matter was explained by Mr. Drayer on page 217 of last week's issue of this journal.

The proposal made and the relationship effected call attention to the so-called Nashville plan, originating with Hunter McDonald, which proposes—presumably for exercising the civic functions proper to engineering societies—that engineering society organization be on a federal plan, with the Engineering Council as the national body. Societies in any one locality would be consolidated and have representation in a state society, while the state society in turn would be represented in the national body.

In the past five years, sentiment for strengthening the local has grown particularly strong in the Middle and the Far West. Mr. Drayer well analyzes the movement when he says that "the higher the standing of

the individual engineer in the community, the greater is his obligation both to the profession and to the community." That point of view has not been emphasized. In fact, no national engineering society professes, in its constitution, to accept any responsibility to the community. The present day is forcing a revision of traditional attitudes, and once the engineer's civic obligations and the pertinence of his participation through his organization in engineering questions of a public nature are clearly recognized, the need for strong local bodies is apparent.

While the immediate emphasis upon the need for strong local societies comes from the West, the thought is, of course, not new. One recalls that the present movement bears a strong resemblance to the Civic Scientific Alliance proposed by W. L. Saunders. That movement got so far as the drafting of a constitution and its submission by an organizing committee to the four national engineering societies and the American Chemical Society. In fact, the American Society of Mechanical Engineers approved of its formation. Before further steps could be taken, the plan for the Engineering Council was announced and Mr. Saunders advised that the proposed Alliance be held in abeyance until the council had an opportunity to prove that it was the proper instrument for centralizing the civic functions of the engineer. Under Mr. Saunders' plan, the engineers in any one state would organize and elect their delegates to a national body. As then proposed, it did not take cognizance of the local, but nevertheless was distinctly national in character. Later the proposed organization was spoken of as the Engineers' Civic Federation and the plan expanded by providing for local subsidiary bodies. The only value of this historical reference is to show that there are those in the East who can be counted on to support a matured plan for a national organization of what might be termed the civic forces of the profession.

Judged by the ideals of the proposed Engineers' Civic Federation, the Engineering Council so far has fallen short of the requirements. Thus far its affiliation extends only to the four national engineering societies, and its present plan includes the accession to membership of national bodies only. That plan is too narrow and must eventually give way. While it may be tolerated for the moment as a safe step in the development of the organization of the Engineering Council, we believe that the movements in the West will gain such headway as to force it to broaden its scope.

The coördination needed is not along technical lines. Technical committee work and technical functions generally can be carried on satisfactorily by the nationals without affiliation with the local bodies. But civic activity and the enlargement of the horizon of the engineer depend upon a national coöperative movement, participated in by broad men, giving a forum for receiving and disseminating views from every part of the land.

While such a civic movement pushed vigorously by the Engineering Council would not lack support, it would be materially strengthened if the national societies would see fit to insist upon membership in a local body as a prerequisite for membership. The proposal will come as a shock to the ultra-conservatives, but we see no direction in which it would affect detrimentally the standing of the larger bodies. They would still be free to grade their members as they chose and to select them with the utmost strictness. They could not elect a candidate unless he belonged to a local body—that would be the only limitation.

Any plan by which a national organization would be headed up into the Engineering Council would mean a readjustment of the present relationship to that body of the national engineering societies. Adjustments, however, are mere matters of detail, if a plan can be devised that will amalgamate for civic service the engineers of this country. The Cleveland movement, the Nashville plan and the federation proposed by Mr. Saunders are steps toward a much desired end.

"The Road to Berlin Begins in America"

MOTOR-TRUCK advertising, with rare exceptions, has been used to emphasize the particular advantages of the make of truck advertised, some detail of its construction or some of its remarkable performances. We recall, however, that the Autocar Company and the Garford Motor Company have appreciated the necessity for building a good track for the truck to run on. One of the most striking evidences, however, that we have seen of a true appreciation of the position of the hard road itself in highway transportation is expressed in an advertisement of the White Company printed in the *Saturday Evening Post* of July 27. It is prefaced by the striking slogan used as the title for this note, "The Road to Berlin Begins in America," and points out that it is useless to manufacture materials if they cannot be transported. The advertisement correctly says, "Highways must relieve the railroads and highways *cannot* unless they are built to endure heavy trucking. Last winter more factories would have shut down for lack of coal, large cities would have suffered from food famine, and war exports would have been retarded if motor trucks had not been able to operate from country to city, from inland to seaboard. But, *all* of this assistance was *limited* by the scarcity of good roads."

We wish that more manufacturers—yes, and more officials in Washington—would take the same broad point of view that is taken by the White Company in this advertisement. What use to build trucks, what use to produce food or manufactured articles, unless they can be transported? For our railways the government has a denfinite policy of increasing facilities; on the conversion of industries from a peace to a war basis Washington's ideas are most definite; on the restriction of luxuries, the rationing of foodstuffs, on forcing men into important work there are clearly defined policies. On highways, strictly a war essential, there is confusion. Washington blows hot and blows cold in almost the same breath. It declares in one moment that the investment in highways must not be lost and that highways are a necessary part of the transportation system. The next minute it passes priority order No. 2, prohibits the use of certain bituminous materials for roadbuilding (though plentiful supplies are available) and threatens the ruin of contractors by raising railroad rates on roadbuilding materials from 50 to 200 or 300%. Would that there were more straight thinking, such as evidenced in this advertisement, in official Washington.

Concrete Caisson of New Type Used in Breakwater

Trapezoidal Shape Adopted for Economy—Caissons Launched, Sunk in Place and Filled to Carry Superstructure of Monolithic Concrete

HOLLOW reinforced-concrete caissons of trapezoidal section—that is, having sloping sides—are being used for the south breakwater now under construction at Racine, Wis. They are launched on inclined ways and after being floated into position are sunk upon a prepared bed of broken stone. Upon them is a superstructure of monolithic concrete. Similar caissons, but of rectangular section—with vertical sides—have been used for the north breakwater at Racine and also at

HOLLOW CONCRETE CAISSON HAS TEMPORARY DECK FOR TOWING TO BREAKWATER 25 MILES AWAY

Milwaukee, Sheboygan, Manitowoc and Algoma, all ports on the west shore of Lake Michigan.

The trapezoidal caissons for the work at Racine were adopted primarily to secure greater economy in construction and increased stability. The principal saving is due to the reduced section of superstructure, as compared with that of the rectangular section formerly used, the total reduction amounting to $25 or more per linear foot of breakwater.

All the caissons are 54 ft. long, 10 ft. wide on top, with sides sloping 3 on 1. Each is divided into compartments by three 10-in. cross walls. They are of three heights: 21 ft. 3 in., 18 ft. 3 in., and 15 ft. 3 in., with bottom widths of 24 ft., 22 ft. and 20 ft., respectively. Those of the smaller sizes are built in forms made by cutting 3 ft. from the bottoms of the forms for the next larger size. In the largest caissons the side walls are 12 in. thick at the top and 16 in. at the bottom, while the end walls are 16 in. and the bottoms 24 in. thick. Concrete is proportioned 1:2:4, with 1-in. broken stone for the coarse aggregate. Double reinforcement is provided in the sides, ends and cross walls.

The reinforcing steel for the bottom is suspended from the cores and supported by small concrete briquets laid on the plank bottom. The reinforcement for the sides, ends and cross walls is assembled over templets on the floor of the wharf and built up into mats which are hoisted and placed by a locomotive crane, being then secured in position with steel spreaders and wires.

The bottom of the form is 3-in. plank placed on blocking. This planking remains as part of the caisson, being anchored to the concrete by ⅜-in. wire spikes 7 in. long. The core forms are supported on steel knees which rest on the plank bottom. Their tapering ends are made in halves so that by unbolting the vertical center joint they can be taken apart for removal. The outside forms are held by trussed strongbacks of 12 x 18-in. timbers, connected by the rods beneath the bottom and above the top of the caisson.

Concreting is done in one continuous operation, the entire form being completed before this is begun. The concrete is allowed to set for 10 days before the launching. These caissons are made at Milwaukee, Wis., by hired labor at a plant built specially for the purpose by the United States Government. This plant is equipped with a locomotive crane, a 1-yd. mixer with side loader, sand and stone bins for gravity charging, and sheds for storing steel and cement. The locomotive crane is used for handling forms, placing steel reinforcement and pouring concrete.

The caissons are launched from ways having a slope of 1 on 8, according to the method described on p. 287, of this issue. These extend from about 3 ft. above water to about 20 ft. below the water surface, so that the largest caissons float free of their supporting shoes without plunging. This elimination of plunging permits the minimum amount of reinforcement to be used and makes it unnecessary to place temporary decks for launching. With the two launch ways at this plant it is possible to build and launch a caisson every six to nine days, depending upon the size. The launching

OUTER AND INNER FORMS OF HOLLOW CONCRETE CAISSON FOR BREAKWATER

weight of a caisson of the largest size is a little more than 500 tons.

After being launched, the caissons are stored generally by sinking them with water ballast so as to rest on the lake bottom in such depth of water that their tops are above the surface. When caissons are to be used they are freed of water by siphoning and then provided with temporary decks and towing rigs. They are towed to Racine, a distance of about 25 miles, and are delivered to the contractor.

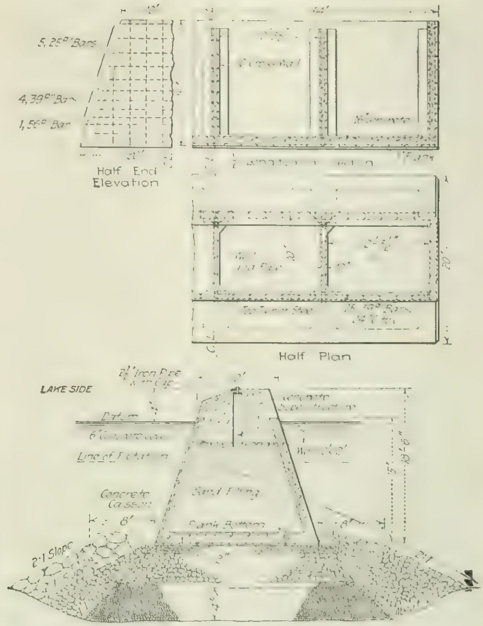
The temporary decks are 3 in. thick, and are composed of 2-in. tongued-and-grooved plank and 1-in. matched lumber, with a layer of painted canvas between the two courses. Each caisson has four sections of deck, secured by anchor bolts embedded in the tops of the walls, and made water-tight by gaskets formed of ½-in. water hose. The joints between the sections are calked.

LOCOMOTIVE CRANE PLACES REINFORCEMENT FOR CAISSON. LAUNCHING WAYS UNDER THE DECK

The decks are removed by the contractor and are returned to Milwaukee on a small scow taken with each tow for that purpose. The towing speed is 2½ to 3 miles per hour, with two caissons towed on each trip.

A bed of broken stone forms the foundation of the breakwater. For this a trench was dredged 4 ft. in the sand, with a bottom width of about 40 ft., the slopes being approximately 1 on 2. This was filled with 4 ft. of flux stone deposited from dump scows. The upper part of the foundation bed is of 50-lb. to 200-lb. stone, except that to facilitate leveling a thickness of about 1 ft. at the top consists of stone of 10-lb. to 50-lb. size. The surface of the stone fill is leveled by divers to provide a uniform bearing for the entire base area of the caisson. A small amount of 500-lb. to 1-ton stone is placed on the lake side of the foundation to keep wave action from disturbing the smaller stone.

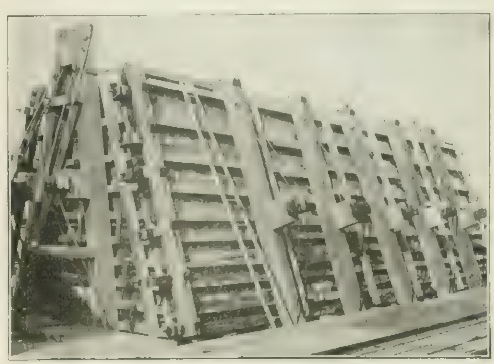
Caissons are floated to place and then sunk upon the stone foundation by filling with water, either through siphons or by pumps. Sand or 50-lb. to 200-lb. stone is



BREAKWATER OF HOLLOW CONCRETE CAISSONS HAS BROKEN-STONE BED AND CONCRETE TOP

used to fill the caissons to within 4 ft. of the top. This is sealed or covered with a 6-in. layer of lean concrete, 1: 5: 10, placed in the dry, in order to keep the filling from being washed out by wave action before the superstructure is built.

The superstructure is a monolithic cap of concrete extending from the 6-in. concrete cover to a height of 3½ ft. above the top of the caissons. Concrete of 1: 2: 4 mix, made with 2½-in. broken stone, is placed in the dry, timber forms being used for the upper 3½ ft. Where sand filling is used, a well 12 in. square is formed above each compartment, extending from the top of the fill to within 6 in. of the top of the superstructure. A 2½-in. pipe, with cap, extends through this 6-in. cover. The



FORMS FOR HOLLOW CONCRETE CAISSONS FOR BREAKWATER AT RACINE, WISCONSIN

pipe and well permit of taking soundings in the future to determine if there has been loss of sand through cracks in the caissons, such as might develop from uneven settlement of the foundation or from other causes. In case of serious loss of sand filling it is purposed to fill the space with grout poured through the pipe. The top of the superstructure or finished breakwater is 4 ft. above United States datum for Lake Michigan or about 5 ft. above mean lake level.

Material for a 54-ft. length of breakwater, with caisson 54 ft. long, 20 ft. wide on the bottom and 15 ft. deep, is as follows: Concrete in caisson, 151 yd.; concrete in superstructure, 103.69 yd.; concrete cover, 8.8 yd.; sand filling, 238 yd.; plank bottom, 3240 ft. b.m., reinforcing steel, 10,287 lb.; bottom spikes, 97 lb.; rip rap, 40 tons. The length of this concrete caisson breakwater is 1512 ft., of which 702 ft. remain to be built this season. The foundation work, sinking and filling the caissons and building the concrete superstructure are being done by the Greiling Bros. Co., Green Bay, Wis., with Robert Moser as local superintendent. The caissons are built by day labor and under supervision of the engineers of the United States Government, as noted above. All the work is under the direction of J. A. B. Tompkins, district engineer, United States Engineer Office, Milwaukee, Wis. E. M. Nisen is United States assistant engineer, and A. I. Reed is United States inspecting engineer.

Lukewarm Concrete Enough Precaution for Zero Weather Dam Work

Perfect Bond and Sound Concrete Secured by Placing Fifty-Degree Mixture on Frozen Surfaces—Concreting Kept Up in Heavy Frosts

BLINDING snow storms were the only weather conditions which stopped concreting last winter on the Dead River Dam in northern Michigan. At other times work progressed steadily during a period of three months when the mercury sank below zero more often than it rose above freezing. Two boilers, a steam coil in the sand bin and another in the water tank, and a force pump, with hose line, connected to the hot-water tank were the only frost-fighting apparatus that was employed.

Warm concrete deposited on the frozen top of the previous day's work took out the frost and made a perfect bond even when the frost layer was 3 in. thick.

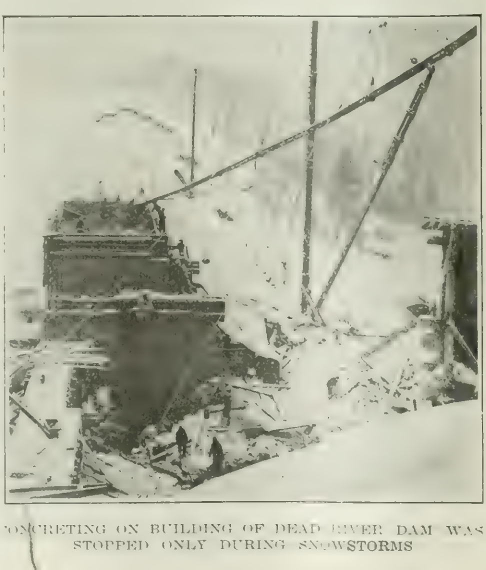
The dam, on Dead River northeast of Negaunee, Mich., is a part of a new 10,000-hp. hydro-electric development for the Cleveland Cliffs Iron Co. It is 400 ft. long, of gravity section and contains 17,000 cu.yd. of concrete. The foundation and one abutment are ledge rock; the other abutment is a sand hill into which the masonry penetrates and which is guarded from scour by sand-filled timber cribbing. The retaining wall top is at Elevation 1201 and the spillway crest at Elevation 1197.

Construction of a 2½-mile railway was necessary to reach the dam site from the Lake Superior & Ishpeming Ry. Contract was closed last summer, and it was fully expected that construction would be well under way by July so that the bulk of the concrete could be placed before cold weather set in. Unfortunately, this program was upset by delays in obtaining track materials. With the very best effort the railway could not be completed before Oct. 1, 1917, and it was not possible to begin concreting for another month. This left the greater volume to be placed during December, January and February. Lake Superior winters are cold always, and last winter is memorable as a winter of extraordinary cold everywhere. The construction prospect was not alluring. Yet, as already stated, cold weather was not permitted to stop construction. Even during the 30° below zero frosts of January concreting progressed steadily. Sometimes the gang would be snowed in for a day or two, but severe frost alone was regarded scornfully by the working force.

Naturally, it will be thought, exceptional precautions were taken to make this cold weather concreting safe. Herein lies the interest of the work. Only the most commonplace methods were employed. A little hot water for surface thawing and good warm concrete turned the trick.

Two steam boilers supplying coils in material bins and in the water tank heated the sand and water. A tower 135 ft. high and chutes with a maximum run of perhaps 200 ft. distributed the concrete. No especial precautions in chuting were employed to keep the concrete warm. It went into the forms, according to thermometer records kept during the very coldest weather, at temperatures varying from 40° to 65° and averaging 50 degrees.

It was planned at first to employ some means of heating the concrete in the forms. The sections concreted being too large for easy housing, canvas was spread over the concrete and live steam was turned underneath



CONCRETING ON BUILDING OF DEAD RIVER DAM WAS STOPPED ONLY DURING SNOWSTORMS

through jets. This was not a success. Except in the immediate vicinity of the jets the concrete froze. Finally all notion of keeping the mass from freezing on top was discarded, and after each day's work the concrete was left exposed to the elements overnight, but the precaution was taken to bulkhead the work in such a way that a day's run of concrete would fill up at least a 5-ft. vertical lift.

After being exposed overnight to a heavy frost, say 20° below zero, the frozen layer on top and sides would be about 2 in. thick. It was planned at first to remove the frozen top by picking. This proved laborious and delayed the work. Finally it was decided to take the chance of securing a good bond by merely thawing off the top skin of ice and frozen laitance and then depositing the fresh layer.

For removing the frozen top skin the most successful method was hosing with hot water. A small feed pump connected with the hot-water tank was used to give water pressure to any part of the work. The hot water proved to be much more effective than live steam. It was found that by running water over the frozen surface and letting it stand a few minutes all surface frosting was removed. The fresh concrete was then placed.

Observations upon the action of placing fresh warm concrete upon the frozen layer of the previous day's pouring showed that when the concrete placed was at a temperature of about 50°, the warm mass completely thawed the frozen layer and a good bond resulted.

On July 1 water stood back of the dam at El. 1170 and all concrete placed in the extremely cold weather was entirely covered. There were absolutely no signs of leaks from horizontal or vertical joints in the concrete that was placed in the extremely cold weather.

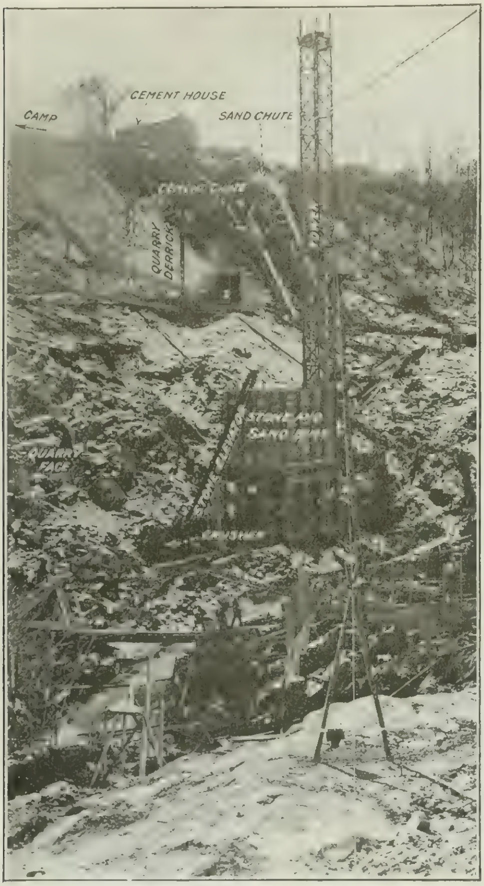
Steel forms were used, and it was found that frost penetrated the sides from 2 to 3 in. Incidentally, where 2-in. plank forms were used, in one or two places there was no freezing on the sides. It was anticipated that the outer frozen surface might slough off and cause a rough looking job, but such was not the result when the concrete thawed in the spring. When the concrete had been placed in the very coldest weather a scaling of about ⅛ in. occurred, but not enough of it to spoil the appearance of the surface.

Owing to its isolated position and the severe winter climate, the Dead River Dam had to be largely a self-contained job. The men lived there. All materials were obtained at the site that could be thus procured. These requirements called for camp buildings, quarries and sand pits, with all the needed working equipment, besides the usual construction plant.

MATERIALS HANDLING SIMPLIFIED BY HILLSIDE LOCATION OF PLANT

About two miles above the new dam the iron company has a 1000-hp. hydro-electric plant. From here a 2200-volt transmission line was carried to the new work, and all construction plant was operated either directly by electricity or by air supplied by an electrically driven 22 x 14 x 18-in. air compressor. The compressor supplied air for drilling at the quarry, for the mixer engine, and for four hoisting engines. One feature was a camp kitchen provided with electric cooking ranges. Steam was used only for heating concrete materials; it was furnished by two small boilers.

The construction outfit was located largely on the south bank of the river, as indicated by the pictures. At the camp site, which was the very top of the hill, the elevation is 1300. This hill breaks off at a slope of about 40° down to El. 1200, which is about dam top height and where a rock bench about 75 ft. wide is struck. On the stream side this bench pitches nearly vertical to the river level. The mixer plant and dis-



DISTRIBUTING TOWER AND TWO DERRICKS PLACED CONCRETE AND PLUM STONES

tributing tower were located at the river level on the downstream side of the dam and close up to the face of the ledge. Chutes from the distributing tower reached to both ends of the dam. The only plant of size along the dam was two derricks for handling plum stones.

Stone for crushing and for plums was quarried from the rock cliff just behind the mixer plant. A crusher, with a bucket elevator to the stone bin, was set on the quarry bottom and was supplied by a derrick from the bench above. On top of the hill was a gravel pit. Here in warm weather a clamshell excavator loaded the sand into a hopper which chuted into a receiving hopper on the ledge level below. From here small cars took the sand to the bin of the mixer plant. In winter the clamshell delivered too many frozen lumps, and shovelers and a car line to the hill-top hopper were substituted. Cement came in cars to the cement house on the top of the hill, and from here the bags were delivered to the mixer through a covered chute.

The construction of the plant and the methods of work, aside from the requirements of local development of crushed rock, plum stones and sand, and the electrical operation of all equipment and winter concreting, had no unusual features. O. D. McClure, chief mechanical engineer for the Cleveland Cliffs Iron Co., was in full charge of design and construction of the project. The Foundation Co., New York and Chicago, were contractors for the dam, under the direction of F. W. Adgate, western manager, Chicago. L. C. Jacobs was superintendent in charge for Mr. Adgate.

Gas Troubles Delay California Tunnel

DRIVING the 8700-ft. tunnel on the Marin Municipal Water project, described in *Engineering News-Record* of Nov. 8, 1917, p. 884, was hampered by the presence of inflammable gas which flowed from drill holes under considerable pressure and which sometimes appeared in quantities after a blast. On one occasion work was discontinued for an entire week while the flow burned steadily in the form of a giant jet. The men became accustomed to the gas, however, and means were found for handling it in such way that the work was completed almost on schedule time despite the inconvenience.

The troublesome vapor, believed to be marsh gas, was first encountered about 3000 ft. from the east portal in a hard diabase rock. For its entire length the tunnel was driven through rock of igneous formation, chiefly a succession of black and green serpentine with occasional ledges of diabase. Later on, gas was encountered in even greater quantities on the west face, about 1000 ft. from the point where it was first met in the east heading. The gas would be ignited by the blasts and when new pockets were opened up the burning continued until they were exhausted.

In the first experience with the gas, some of the men when they returned to work after a blast, were slightly burned in an explosion caused by the uncovered lights. After this more care was used, and when going back to the heading after a blast the men cleared the tunnel of gas by fastening a carbide lamp to a long stick and holding it close to the roof of the tunnel, the men meanwhile keeping close to the floor. In this way the gas was caused to explode, though not with great violence, as the flame would spread along the roof of the tunnel and over the heads of the men. The gas was sometimes ignited and allowed to burn as it emerged from a drilled hole during the process of drilling.

After the first accident two others occurred, one when a timekeeper caused an explosion by climbing up on the rock pile without first testing the air, and another when a dome in the roof collected a considerable amount of gas, the flame from which shot downward on the men instead of along the roof in the usual way. The gas did not seem injurious when inhaled, so no gas masks were necessary at any stage of the work. But when it burned fiercely the oxygen in the tunnel was exhausted, the heat became very oppressive and under these conditions the men could not work.

The work is being done under the direction of M. M. O'Shaughnessy. A. R. Baker is resident engineer in charge.

Keeping Land Drainage Channels Clear of Growth and Debris in the South

Experiences in Removal of Willow and Other Sprouts and Maintaining Cross-Section in Two Drainage Districts—Cost Data Given—Force Account Considered Better Than Contract Work

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn

If drainage channels are to give the greatest return upon the capital invested they must be maintained in a free and unobstructed condition so that their discharge capacities will continue undiminished. The regimen of the ordinary drainage channel is that soon after it is excavated willow, cottonwood and other sprouts spring up along the berms and waste banks and in the channel itself. Before the banks of the channel have stood for a sufficient time to weather down to their natural slopes, the material slides, caves and is washed into the channel. To some extent, the growth on the berms and waste banks helps to prevent washing and sliding of the material into the channel. But the growth in the channel itself is extremely undesirable as an adjunct to an efficient waterway.

In carrying out maintenance work, not only should the growth be removed but all débris, such as logs, drift, fences, objectionable floodgates and other obstructions to the flow should be removed. Where the growth is not too large, it should be removed root and branch. Where the growth is of such a size that it cannot be readily pulled out, the sprouts should be cut off at the roots below the surface of the ground with a mattock, an axe or a machete. In either case the sprout is removed so that no stub remains projecting above the ground. Some few rootlets will be left in the ground even after the sprouts are pulled out, but experience shows that the succeeding season's growth is less from these rootlets than where a stub is left protruding above the surface.

Growth Should Be Pulled While Sap Is Up

The proper time to pull growth is while the sap is up, for if the sprouts are pulled when the sap is down the pieces of roots broken off below the surface spring up much more readily the next season. The sap is up in the South from about the first of May until the early part of September. The month of August has proved to be the best time for removing growth.

On newly constructed work there are always in the ditches a considerable number of small bars and minor slides that are the result of the natural agents of weathering and which constitute deterioration that must be expected with the present methods of construction of ditches by floating dipper dredges. In planning a system of drainage channels, it is good practice to construct the ditches a foot or two deeper than necessary for good drainage, considering that the drainage value of the lowest foot of channel will soon be lost through natural deterioration. It is not necessary, then, to remove bars unless they are a foot or more above grade. Where there are only a few bars in a channel a low-water channel may be opened through them to prevent ponding of water behind the bars. Where a ditch deteriorates throughout a considerable length and more than a foot above grade, the cost of opening a low-water channel would be quite heavy. Each individual case must be considered to determine the work to be done.

In far too many drainage systems these fundamental principles have gone unheeded, with the result that the ditches have deteriorated so that proper drainage is not obtained. Two of the largest drainage districts in the South, however, have been keenly awake to the necessity of maintenance and have carried forward extensive operations to prevent deteriorating influences from interfering with the best drainage. These districts are Grassy Lake and Tyronza Drainage District No. 9, Mississippi County, Arkansas, and the Bogue Phalia Drainage District, Washington County, Mississippi. In both districts, the Morgan Engineering Co. of Memphis has directed all the maintenance operations.

There are about 300 miles of channels in Drainage District No. 9. Excavation was started in 1912, and by the summer of 1915 there were about 40 miles of ditches which had been dug for two years or a few months more. They had thus passed through from two to three growing seasons during which growth had sprung up to such an extent that its removal was considered necessary. Practically all of these ditches were 14 ft. wide on the bottom with bank slopes of ½ to 1 or 1 to 1 and an average depth of about eight feet.

To determine the condition of all of the ditches excavated up to that time an inspector walked out each ditch and made notes concerning the size and character of the growth and obstructions in the channels. For the most part the growth consisted of young willows and cottonwoods up to 2½ in. in diameter. The number of sprouts ran up to as many as 450 per 100 ft. of ditch, with the greater part ranging from 20 to 50 sprouts per station.

Establishing Reasonable Contract Prices

Very few contracts had previously been let in this section of the country for removing growth from ditches. To establish a basis for reasonable prices for letting the work, typical lengths of ditches were selected and cleared with a crew consisting of a foreman and five or six negroes. This experimental work was undertaken in the early part of July at a time when negro labor is largely engaged on working the cotton crop and is not easily obtained for other work. It was recognized that better and cheaper labor would be available a few weeks later after the cotton was laid by. It was necessary to do the test clearing with a crew of only five or six negroes, whereas the economical size of a crew is about twice this number to one foreman. Notwithstanding the somewhat adverse labor conditions, the results of the experiment showed that the growth could

be cleared from the ditches at costs varying from $25 to $50 per mile.

Following the experimental work, contracts were let for about 40 miles of ditches at prices ranging from $27.50 to $57 per mile. More than half of the work was let for $50 per mile. The work was done by local contractors, some of whom were planters with land in the district whose negro hands had little to do after the cotton had been laid by.

By the summer of 1916, the greater part of the channels in the district had been excavated and it was necessary to inspect again the ditches and obtain information from which to determine the maintenance work necessary. Each inspector, in addition to having the maps and profiles used for the location of the work in the field, was supplied with a hand level with which to determine whether or not a ditch had filled in above the grade line of the original design. Special detailed instructions were issued to the inspectors outlining the points to be covered in their reports. These points were: (1) willows and other tree growth; (2) fills and bars; (3) fallen trees; (4) drifts, and (5) fences and flood gates.

Under the first classification, the size and number of willows, cottonwoods and other growth were noted. This was determined by counting the number of each sized sprout within a typical section of ditch, usually about 200 ft. long. Separate notes were made for growth in the channel, on the berms, and on the waste banks. Where sprouts were growing from stumps on the berms, the number of stumps per 100 ft. was recorded together with the height, size and number of sprouts on each stump.

Fills and Bars Classified

The general dimensions of all earth deposited in the channels of the ditches were noted. The approximate height above grade was determined with the hand level. Fills and bars were classified as nearly as possible according to three main causes that produced them: (a) from material deposited by the cutting back of local drains entering through openings in the waste banks; (b) from material washing down from the slopes of the ditch itself, and (c) by slides in the banks of the ditch and, in some cases, in the waste banks also. Whether or not a bar completely stopped the channel so that ponding occurred and the extent of any ponding were also recorded.

In the case of fallen trees the position of the tree with respect to the channel was given, and an estimate of the percentage of the waterway that was blocked was made. The character of all drift was noted as well as the agencies that caused the drift. These are usually bars, fallen trees, fences or floodgates, or improperly constructed bridges. The location and construction of all fences built across the bottom of the ditches were set down. Special attention was given to flood and water gates to determine whether they were of such construction that they would operate properly in times of high water and whether these gates had in the past been the cause of the collection of drift or the formation of bars.

Inspection of the channels showed that most of the fills and bars were not serious obstructions, and it was thought best to defer the removal of the filled-in material for another year, by which time the ditches would have passed through another winter and another high water—both of which factors tend to bring the ditch banks into a condition of stability—so that there would be little likelihood of further trouble from slides. A selected number of bars were removed by shooting with dynamite, for experimental purposes, for determining the cost and effectiveness of this method.

The inspection of channels further showed that about 95 miles of ditch should be cleared of growth and débris. About 72 miles of this work was contracted to be done at a price of $35 per mile, 20 miles were let at $40 and the remaining 3 miles at $45 per mile.

Specifications for the Work

The following paragraphs from the specifications for removing growth and débris indicate the manner in which the work was required to be done:

1. Description—The work to be performed under these specifications shall include the clearing of all tree growth from the excavated section of channels and from a strip 12 ft. wide measured from the top edge of the ditch, the removal from the channel section of all logs, stumps, trees, tree-tops, drift, fences, floodgates, and débris of all kinds, and shall include all other incidental operations necessary to carrying out the purpose for which the work is undertaken.

2. Character of Work—All willows, cottonwoods or other young sprouts under 2 in. in diameter shall be pulled out with their roots. All such growth exceeding 2 in. in diameter shall be cut off at the roots 3 in. under the surface of the ground. All obstructions of whatever nature now in the channel of the ditch shall be removed. Where fences extend across the channel, or a portion of the channel, that portion of the fence within the limits of the excavated section shall be carefully removed to the side of the ditch. Floodgates shall be removed from all channels unless instructions to the contrary are given by the engineer.

3. Disposal of Material—The contractor shall pile and burn all growth and obstructions cleared from the channel of the ditch. The contractor may, however, place all material that is removed entirely over the waste bank instead of burning it, provided by so doing no damage is done to lands adjacent to right-of-way.

It will be noticed that a diameter of 2 in. was used as the maximum size of sprout to be pulled. This was selected after tests had been made in the field which showed that sprouts over 2 in. in diameter could not be pulled without the use of mechanical aids, and that when growing in dry ground the sprouts would break off before they could be pulled out. After two seasons' operation with 2 in. as the maximum diameter to be pulled, it is now believed that this is too large and that a smaller diameter should be used.

Work in the Bogue Phalia Drainage District

In the Bogue Phalia District there are about 180 miles of drainage channels. The greater part of the excavation work was started about the first part of 1915. By the summer of 1916 many of the channels were passing through their second growing season. An examination of each ditch along the same lines as those

described for Drainage District No. 9 disclosed the same general conditions.

Some experimental work was done in this district on the use of chemical destroyers for killing trees, sprouts and coco grass. In general, the results of this work were unsatisfactory. In the case of trees, it was necessary to hack well around the tree in order to apply the chemical. This alone is usually sufficient to kill it.

The removing of growth from the ditches was done by contract and by force account. The latter proved the more satisfactory.

The force-account work was carried on by a crew consisting of a white foreman, nine negro laborers and a cook, all working directly under the resident engineer. The party lived in tents and ordinarily camped near the ditch upon which work was being done. Due to the short duration of the work, only temporary cooking utensils were required so that only a small expense was incurred for that part of the outfit.

Variety of Tools Used

Machetes and brush axes were used for cutting all willows and other growths too large for pulling. A cross-cut saw, sledge, wedges and axes were used for cutting up trees and débris so that they could be removed from the ditches. Cant hooks were provided for lifting the heavier logs from the ditches. Cotton gloves were furnished the men to protect their hands. A pair of these gloves lasted about a week. The gloves were found quite useful in preventing sore hands, although in some cases the men's hands became sore even with gloves.

In clearing a channel of ordinary size, the party was scattered so that there would be little interference among the workers. The men were, however, kept close enough together so that they could assist one another in removing drift too large for one man to handle. It was found that for the most efficient operation the party should not stop its work of willow pulling and drift removing in order to saw and cut up trees which were in the channel and which had to be sawed and cut before they could be removed. This work was all left for a return trip.

All except two of the men were ordinarily engaged on pulling the willows and sprouts and removing the small drift. The other two men followed behind the rest of the party and cut the willows which were too large to be pulled and cut the grass and weeds in the bottoms of the ditches. For cutting the sprouts, the machete has proved to be the most useful tool. Willows that could not be pulled by one man were usually left to be cut, for it was uneconomical for more than one man to pull on one willow. Except on large ditches, the sprouts were thrown out on the waste bank at the time they were pulled, the earth adhering to the roots giving weight so that they could be easily thrown.

In the ditches of large size, where the distance to the waste bank was too great for throwing, the sprouts were either piled and burned or carried out of the ditch. No limiting size of sprout for pulling was used, for it was found that the size that could be pulled varied according to the condition of the soil at the time of clearing. In wet ground, sprouts of quite large size could be pulled without difficulty, while in dry, hard earth even small sprouts were not easily pulled and often broke off near the surface of the ground.

The costs of the work done by the force account party are given in Table I (see next page). Note that the cost of clearing three miles of Ditch 12 was $36.73 per mile. This ditch was very wide and deep, the base being from 80 to 120 ft. and the depth about 18 ft., which made the cost higher than for a ditch of ordinary size. The 14-ft. bottom ditches of ordinary size were cleared at costs from a little more than $13 to slightly less than $21 per mile, except in the case of Ditch 24, which cost $35 a mile. This high cost was due largely to the fact that camp was not pitched immediately in the vicinity of the work on this ditch, and it was necessary for the party to walk long distances in order to reach the work. This reduced the actual time that could be put in working and the cost was correspondingly increased.

The cost of contract work is given in Table II. A comparison of this table with Table I furnishes information on the relative merits of the two methods of operation on this particular job. The range of the contract prices is from $15 to $25 per mile. It will be noticed that the length of ditches cleared was short. This is due to the fact that the work was done by negroes who lived along the ditches and who could only contract to clear small stretches of ditch. This condition, however, operated for a low contract price.

The prices in Tables I and II are lower than the costs in Drainage District No. 9. The difference is partly due to the fact that the berms were not cleared on the Bogue Phalia work but were included on the District No. 9 work. Labor conditions were also more favorable on the Bogue Phalia work.

Comparisons of Costs of Two Methods

A comparison of costs for the force-account and contract work shows little in favor of either method. The growth on the force-account work was somewhat heavier than on the contract ditches, so that there is a small margin in favor of the force-account work. But aside from actual costs, there are other considerations that make the force-account work preferable. Better work can be obtained. With contract work, unless inspection is very rigid, it is difficult to make the contractor pull all the growth that should be pulled. Although the contractor is required by the specifications to pull all sprouts of one-man size and cut the remainder below the ground, it is not at all unusual for the ordinary contractor on this class of work to cut willows which could be pulled easily, since it is much easier to cut than to pull them.

When the work is done by force account, the foreman has no object in cutting any of the willows which can be pulled and the ditch is left in a better condition as a result. Where the willows are cut off they spring up again the following season but where they are pulled out there is nothing left to promote further growth except some tiny rootlets. The fewer sprouts that are left in the ditch cut off under the ground the less the thickness of the next season's growth is likely to be. It appears, then, that on force-account work, fewer willows that could be pulled would be cut off under the surface, and hence the next season's growth would

TABLE I. DITCH CLEARING WORK DONE BY FORCE ACCOUNT

Ditch No.	Miles From	Miles To	Length Cleared, Miles	Average Diameter of Sprouts, In.	Number of Sprouts per Station	Obstructions in Channel	Dimensions of Ditch: Base Width, Ft.	Dimensions of Ditch: Side Slopes	Dimensions of Ditch: Average Depth, Ft.	Growing Seasons since Construction	Cost per Mile
12	0	1	1	[illegible]	200 400	1 small drift	80	2:1	18	2	$36.73
	1	3	2	[illegible]	200 400	1 large drift	120	1½:1	18	2	36.73
14	0	1	1	[illegible]	50–100		14	½:1	6	2	15.28
	1	4	3	[illegible]	150 200	3 trees	14	½:1	8	2	15.28
	4	5	1	[illegible]	20	1 log, and some debris	14	½:1	8	2	15.28
16	0	3	3	[illegible]	150 200	9 trees, debris, 1 stump	14	½:1	8	2	20.83
	3	4	1	[illegible]	50 100		14	½:1	8	2	20.83
17	0	3	3	[illegible]	200 500	2 logs	14	½:1	8	2	20.75
	3	4	1	[illegible]	25 50		14	½:1	8	2	20.75
18	1	4.2	[illegible] 2	[illegible]	200 400	Some debris	14	½:1	8	2	13.10
24	0	1	1	[illegible]	50 200		14	½:1	7	2	35.00
	1	2	1	[illegible]	400 500		14	½:1	8	2	35.00
	2	4	2	[illegible]	50 200	1 tree	14	½:1	8	2	35.00

The costs per mile include labor, moving camp, groceries, cook's salary, and depreciation on camp equipment and tools, together with all incidental expenses Engineering supervision is not included, as a part of the cost for this expense occurs alike on force account or contract work. The wages paid on this work were: Foreman $3 per day, laborers boarding in camp $1 per day, and laborers boarding themselves $1.25 and $1.50 per day.

in all probability be less, which would mean that the cost of clearing would be lower next season.

Correlated with the last-mentioned advantage of force-account work is the fact that the actual engineering supervision and inspection needed is considerably less than on contract work. In order to secure good work on contract jobs of this kind, it is usually necessary to keep a very close watch on the work and this, of course, requires considerable time of the engineer.

Still another factor in favor of force-account maintenance work is that on a contract basis per mile the variations in the condition of different portions of the ditches do not receive proper weight and consideration. A section of ditch that has little growth is paid for on the same basis as an adjoining section that may be heavily overgrown. It might be thought that the contract price would represent average conditions for a contract, but practically this does not work out. The contract price inclines almost always toward the portions that are more thickly grown up. Where the work is done by force account, these variations are automatically adjusted by the time required to clear each part of the work, which must vary according to the heaviness of the growth.

The results of the work in the Bogue Phalia District point therefore to lower cost, a better degree of work, a lower future cost, lower costs for engineering supervision and a proper consideration of the variations in growth along a ditch, if the work is done by means of a force-account party than if done by contract.

The district, some time previous to the 1916 maintenance work, furnished wire and fenced a portion of the main drainage channel of the district to determine whether or not it was profitable to keep down the growth along the channel by pasturing stock within the fenced area. The fence was built so that a strip averaging about 250 ft. in width was left between the water's edge and the fence. This method of keeping down the growth did not prove a success, because a sufficient number of animals could not be kept on the pasture, a condition brought about largely because pasture land was plentiful in relation to the number of head of stock to be pastured. The condition of the banks of the stream for practically the entire distance pastured were found to be very similar to the banks of the portions of the stream which were not fenced. There was one exception to this in the case of a small tract which was used for grazing mules. In this tract the mules kept down the weeds and brush with the exception of the willows. Mules do not ordinarily eat willow sprouts unless other grazing is scarce. Cattle, however, will eat the willows.

In country that has been developed long, where pasture land is scarce, and where a sufficient number of stock can be pastured upon each acre of land, it is both successful and economical to use this method of keeping down growth. In new country, as the Bogue Phalia District, pasturing is not likely to be a success.

TABLE II. DITCH CLEARING WORK DONE BY CONTRACT

Ditch No.	Miles From	Miles To	Length Cleared, Miles	Average Diameter of Sprouts, In.	Number of Sprouts per Station	Obstructions in Channel	Dimensions of Ditch: Base Width, Ft.	Dimensions of Ditch: Side Slopes	Dimensions of Ditch: Average Depth, Ft.	Growing Seasons since Construction	Cost per Mile
4	0	[illegible]	1.9	[illegible]	500–750	2 large drifts and debris	25	1:1	16	3	$25
5	0	[illegible]	2	[illegible]	50 400	Debris and 1 tree	14	½:1	8	2	15
7	0	1	1	[illegible]	100 200		14	½:1	7	2	20
18	0	1	1	[illegible]	200 400	3 trees	14	½:1	8	2	25
27	0	1	1.5	[illegible]	100 200	3 trees, 1 log, debris	14	½:1	8	2	20
	3	5	2	[illegible]	100 150		14	½:1	9	2	20
29	0	1	1	[illegible]	100		14	½:1	8	2	20

Spruce Preferable for Wood Airplane Parts

Spruce is preferred for the wooden portions of airplanes, both because it is the toughest of soft woods in proportion to its weight and because it possesses tremendous shock-absorbing qualities. Another valuable property is that it does not splinter when hit by missiles. Sitka spruce, white spruce and red spruce are used, the Sitka spruce being preferred. When spruce cannot be obtained, fir and Port Orford cedar are used. Practically all the spruce suitable for this purpose is found in the United States and along the western coast of British Columbia.

Molten Slag Is Hauled by Rail for Making Embankments

Union Railroad at Pittsburgh Handles Hot Materials in Ladle Cars—Fills Made in Layers Prove Very Substantial

DISPOSAL of large quantities of blast-furnace slag in the Pittsburgh iron and steel district is effected by dumping it to form railroad embankments and to fill areas of low ground which may then be utilized as industrial sites. Molten slag is hauled several miles in short trains of special ladle cars, which can be dumped at will. Cold openhearth slag is also disposed of in large quantities. About 1,600,000 tons of refuse is distributed annually. The hot material is said to have proved very satisfactory for railroad embankments, and by careful placing, with solidified material placed on the outside to serve as a retaining wall, can be made to stand almost vertically.

Transporting and dumping the molten slag is a special class of business on the Union R.R., which is a terminal line serving principally three of the large plants of the Carnegie Steel Co. in the Monongahela valley. These include the Edgar Thomson works, the Duquesne works, and the Homestead plant with its auxiliary the Carrie furnace, at Rankin. They have a total of 24 large modern blast furnaces. Later the railroad will serve also the Clairton plant, with three furnaces.

Slag output from the 24 furnaces has been about 2,000,000 tons per year for several years, and about 80% of this is disposed of by dumping in molten condition, mainly along the line of the Union R.R. Its weight in the dump averages 2800 lb. per cubic yard. Most of the molten slag not used in this way is granulated for use in the manufacture of portland cement, and for temporary ballast, yard ballast and special filling on the railway.

In addition to the blast-furnace slag, there is "cold filling" which averages more than 100 cars or 5000 tons per day. This includes openhearth slag, ashes and all other kinds of refuse shipped from the mills. It is used in making fills for plants, railway embankments and yards. Large quantities are turned over to the Bessemer & Lake Erie R.R. for similar use on its lines. After all this supply for useful purposes there is still a large amount that must be disposed of as waste.

For disposal of the molten slag and cold waste the Carnegie Steel Co. has acquired low-value ground in tracts of 60 to 400 acres along the line of the Union R.R. The largest is at Mifflin Summit, where dumping of molten slag has been in progress for about five years, and will continue for many years. The site is at the headwaters of some small streams and presented filling accommodations for 30,000,000 to 40,000,000 cu.yd., depending upon the final elevation of the surface. Of the smaller tracts, 60 to 100 acres each, some are for hot filling and others for cold filling. This facilitates operations and avoids trouble from fires starting in the cold filling. Heat is retained in the slag fill for long periods, depending upon the depth and mass.

Ladle cars consisting of ladles or pots mounted on railway trucks are used for handling slag which is to be disposed of in molten condition. The slag is tapped from the furnaces into these ladles, each of which has a capacity of 8½ cu.yd. or 13 tons. Trains are composed of from seven to fifteen cars hauled by a 70-ton engine, and a pusher engine of the same weight is used where there are more than eight cars. The haul averages seven miles, with a maximum of about 11 miles, and from 375 to 400 ladle cars are handled and dumped per 24-hour day.

Air-brake train lines on the cars provide for their control while in transit, and are connected to a compressed-air dumping mechanism on each ladle, which is thus operated from the locomotive. This mechanism is provided with a lock which holds the ladle steady and prevents it from tipping and spilling the slag along the track.

RAILWAY BUILDS EMBANKMENTS OF MOLTEN SLAG ALONG MONONGAHELA RIVER

During the longer hauls the slag cools sufficiently to form a crust from 1 to 2 in. thick over the top, and a cinder or skull on the interior surface of the ladle. At the dump, air from the locomotive is turned into the dumping mechanism of each ladle successively, tilting them gently but rapidly, thus discharging the molten material with sufficient velocity to throw it clear of the track. The ladle is tipped until its lip is about level with the top of the ties, in order to drain it thoroughly and discharge the hard skull. These skulls generally break when discharged, and on low dumps the pieces tend to remain near the railway track, while on the higher dumps the larger pieces usually roll down the slope.

Solid floors on the bridges prevent any splashing slag from falling into the streets. Should the ladle be so full as to overflow slightly when the train is rounding a curve, the spread of the vessel generally throws the material clear of the ties. The small amount spilled in this way is usually spread out on the ground so that it does not retain its heat long enough to set fire to hardwood ties. Steel ties, however, are used mainly on the Union R.R., having been adopted as standard several years ago. But even when wood ties were used it is stated that there was very little trouble from burning them with the slag.

Steel ties are used exclusively on the hot-slag dumps, and these stand up well, it is said, under the severe treatment to which they are subjected. When wood ties

were used on these dumps there was considerable trouble from burning, caused by the discharged slag and more particularly by the drippings from the ladle and the congealed cinder or skull mentioned above. In fact, these skulls were found to be the principal trouble, especially if they remained near the track, owing to their mass and their interference with the free spread of the molten slag.

Cold filling is handled largely in ordinary steel bottom-dump hopper cars, but the railroad has a large number of special side-dump cars of the Summers and Clark types which are used extensively in this service. The labor cost for disposition of the material is considerably higher than that for the hot slag. For leveling the cold fill a Jordan air-operated spreader car is sometimes used.

Slag deposited hot has been found to make a very substantial fill, and both the Carnegie Steel Co. and the Union R.R. Co. have built sructures upon this material. It permits of an almost vertical wall being constructed along the limits of a fill if this is required, although usually a slope of ½ : 1 is allowed. This method has been used for filling out to the limiting lines of the channel of the Monongahela River, along which a number of the steel company's works are situated and which is skirted by the main tracks of the railway.

How Embankments Along River Are Made

For these railway embankments along the river a trench is usually excavated to a little below the low-water elevation. This is filled with cold slag, such as ladle skulls and blocks of openhearth and converter-mill slag. The front of this filling is carried up to 12 or 24 in. above ground, and the space behind it is filled with molten slag, which trickles through the openings in the face and thus cements it into a solid mass. Where any water stands in the trench the slag tends to granulate, but the heavy blocks embedded in it have been found to provide ample stability.

When the semi-liquid fill reaches the top of the face wall the latter is built up about 18 in., and the pouring of slag is then repeated. These operations are continued until the fill has reached the desired elevation, as shown by the accompanying drawing. More than six miles of main line have been built on fills of this kind.

For the waste dumps no restricting walls are required. A single-track roadbed is excavated in the side-hill slope of the ravine or other low land to be filled, and from this the dumping is started. The molten slag usually spreads well down the slope. While the fill is made more or less in layers, each hot deposit bonds itself to the preceding layer, so that the entire dump forms a solid mass. When the fill has widened sufficiently the track is shifted out to the edge. This process of dumping slag and shifting track is continued, the fill increasing until in one place it is 150 ft. high. It has been found that the higher the dump the more nearly the slope tends to a vertical face.

Molten slag cools quickly when allowed to spread freely, but the skulls retain their heat for a considerable time. Pools of hot slag are caused by the skulls and by irregularities on the slope, and these cool more slowly. Even in such conditions, however, the men can usually walk over the dump in about an hour after the pouring, in winter, and from four to five hours in summer.

In preparing to shift the dump track to the edge of the fill the deposit of crusts and skulls must be leveled and slag drippings removed, the latter accumulating near the ends of the ties so that they cannot be shifted. This work was done formerly by hand, but a Mann-McCann air-operated steel spreader car is now used. The spreader wing of this car is fitted with a special plow which cuts a deep furrow just outside the ends of the ties, thus breaking up the congealed slag drippings from the ladles. This machine can be operated directly after the slag has been poured, so that the lining and surfacing of the track can be done in less time than when the leveling was done by hand.

The saving in labor due to the use of the machine is expected to be considerable. A certain number of men are necessary for shifting the track, and must be available when required. This number is considerably more than would be required for ordinary dumping operations.

If this gang of men can be employed for a portion of the time on other work in the vicinity, or if it can be worked on a series of dumps in succession, it is pointed out that there will be a greater saving than if the entire gang must be kept at one dump. Again, more track shifting is necessary on a low dump than on one of considerable height, so that the saving per cubic yard or per ton of slag dumped cannot well be stated. From thirteen to twenty men are used in lining the dump track, depending upon its stiffness due to curvature or other conditions.

Disposal of the entire refuse product is made by facilities owned or controlled by the steel company. The material goes to the trunk-line connections only when they ask for it in case of washouts and other emergencies.

Information as to this special kind of filling has been furnished by E. C. Brown, chief civil engineer of the Carnegie Steel Co., and D. E. Woozley, engineer maintenance of way of the Union Railroad.

Inaugurate Patrols on Wisconsin Highways

A patrol system for the maintenance of the Wisconsin state trunk highways was organized May 1, as provided by law, by the counties in which the roads lie. A. R. Hirst, state highway engineer, in a quarterly report to J. G. D. Mack, state chief engineer, reports that 555 maintenance patrolmen have been employed. While the system is only two months old and still far from perfect, a favorable showing has been made, according to the report. One outstanding fact is that the man-and-team patrol is far superior to the truck patrol in all ordinary circumstances. Construction in the counties will be about 40% of the work originally financed, although the commission issued authority for 45% of this construction contemplated for this year under tne state highway law. Engineer employees of the division continue to enter the United States service, nine men leaving during the quarter which ended July 1. Mr. Hirst says, "We give them up gladly, but their departure creates a very difficult situation, as it is impossible to fill the vacancies with men of like capacity."

Army Supply Depot at Chicago Is Large Concrete Warehouse

Floor Area Twenty-Nine Acres in Six-Story Building—Tracks on First Floor—Tunnels For Trucking and Utilities

By A. Epstein
Structural Engineer, Central Manufacturing District, Chicago.

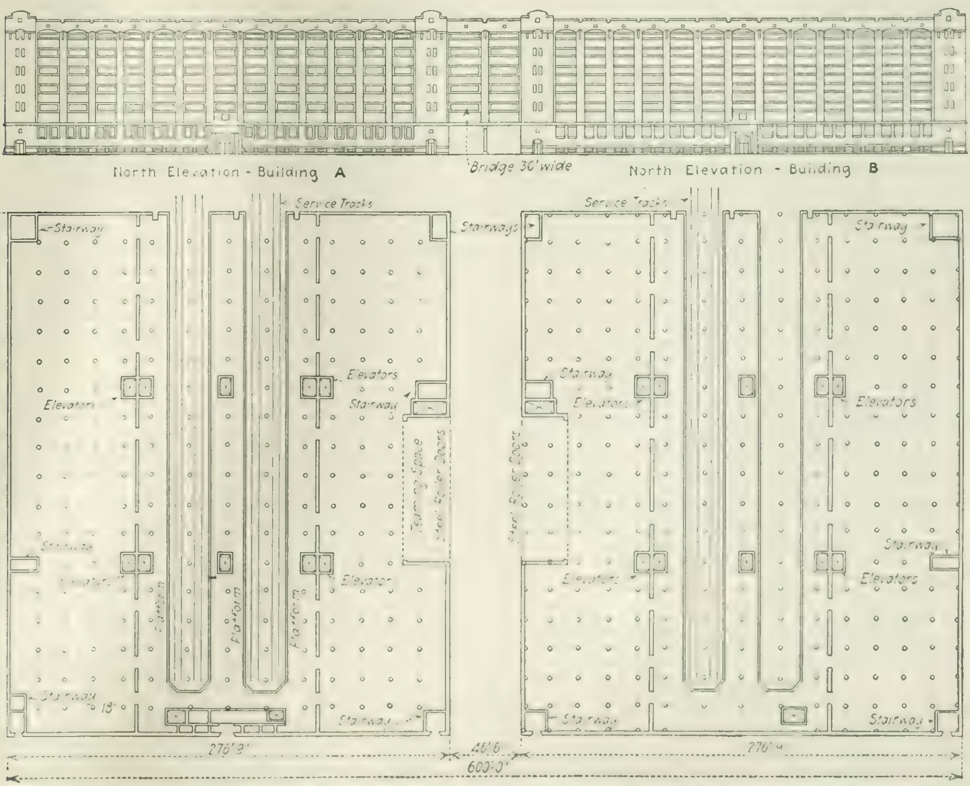
ONE of the largest reinforced-concrete buildings in the world is now being completed by the War Department at Chicago for use as a permanent interior storage depot for the Quartermaster Department in its system of inland and terminal storage warehouses for the army. The Chicago depot is located in the Chicago Central Manufacturing District and is on Government leased ground in that district, now occupied also by many temporary structures all devoted to storage purposes.

The new building consists of two units, A and B, each having a frontage of 276 ft. on 39th St., and a depth of 324 ft., and each being six stories in height, with a basement. They are separated for light and ventilation by a 46-ft. paved court, in which are situated the teamways extending into each building for a depth of 26 ft. and a length of 90 ft. Typical floors of the two units provide 180,000 sq.ft. of floor space, the total for the entire building being somewhat more than 1,250,000 sq,ft., or about 29 acres. By means of large rolling steel shutters the teaming spaces may be converted into fireproof garages with a total capacity of 10 large trucks in each building. Trucks partly loaded or unloaded can also be left in these inclosed areas overnight. At every floor above the first the two units are connected by means of an inclosed concrete bridge, 36 ft. wide, with fireproof rolling steel doors.

The buildings are of the simplest type of flat-slab reinforced-concrete construction, with columns founded on caisson footings and with skylight roofs in sawtooth framing.

The column design was made in accordance with the new revised city ordinance, which provides for bending stresses developing in the columns due to the possibly unbalanced floor loading. For the support of the interior and wall columns 600 caissons were sunk. These caissons vary in diameter from 4 to 4½ ft., and are designed for a load of 40 lb. per square inch. They are sunk to an average of about 25 ft. below the base of the floor level. At the bottom, where hardpan was encountered, the caissons were belled out to about twice the diameter, allowing 6½ tons per square foot on the hardpan.

The floors, of the Leonard flat-slab type, are designed for 300 lb. per square foot live load over the 18 x 18-ft. typical panels. The floors were poured to ½ in. from the top, and before the concrete attained its initial



QUARTERMASTER DEPARTMENT BUILDING IN CHICAGO DESIGNED FOR EASY HANDLING OF GOODS

set the surface was roughened to obtain a good binding surface for the top finish. Topping was a 1:1½ cement-sand mortar applied as dry as possible, floated and troweled until a smooth, hard and uniform finish was obtained. After hardening the floor was covered with sawdust and thoroughly saturated and kept wet for four or five days. No metallic hardener of any nature was used. The finish cost about 4¾c. per square foot.

To provide for expansion and contraction an expansion joint was made the center of the bridges connecting two units of the building. This joint was made by means of two 8 x 13½-in. concrete beams running in the short direction of the bridge, with ½ in. between the beams. Where the beams connect to the column a seat bracket was put on the column, the beams resting freely on this bracket. To facilitate free movement greased steel bearing plates were put under the end of the beams at the points of contact, and the space between the beams was covered with asphalt filler.

The building is served by tracks of the Chicago Junction Ry., four tracks entering each unit in the rear at the grade levels and continuing into the building for its full length. Loading and unloading are done from a 20-ft. center platform and two 10-ft. platforms at each side of the track. Thirty-two cars can be placed in each unit at one time. The center loading platform is a 5-in. concrete slab supported on girders running crosswise to the platform, resting on piers built on top of spread footings.

The entire train-shed area can be inclosed by means of 14 x 17-ft. rolling steel doors in the rear of the building at points where tracks enter. The first floor level was established at an elevation of 4 ft. above the top of the rail, and in order to allow for the swing of the doors on refrigerator cars slots 8 in. deep and 2 ft. 3 in. wide were left for some distance along the edge of the concrete platform. During loading and unloading of all cars, except the refrigerator type, these slots are covered with movable slabs flush with the remainder of the platform as well as with the car platform.

Concrete Walls Around Elevator

Each unit contains one 9 x 20-ft. truck elevator and seven 8 x 14-ft. standard freight elevators with provision for four additional elevators in each unit. Elevator inclosures around all typical elevators were made of 12-in. concrete reinforced on both sides of the wall with vertical and horizontal rods. These walls, in addition to being self-supporting, were designed to carry the load of the adjacent floor panels. The use of concrete walls around elevators was decided upon in order to afford the best possible durability to withstand the heavy trucking anticipated on the floors, as well as to replace the columns which would otherwise have to be placed in locations interfering with the clear elevator hatches and with passage to and from the elevators. Elevator walls were formed ano poured with the floor directly above, making an integral and homogeneous unit. In addition to the electric elevators, the building will be equipped with conveyors, spiral chutes and automatic intercommunicating telephones and pneumatic tubes. Tunnel connection will be provided between the building and the union freight station. This tunnel will be of sufficient size to serve for the movement of l.c.e. freight and express by means of four-wheel trucks hauled by electric tractors. The basement floor on each side of the track is connected by a 16-ft. tunnel passing under the tracks and reinforced to carry the engine load. The remaining portion of the track space is left unexcavated, with the tracks resting directly on the ground.

The building is equipped with a sprinkler system, steam heat, electric-light and gas connections. Power and water are supplied from the power house and gravity tower owned by the district and situated about a quarter of a mile west of the building. The building is connected with this power house by means of a concrete service tunnel along the front wall of the building. The tunnel is 7 ft. high and 6 ft. wide, and is situated directly under the sidewalk in front of the building in such a way that the top of the tunnel serves as a sidewalk.

In the entire job the following amounts of different materials were used: Concrete, 62,000 cu.yd.; forms, 4,000,000 ft.-b.m.; reinforcement, 3500 tons; sprinkler heads, 13,000, and piping in conduits, 450,000 lin.ft. The building can store about 7600 cars of supplies and its elevators have a total lifting capacity of 77 tons. The total cost of the building will be about $3,000,000, at the rate of $2.40 per square foot of floor area, or 18c. per cubic foot of volume. Very rapid construction, following a rigid time schedule, will bring the probable date of completion to about Sept. 1. Excavation was started Mar. 6. An arbitrary date for completion was set at Oct. 15.

The plans for the building were prepared under the direction of S. Scott Joy, architect for the Central Manufacturing District. The work of construction was intrusted to the E. W. Sproul Co., general contractors, and the Tait Engineering Co. prepared the structural plans for the building. The work was in charge of Maj. F. L. Nelson, U.S.N.A., constructing quartermaster for the construction division of the Army. He was aided in his work by G. C. Nimmons of Chicago, supervising architect, and F. T. Forbes, supervising engineer. The writer assisted the architect in working out the engineering features of the building and in the supervision of the work.

Put Street Repair on Scientific Basis

That street repair should be put upon a scientific basis was asserted recently by Robert Hoffmann, chief engineer of the Department of Public Service, Cleveland, Ohio. The repair of the city streets of Cleveland, which was under a separate department, has now been placed nominally under the chief engineer. The former system, with a separate repair department, was unsatisfactory, and the present arrangement has been but partly successful, principally due to shortage of help and funds, it is said. Mr. Hoffmann believes that instead of making appropriations for maintenance and repair, a certain levy in each year's taxes, based on a program of keeping maintenance up to standard, should be made. He asserts that this would overcome the present necessity of allowing this class of work to accumulate or be neglected until it is too late and the whole street requires repaving at heavy cost.

Concrete Barges Designed for New York State Canal

Shipping Board Prepares Plans for 500-Ton Towboats To Be Operated by Federal Railroad Administration

CONCRETE towboats to be operated by the United States railroad administration on the New York State Barge Canal are to be built after a design prepared by the concrete ship department of the United States Shipping Board, Emergency Fleet Corporation. This design follows in general outline the design of the 3500-ton reinforced-concrete ship prepared by the same department and illustrated in *Engineering News-Record* of July 4, p. 17; that is, the barge has a center and two side keelsons forming the longitudinal stiffeners and side frames of normal reinforced-concrete girders spaced 5 ft. on centers and carrying an outer single shell.

The barge is 150 ft. long, 21 ft. beam and is 12 ft. deep at its side. It has a loaded draft of approximately 9½ ft., a displacement loaded of 756 tons, and a deadweight carrying capacity of about 489 tons. It is of the open-hull type, with cargo hatches 14 ft. wide, leaving 3½ ft. side decks. At bow and stern are cabin and storage spaces. It is intended that the barges be towed in groups of four, the largest number of this size which can pass a lock in the New York State Barge Canal at one time.

The reinforced-concrete details are shown in the accompanying drawings. The barge is practically square for most of its length, with rounded bow and formed stern. The main frames along the bottom are 6 x 18-in. girders with square bar reinforcement in upper and lower planes connected by small bar stirrups. This frame turns at the corners, where it is reinforced by extra stirrups, by increasing the depth and by diagonal rods. The vertical part of the frame is a 6 x 12-in.

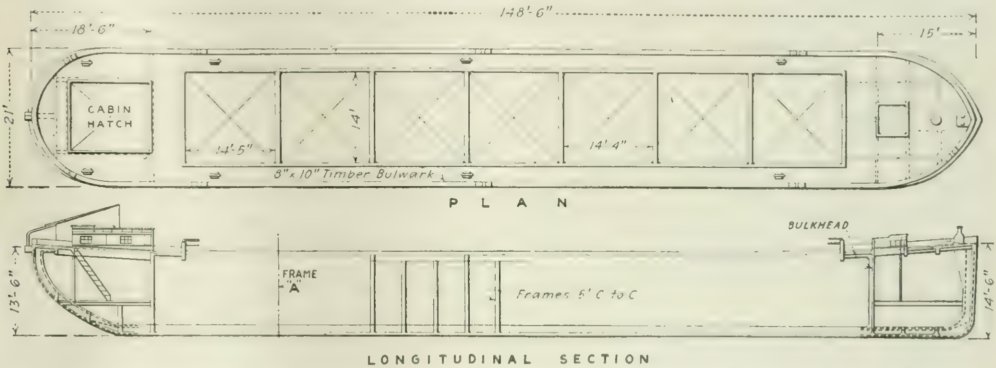


FIG. 1. 500-TON CAPACITY TOW BARGE OF CONCRETE NOW BEING BUILT FOR NEW YORK STATE BARGE CANAL

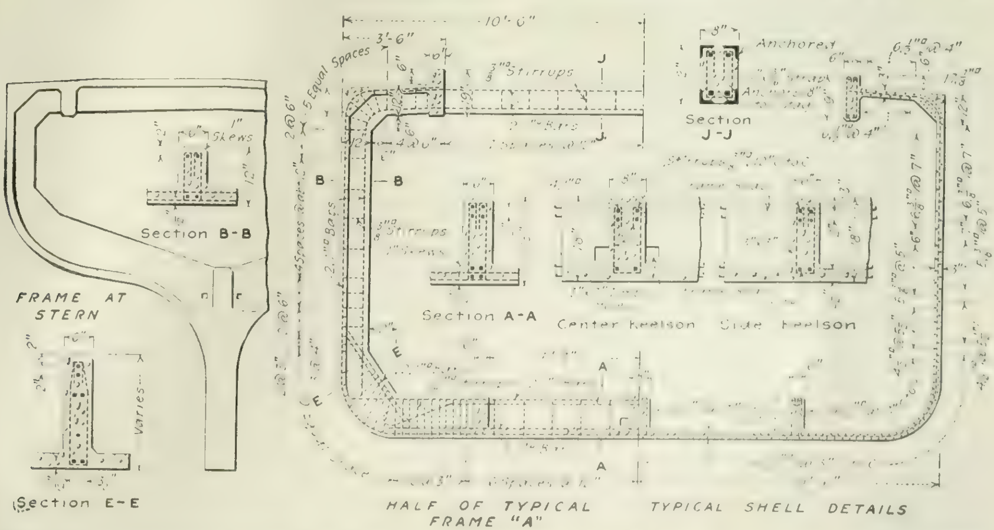


FIG. 2. CONCRETE BARGE SECTION OF REINFORCED-CONCRETE GIRDER FRAMES CARRYING THREE-INCH SHELL

girder. It turns at the deck to the hatch combing and every fourth frame is carried across the hatches as a cross-brace. The shell is 3 in. thick throughout except forward of the forward bulkhead, where it is $4\frac{1}{2}$ in. thick, and aft of frame 26, where it is 4 in. The deck slab is 3 in. thick. Both the shell and deck slabs are reinforced with $\frac{1}{4}$-in. and $\frac{3}{8}$-in. rods running horizontally and spaced variously, according to the location in the shell or deck. There are also $\frac{1}{4}$-in. vertically running shear rods spaced 7 in. c. to c. Additional stiffening of the shell at the turn between the side and the deck is gained by a number of extra longitudinal rods, as shown in the detail. All horizontal steel in the side and the midship section is carried around the bow and the stern. The steel in the bottom and the bilge is carried forward and aft as far as possible without interfering with the steel from the sides.

A bulkhead is placed across the ship 15 ft. from the bow. This consists of a 3-in. vertical wall bearing against three 7-in. vertical girders which frame into longitudinal deck girders, as shown in the detail drawing, Fig. 4.

There is a wooden floor in the hold consisting of 4-in. plank laid across the hull frame and extending up the sides to the underside of the deck. The hatch covers are of timber frames which can be lifted off the seat and are made up of 6 x 8-in. yellow pine timbers bolted to the reinforced-concrete girder forming the hatch combing.

The specifications for the concrete work have some novel features. The cement is to be ground to such a

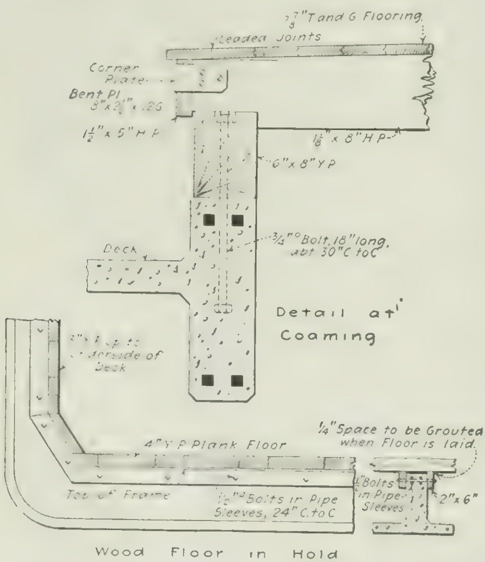


FIG. 3. DECK, HATCH COVERINGS AND HOLD FLOORING OF CONCRETE BARGE ARE OF WOOD FRAMES

fineness that a residue on a standard No. 200 sieve shall not exceed 10% by weight. So fine a cement is prescribed in the hope of getting a high-strength concrete at a comparatively early date. The aggregate is not to

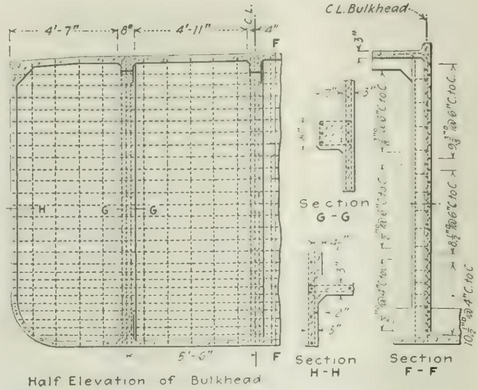


FIG. 4. COLLISION BULKHEAD A VERTICAL SLAB BEARING AGAINST VERTICAL GIRDERS

be more than $\frac{1}{2}$ in. in greatest dimension. All concrete is to be mixed continuously for a period of at least 2 min. after all the materials are in the mixer. Concrete for the slabs—that is, for the deck, bulkhead and shell—is mixed in the proportion of one sack of portland cement, $\frac{5}{8}$ cu.ft. of fine aggregate and $1\frac{1}{3}$ cu.ft. of $\frac{1}{4}$-in. aggregate.

Fine aggregate is sand or crushed gravel passing when dry a standard No. 8 sieve and $\frac{1}{4}$-in. aggregate must have such dimensions that it will pass when dry a sieve having $\frac{1}{4}$-in. square openings and be retained on a standard No. 8 sieve. For the frames a concrete can be used consisting of one sack of portland cement, 1 cu.ft. of fine aggregate, and 2 cu.ft. of $\frac{1}{2}$-in. aggregate. Continuous concreting is to be carried out if possible. In case a joint is necessary only one will be allowed, and that will occur on a line 2 ft. below the deck of the barge.

Contracts for the construction of these barges, to be built at sites accessible by water to the New York State Barge Canal, have been let by the railroad administration, as given in detail in the news columns of this issue.

Large Increase In Use of Motor Trucks In New York State

The use of motor trucks in New York State increased 47% during the year which ended July 1, according to a report issued by Secretary of State Hugo. This increase occurred in a period when general motor vehicle usage increased only 21 per cent.

The total registration of motor vehicles was 422,853. Of these 335,245 were passenger vehicles, an increase over 1917 of 15%; 67,330 were motor trucks, an increase of 47%; and 16,319 were omnibuses, an increase of 72%. These figures are considered very interesting because the increases have occurred under abnormal conditions. The increase in passenger automobiles is particularly so in view of the many pessimistic predictions made in the early part of the year. It was thought that although motor truck usage might increase pleasure car sales would show a decrease.

Iowa County Puts Road Maintenance on Sound Basis

Patrol Men with Team and Wagon Get $150 per Month—County Engineer Gives Clear Instructions—Dragging a Separate Item

By J. L. Parsons
County Engineer, Webster County, Iowa

MAINTENANCE of its road system by the common method of hiring farmers to do the dragging and any available person to make the usual repairs, has until recently been the method employed by Webster County, Iowa. Haphazard maintenance and confusion in placing responsibility for the correction of defects where it belonged was the usual and inevitable consequence. So, for 1918, the board of supervisors, in cooperation with the county engineer, have initiated a program which promises much for the future serviceability of the county road system.

As yet the county has but a small mileage of completed gravel roads—which require intensive maintenance—so with the idea of experimenting on a conservative basis, provision was made for only four patrolmen, and the 187 miles of county roads were apportioned so that each patrolman would reside near the center of his territory. As was previously the case, about 72 draggers are employed to do the periodic dragging.

Patrolmen Get Precise Instructions

The work of the patrolmen will cover the general maintenance and repair of the roads as set forth in the following instructions:

"Each patrolman should inspect all of his county roads often enough to be sure that the roads are in good condition, especially in wet periods. During the inspection work sufficient time should be taken on each mile to keep all bridge and culvert openings clear, level bridge approaches, fill holes in the road, keep side ditches open, remove stones from the road, and do all other necessary repair work.

"The grader should be used early in the spring to shape the roads, especial attention being given to the leveling of the ridges formed in the center of the road by draggers and the shaving off of the grassy strip along the sides of the road. The light graders are not intended to be used in the road ditches, excepting where they are useful for opening watercourses. After the roads are shaped properly in the spring the graders should be used for repair work on short sections, and often enough on all the county roads to prevent the growth of grass and weeds.

"All entrance culverts are to be placed and kept in repair by the patrolmen. In case new culverts are necessary in places where the water does not drain both ways away from the gate or cannot be cared for by inlets to tile drains, an order for the required culverts should be sent to the county engineer. Also necessary road culverts should be ordered and cared for in the same manner.

"The township plats furnished should be frequently consulted in order that the location of tile lines may become familiar and the tile kept in repair. In all low places where there are not inlets installed, inlets to tile lines should be constructed by the use of 8-in. sewer pipe thoroughly cemented to the tile and at the joints and covered with 8-in. cone grates sold by the Fort Dodge Foundry. All necessary materials should be ordered on the requisition blanks. It is very important that all inlets be kept open and in repair.

"As much as possible the character of the work done by the draggers should be investigated and the draggers instructed as to proper times and methods of dragging and the care and repair of drags. In cases where the dragging is neglected the patrolman should have the dragging done by using the grader, by using an extra team on the drag, or by employing additional help. In case a dragger unreasonably neglects his work the facts should be reported to the county engineer.

"All bridge repairs on the county roads will be in charge of the patrolman. The lumber owned by the county should be cared for and all possible precautions taken that it be not used for private purposes. Repairs on township road bridges will be done by patrolman when directed by the county engineer or supervisor. Additional help may be employed for this purpose when necessary. Only repair work on bridges proper should be done on township road bridges, as the township is responsible for all grading.

"The county roads should be kept clear of obstruction for the entire distance between fences by the destroying of brush, trees, etc. It is the duty of property owners to cut weeds and grass and these owners should be urged to do this work. In cases where the property owners refuse the county engineer should be notified and special instructions will be issued.

"Additional copies of the plats showing locations of tile lines and bridges will be furnished whenever needed. Any information gathered not shown on the plats should be reported to the county engineer. Requisition books will be furnished to each patrolman and signed requisitions must be issued for all material and labor ordered. Carbon copies of all requisitions should be kept and forwarded to the county engineer each month with the monthly report. Each day the patrolman's time should be entered in the proper columns on the monthly time report sheet. When these reports are properly filled out and filed with the county engineer warrants in payment for the previous month's work will be issued by the county auditor."

With the idea of attracting competent applicants, a salary of $150 per month was offered for man, team and wagon, the county furnishing light graders and all other tools and equipment. Fortunately, incompetents and political favorites are not among the men who have been selected.

Patrol Work Under County Engineer

The board of supervisors has recognized the advantage of a centralization of authority and responsibility, and has authorized the county engineer to issue all necessary instructions and generally to supervise and direct the patrol work. Undoubtedly changes and readjustments will be found advisable, but the outstanding feature of a program of this kind is the adoption of a definite plan.

The great obstacle to the institution of progressive maintenance methods, in Iowa as elsewhere, has been the prevalent inertia of custom and prejudice. In

the prosecution of the general construction and maintenance work of the county in the past there has been as in other localities a measure of public criticism and impatience with progress and results. Some of this has been justified by conditions which were under the corrective control of the county officials, but much of it is unwarranted. In order that the facts may become more generally known and a proper basis for judgment be provided, the county engineer has adopted the plan of furnishing short, concise articles for the county seat press once each week. In the few months that this plan has been in operation a more friendly spirit of understanding and coöperation between the public and its officials is becoming evident.

Urges Improved Status for British Municipal Engineers

INTRODUCING the subject with the general statement that "practically everything that matters in the public life of the community depends, to a large extent, upon the skill and ingenuity with which municipal engineers deal with their problems," T. W. A. Hayward, borough engineer and surveyor of Battersea, England, devoted a considerable part of his inaugural address, as president of the Institution of Municipal and County Engineers, to the status of municipal engineers in Great Britain. A joint committee on the status of municipal engineers, Mr. Hayward said, has reported its conviction "that it would be to the public advantage if the qualifications of municipal engineers were investigated, their duties more clearly defined, and their salaries fixed on some more consistent basis than is now the case." The committee was of the opinion, Mr. Hayward stated, that "appointments of municipal engineers should be under the supervision and control of the Local Government Board to the same extent as are those of medical officers of health." Continuing, Mr. Hayward said:

"Hitherto a local authority has been able to appoint as its engineer and surveyor a person who has had neither the scientific training nor the practical experience which are necessary for the proper execution of the work he is expected to devise and control, without even a comment from the Local Government Board. The council of this institution has recently been compelled to refuse to admit to membership men who have been appointed to positions of responsibility but who do not possess the necessary qualifications."

Constantly changing membership of municipal councils, with frequent reversals of policy, were mentioned by Mr. Hayward as one of the drawbacks to municipal service. The speaker declared that "too often, alas, the faithful officer is persecuted because he dares to do what he considers right when he comes into conflict with counselors and others whose interest may be disturbed, and his life is made so unbearable that he has no alternative but to resign his position."

Finally, Mr. Hayward spoke of the coöperation between his institution and the National Association of Local Government Officers in promoting superannuation, adding that at present the Local Government Board is moving toward the appointment of a special committee to investigate this subject.

Looking Back Half a Century

How a Young Engineer, Since Grown Famous, Got His Start in the Engineering of That Day

By CHARLES WHITING BAKER
Consulting Editor Engineering News-Record

RUDOLPH HERING, the dean of American sanitary engineers, completed on June 1 his fiftieth year of active work in engineering. It was in June, 1868, that young Hering, just returned to America from four years of study in an engineering school in Dresden, Germany, landed his first engineering job—the humble position of chainman on the survey of Prospect Park, Brooklyn.

Engineers were few in those days, it is true; but engineering positions were few also. In his studies Hering had specialized in bridge and railway engineering, and was eager to put his newly acquired scientific knowledge into practice; but bridge building as a business was hardly born and railway companies in those days used engineers merely in the original surveys and construction. When a railway was once built there was supposed to be no further use for engineers.

Hering had not the slightest premonition of where his future career was to lead. Chance, not intention, determined that—as is very generally the case with engineers as well as other men, regardless of laborious specialization in the schools.

Told to Take First Job He Could Get

Rudolph Hering's father was an eminent scientist and physician of Philadelphia, who immigrated to the United States from Germany in 1826. Among his intimate friends was Julius E. Hilgard, who was later head of the United States Coast Survey. To young Hering, in his quest for work, Hilgard gave letters of introduction to half a dozen well known engineers, among them his personal friend Alfred P. Boller, the bridge engineer. Mr. Boller sent Hering to James P. Kirkwood of Brooklyn, then the most eminent American authority on the filtration of water. Mr. Hering recalls Kirkwood's advice to him to take the first engineering job he could get, no matter how humble or in what field of work, if he wanted to break into engineering. Through Kirkwood's recommendation, Hering became chainman in one of the field parties then working on Prospect Park, in June, 1868.

The first chief engineer on the Prospect Park construction was Joseph P. Davis, who later became city engineer of Boston, and afterward achieved important success as engineer of the Bell Telephone Co. The landscape architects for Prospect Park were Olmsted and Vaux, fresh from their great success in the creation of Central Park. Mr. Davis was a careful, methodical engineer who prided himself on laying out work accurately and computing excavations and embankments to close limits. To change the plans during the progress of work was, to his mind, little short of criminal. Very different were the ways of the landscape architects. Where the merit of work lies in its appearance to the eye, how shall you tell beforehand to a hair's breadth what shall be done?

"Mr. Davis," Vaux would say on one of his frequent visits of inspection, "I don't like the looks of this slope. Won't you fill in two or three feet more here? And this

path had better be swung off in this direction instead of where you have built it." Such was the havoc played with the engineer's careful calculations that it worked on Davis's nerves till he resigned in disgust.

Another Nestor of American engineers still in active professional work who was on the Prospect Park survey fifty years ago was John Bogart, who held the position of principal assistant engineer. Mr. Bogart later became widely known to the profession by his services as secretary of the American Society of Civil Engineers for the twelve years from 1878 to 1890. Later he did valuable pioneering in hydro-electric power development in planning the first harnessing of Niagara Falls.

Another important member of the Prospect Park group was C. C. Martin. He was the chief engineer from 1867 to 1870 and later served for many years as chief engineer of the Brooklyn Bridge when that structure was counted among the world's greatest engineering works. Still another was A. M. Wellington, who was leveler in the division adjoining Mr. Hering's, and whose notable work as editor of *Engineering News* from 1887 until his death in 1895 is still fresh in the memory of many engineers.

In 1868, when Prospect Park was in the making, there were only dreams of a bridge connection with New York City. Brooklyn was a residential city for those who did business in New York (which meant the lower end of Manhattan Island) and was famous far and wide as "the City of Churches." Prospect Park was to be just such a recreation spot for these "suburban dwellers" as the newly opened Central Park was to New Yorkers who lived "uptown" (above 14th Street).

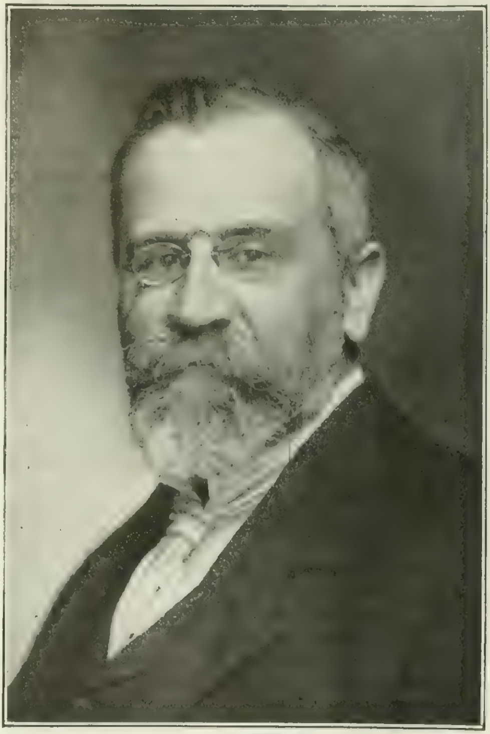
The only means of travel for New Yorkers in going to and from business was the Broadway omnibuses (whose chronic congestion in rush hours was the first example of that coming "peak of the load" which was to be such a problem to the engineers of a future generation) and a few newly built horse-car lines. The same class of New York business and professional men who nowadays flock to the New Jersey suburbs to escape the congestion of Manhattan Island went to Brooklyn to find homes in the fifties and sixties.

No one at that day foresaw Brooklyn as a vast hive of manufacturing industry. Even the farsighted Wellington, in his notable studies of the future development of greater New York, published in *Engineering News* in 1887, soon after he became its editor, placed his entire emphasis on Brooklyn as a residential city for those who earned their living in New York.

The work of young Rudolph Hering on Prospect Park lasted only a year. Funds ran low, and in 1870 the work had to be suspended for a time. So the future sanitary engineer, who was still longing to be a bridge engineer, sought another job and found it in his own home city of Philadelphia, where the new Fairmount Park was just then being laid out. Here again his work was surveying, but he was put in charge of a party.

The first task was to make a topographical map of the area. Hering had been instructed abroad in the then little known art of surveying with a plane table, and he suggested its use for the Fairmount Park surveys. He met with no encouragement until he broached his idea to the principal assistant engineer, Hermann Schwartzmann, who had also had experience abroad. To Hering's suggestion that the plane table be used, Schwartzmann replied, "Of course that's the best way to do it; but nobody here knows how to use a plane table." "Well, I know how," said Hering. "Then use it, by all means," said Schwartzmann.

Another young engineer associated with Hering on the Fairmount Park work was Lewis M. Haupt, who a few years later became professor of civil engineering at the University of Pennsylvania. Still another was J. Foster Crowell, who was assistant engineer for the area east of the Schuylkill River while Mr. Hering was



RUDOLPH HERING

engineer for the west side. In later years Mr. Crowell was a well known consulting engineer in New York City and was at one time commissioner of the Street Cleaning Department.

It is a little difficult to realize now that at that day the making of surveys and measurements was considered the chief function of an engineer. An engineer was a man who used a chain, a compass and other instruments set up on three legs, who set down figures in a book and drove stakes marked with red chalk that told where this and that was to go. There was an underlying reason why engineers were not in demand except for the absolutely necessary work of surveying, and were especially not wanted to meddle with anything relating to prices or to the award of contracts. Those were the palmy days of corrupt municipal government in the United States. Most cities were governed by political

machines which were run for the enrichment of the "machinists."

Relics of that old-time view of the engineer still survive, as in the State of New York, where the state engineer is required by law to do the scientific and mathematical work in connection with the state's public enterprises, while the award of contracts and the inspection of contract work are reserved to the Superintendent of Public Works, who is by tradition a carefully selected politician.

In January, 1872, about the time the Fairmount Park surveys were completed, the newspapers were full of the discoveries of wonderful spouting springs in the Yellowstone region of the Rocky Mountains. Congress had set aside for a national park a great tract 60 miles square containing these geysers. Hering was becoming a park engineer, so why not seek a job there? Through his father's friend, Hilgard, he was introduced to Hayden, the geologist, who was to head an exploring party to the Yellowstone, and Hering was appointed one of the two astronomers of the expedition, the other being the late Henry Gannett.

Predicted Fall of Bridge

After six months of active adventure in the Yellowstone, and another six months in Washington working up the data, Hering returned to his home town of Philadelphia and at length gained his long desired opportunity to practice bridge engineering. Samuel L. Smedley, then city engineer of Philadelphia, placed Hering in charge of the new Girard Avenue bridge over the Schuylkill. Another bridge over the Schuylkill at South St. was at the same time in charge of D. McN, Stauffer, who eight years later became editor of *Engineering News*. This was the ill-fated South St. stone arch structure which fell in ruins before its completion, because there was a stratum of soft clay below the crust of hardpan into which the piles that supported one of the piers were driven.

That failure was one of the notable engineering disasters of the time. The slow, steady settlement of the pier and the consequent distortion of the arch were accurately measured by Hering, and the curves of pressure as well as of settlement were plotted day by day. One Thursday Hering said to his chief, "Mr. Smedley, that arch will fall in a few days." On Saturday he computed that it would fall on Sunday morning about 7 o'clock. At 7 o'clock Sunday morning Hering was at the site of the work, but at 6 a.m., within an hour of the time he had predicted, the huge masonry arch had crashed to the ground.

It should be said here that neither Hering nor Stauffer was responsible for the design of the bridges on whose construction they were the resident engineers.

After three years spent on the Girard Ave. bridge, City Engineer Smedley in 1875 transferred Hering to a field of work in which he was later to become an eminent specialist—the city sewer department. Not that there was much to be learned by a young engineer in the Philadelphia sewer department of that day except the art of how not to do it. Hering was the outdoor assistant, having chiefly to do with the construction of the main sewers and bridges.

In those days in Philadelphia and numerous other cities of eastern Pennsylvania the pedestrian along the streets was continually stepping over a little stream of soapy water flowing in channels across the sidewalk from the house to the street gutters. The smallest sewers built in Philadelphia were 3 ft. in diameter. These were built of a single 4-in. ring of brick laid up, except the arch, without mortar. Indeed, it was explained to young Hering on his entry into the sewer department, by the men of "practical experience" who were in charge, that the sewers must be built without mortar "so that they would drain the ground."

Found Sewer Built of Barrels

Naturally, cave-ins of sewers so built were frequent. One day news came that a street had caved in over a recently built sewer, and Hering was sent down to investigate. Sure enough, there was a long jagged ditch through the center of the street. Taking a pick, Hering started exploring to find the condition of the rest of the sewer, but he could not uncover any bricks. Instead he found barrel staves and hoops. On further inquiry it was discovered that the contractor had obtained a lot of barrels, knocked out the heads, placed them in the ditch, quickly covered them up, collected his money at so much per lineal foot of sewer laid, and departed with all convenient speed.

To a man of Hering's make-up, sewer building in Philadelphia was chiefly instructive as evidence of the need for great reforms—reforms in design as well as in execution. In other cities as well as in Philadelphia the time was ripe for breaking away from the traditions and the prejudices of the old school of sewer builders.

Col. George E. Waring was just then attracting wide public attention by his advocacy of small pipe sewers—a novelty which the leading engineers of that day fought against bitterly, but which the younger and more farsighted men recognized must receive attention. In one of the discussions between Hering and his chief, Smedley, in 1878, the younger man proposed a trip to Europe to study foreign practice in sewer construction. Smedley approved and put in an application to the city councils for an appropriation to pay Hering's traveling expenses. The item attracted the attention of one of the lynx-eyed "watchdogs of the treasury" in the councils. "Go to Europe to study sewerage!" said he, sarcastically. "I can see through that. He wants a junket to see the Paris Exposition. Not on yer life."

Nevertheless, Hering did go to Europe to study sewer construction. In the spring of 1880, after again unsuccessfully trying to obtain aid from the City of Philadelphia, his old friend Hilgard introduced him to Dr. John S. Billings, then surgeon general of the Navy and vice president of the National Board of Health. Dr. Billings promptly welcomed the proposal and Hering went back to Philadelphia to tell his chief that the Federal Government was going to send him to Europe to study sewer design and construction.

So it was that the youth who had specialized in bridge work and railway engineering spent the first dozen years of his professional life on park surveys, bridge building and sewer construction, before he found an opportunity for large development along the line where his future career was to lie.

Other Values and Elements of Value, as Applied to a Going Railroad

Kansas City Southern Witnesses Tell Commerce Commission of Items Not Reflected in Cost of Physical Property—Call It Impossible to Appraise These Items Separately, but Give Total Value of Plant

EXTENSIVE testimony relative to "other values and elements of value" was offered by the Kansas City Southern Ry. Co. at a hearing before the Interstate Commerce Commission last March, in the matter of the valuation of that road. Mark Wymond, W. S. Kinnear and George H. Davis, consulting engineers, and L. F. Loree, chairman of the board of the Kansas City Southern, were among the witnesses. Each held that it was not feasible to fix the intangible values; each offered a figure for total final value, at which he said he arrived by careful consideration of all tangible and intangible elements of value and their relation to one another; and each insisted that the only way to determine the intangible value was to subtract tangible value from total value. Each witness gave earnings, both present and prospective, much weight in estimating total value. Strategic location, easy operating conditions, good terminals, and a good organization were all cited as elements of value, and the road was compared with other roads in the district. The figures offered for the total value of the Kansas City Southern ranged from $75,000,000 to $80,000,000, as compared with about $50,000,000 tangible value found by the Division of Valuation, and a much higher figure claimed by the company.

Mr. Wymond thought $76,500,000 the entire value of all the carrier property of every kind, tangible and intangible, on the valuation date. In arriving at this figure he considered the various cost figures—original, reproduction new and reproduction less depreciation; the market value of the securities, which totaled about $62,000,000; the location of the line, the operating conditions, the character of the country traversed and the traffic, present and possible; and the earnings of the company, present and prospective. He used the Missouri, Kansas & Texas, the St. Louis-San Francisco, the St. Louis, Iron Mountain & Southern and the St. Louis & Southwestern, all parallel and competing lines, as bases for comparison.

Mr. Wymond Cites Strategic Location

Extending from Kansas City, Mo., "a railroad traffic center of the first importance, the traffic originating and interchanged there being enormous," to Port Arthur, Tex., "a United States port of entry of considerable present and very great prospective importance," a distance of 789 miles, the Kansas City Southern, Mr. Wymond thought, had a strategic position of great value. He pointed to several stations along its lines which were "traffic centers of considerable importance," and to "immense resources in coal and other minerals, oil, lumber, petroleum and other oils for which there is a large and constantly growing demand," in the territory the road traverses.

Considering the Kansas City terminus of the line, he pointed to the Kansas City Southern as the shortest route to the Gulf of Mexico. He spoke of the many lines of railroad radiating from Kansas City in every direction, and cited the Chicago, Burlington & Quincy, Chicago, Milwaukee & St. Paul, Chicago Great Western, Chicago & Alton and Union Pacific, operating in the aggregate more than 23,000 miles of railroad. He held that as none of these systems operates south of Kansas City and as the Kansas City Southern does not operate north of it, they do not compete with, but rather supplement each other, and there is a very large interchange of traffic at Kansas City between the systems.

Superior Terminals

The terminals of the carrier at Kansas City, too, he found superior to those of any other system there. He stated that in 1914 its switching revenue exceeded that of the Kansas City Terminal Ry., which is owned jointly by the largest 12 systems entering Kansas City. The carrier has direct physical connection with 15 other railroads in the city and on this account is more favorably located, he thought, than any other railroad there. In that connection, he observed that the principal element of value of such terminals was not dependent on the cost of producing the physical property employed, but on their favorable location, bringing to the carrier a very large percentage of its total freight traffic and revenue.

An element of value of the Kansas City Southern, according to Mr. Wymond, was the comparative absence of branch lines. He held that the operation of branch-line railroads is seldom profitable; that railroad systems construct or acquire them because the anticipated profits on the traffic which they contribute to the main line exceed the losses incurred in the operation of the branch lines, and that the Kansas City Southern, through its connections at various points, derived the benefit of feeders without incurring the losses in their operation.

The southern terminus of the carrier at Port Arthur, Tex., he held to be an element of value. He pointed to the terminals there and their capacity for handling the large traffic, and laid special stress on the fact that they are seven miles inland from the Gulf of Mexico, at the head of a canal, and thus protected against Gulf storms.

That the roadbed of the carrier is well and substantially constructed, with embankments and cuts of standard width; that the track is well ballasted and the whole track system well maintained; and that the steel bridges are designed to carry the heaviest loads passing over the various divisions, Mr. Wymond thought were elements of value.

Nine Favorable Operating Elements

Considering the operating conditions of the road, Mr. Wymond pointed to nine favorable elements, as follows:

1. Greater freight traffic density than that of any of the other four railroads previously mentioned.

2. Grades favorable to economic operation.

3. Favorable location of division points, resulting in operating economy on account of reducing overtime of trainmen.

4. Good balance of traffic in both directions, under normal conditions.

5. Longer average haul of freight than on any of the other four lines.

6. The fact that three items—coal, forest products and petroleum products—that are staples of commerce, with constant and practically uniform movement throughout the year, made up more than 59% of the total tonnage moved by the railroad in 1916.

7. Well located industry tracks, ample yards and passing tracks.

8. Abundance of both coal and crude oil along the line, insuring a minimum cost of fuel for company purposes.

The effect of these favorable conditions, said Mr. Wymond, is reflected in the ratio of operating expense and gross revenue, which was 62.86% for the Kansas City Southern and from 64.35% to 76.54% for the other four roads.

Of these eight favorable conditions, Mr. Wymond pointed out that only three are dependent upon or have any relation to the cost of the physical property, those conditions being the second, third and seventh.

Prospective Earning Power Most Important

Earning power, present and prospective, Mr. Wymond considers the most important element to be considered in placing a value upon the property. He differentiated earning power from earning capacity. The latter is limited by the capacity of the physical property to move the traffic. The former is limited by the opportunity to move the traffic, and in considering it he said account must be taken of the "adaptability, condition and efficiency of the physical property; the strategic position and all other conditions that determine the density and character of the traffic, present and prospective, and the net income, present and prospective, resulting from these characteristics of the physical property, the traffic conditions and the schedule of rates applying on the traffic moved."

To arrive at the prospective earning power of the carrier, Mr. Wymond considered the net income for the fiscal year 1914 and also the trend as reflected by the figures for other years before and after 1914. The net income of the carrier for 1914 he stated to be $3,515,276, which, capitalized at 6 per cent., amounted to $58,587,933. On the assumption that the net income would remain indefinitely the same as of 1914, he thought $58,587,933 might be regarded as the value of the property. But the figures from 1905 on indicated a rate of increase per year of $214,979.20 in net income, and the records for the year which ended June 30, 1917, seemed to him to strengthen his belief that that increase would continue. The net income for the year which ended June 30, 1917, capitalized at 6 per cent., would amount to $73,030,167, and the prospective net income for the year ended June 30, 1924, similarly capitalized, would amount to $94,416,667.

Mr. Wymond thought 10 years a proper period to use in considering the prospective earnings of the carrier, for the reason that the territory served directly by it is only partly developed. With respect to the possibility of changes in rates, he thought it fair to assume that the rates in effect were reasonable, prescribed by competent authority, and that the relation existing between gross revenue and net income would be preserved should changing conditions require a raising or lowering of the general level of the rates. He thought, furthermore, that the level could not be lowered without confiscating the property of some of the other four railroads which he considered, in view of their much lower net operating income per mile.

Intangibles Not Appraisable

He asserted that his judgment of value was based largely but not entirely upon present and prospective net incomes. In existing circumstances, he said, there is no method by which the exact value of the properties of the carrier may be determined. "It is possible, however, to state an amount below which the value of the property of the carrier cannot go......The sum I have named as being the value of the carrier's property is probably less than the actual value......It is a very conservative value that may be safely used for purposes of financing the property, or in considering a schedule of rates applying in the territory served by the carrier."

"It is not possible to state how much weight I have attached to any one of the many things affecting the value of the carrier property........The elements of intangible value cannot be appraised separate and apart from the physical property......If it should appear that the physical property of the carrier was worth $62,000,000, as claimed in its protest, instead of $50,000,000 as suggested in the tentative valuation, that would not affect my testimony as to the final or full value of all of the properties.......If the value of the physical property was placed at $77,000,000, I would still say that the total value was $76,500,000, unless there was some kind of an assumption made by the commission that any road that was indispensable to the commerce of any section was worth its cost."

In reaching his conclusions that $76,500,000 was the fair and reasonable value of the properties of the carrier, both tangible and intangible, as of June 30, 1914, Mr. Wymond stated that he attached the greatest importance to the following conditions and circumstances:

1. The strategic position of the carrier and the friendly relation with connecting railroads through mutual profit, which has brought to it a large present and prospective interchange of business.

2. The characteristics and conditions of the physical properties of the carriers and their operating efficiency.

3. The operation of the properties of the carrier and the going transportation concern with an established profitable business.

4. The development, both present and prospective, of the natural and agricultural resources of the territory directly served by the carrier, and the consequent commercial and industrial development therein.

5. The past, present and prospective gross revenue and net income of the carrier, and the stability of existing rates.

Mr. Loree placed a value of $80,000,000 on the property as an entirety. He thought the correct original cost to date of the property was in excess of $73,000,000, and believed the cost of reproduction of the property to be more than $82,000,000; but he held that the whole property was worth $80,000,000 regardless of the question of the amount of money originally put into the property, or whether the cost of reproduction was $70,000,000, $65,000,000 or $60,000,000.

"I think the intangible values," said Mr. Loree, "represent a sum of a series of relations which involve the strategic position, the resources of the territory served, the operating conditions, the conditions of the physical property, the organization and personnel and good will, and these cannot be allocated and a separate value given to any one of them." Mr. Loree thought that if proper allowance were made for items omitted from the Division of Valuation's tentative figures, the total for tangible items would be $75,600,000, which would leave the intangible value about $4,400,000.

Money expended in building up the carrier as a going business concern to the point of success, he thought, should be included in the intangible property. Assuming that the road had been laid down during the 24 hours of June 30, 1914, and had started in on July 1 to solicit its business, he thought it would have had about $3,000,000 of business local to the property; that it would have had to get, from the property and on the earnings of that year, $11,000,000. It would thus have had $8,000,000 to go out and find. It would have taken seven years to build up that earning—20% of it the first year, 30% the second year, 40% the third year, 50% the fourth year, 65% the fifth year, 85% the sixth year and 100% the seventh year; and estimating the cost of operating under that gross, and taking the interest on the investment, and offsetting that with the net earnings, an algebraic total something in excess of $14,000,000 would be obtained. Mr. Loree said he put it at $5,000,000, although he thought $14,000,000 much closer.

Five Considerations

Five considerations, Mr. Loree testified, influenced his judgment in reaching his figure of $80,000,000 for total value. They were original cost, cost of reproduction new, the value of the business as operated on what he considered a proper rate structure, the probability of increase in the business subsequent to June 30, 1914, and the annual turnover of the capital. Considering the probability of increase, he fixed the value of the property on that basis at $80,000,000, even though it was not then earning 6% on $80,000,000, because he conceived that the property, without substantial increases in its capital investment, was capable of handling a business of $18,000 a mile or about $16,000,000 in total, and that that would produce a net that would show 6% on more than $80,000,000, and would do that in four or five years. As to annual turnover, he said that investments in transportation enterprises usually show a turnover in from six to 6½ years. Assuming a gross earning of $15,000,000, a turnover in six years would show earnings on a valuation of $90,000,000. Taking all five of the methods, he felt warranted in assuming a total value of $80,000,000.

Mr. Kinnear gave $77,000,000 as his estimate of the fair total value of the property. In arriving at this figure he considered the extensive change of line and grade-reduction work done from 1909 to 1912, the original cost to date, the cost of reproduction new and cost of reproduction less depreciation, operating statistics, traffic conditions, competing lines and stocks and bonds. He, also, thought it not feasible to separate the tangible values from intangible values except by subtracting the sum of the tangible values from the total value.

Following are some of the things mentioned by him as contributing to the value of the property: Changes made in division points within the past few years, as a result of a careful study of operating conditions and the economic use, classification and distribution of power; the existence at division points of yards ample and in most cases of sufficient capacity to handle a marked increase in tonnage without additional tracks; liberal provision of team and industrial tracks and freight-house facilities, established as offering the utmost freedom for the care of increased business and future expansion; the terminals at Kansas City, with tracks exceptionally well located for the prompt handling and interchange of traffic with connecting lines, and for the switching of carload traffic to and from warehouses, industries and factories in the two cities, and with switching and classification yards conveniently located to insure prompt handling and grouping of interchange freight; in general, adequate and often rare judgment in providing for future growth; an efficient and well balanced organization.

Accumulative net income was used by Mr. Kinnear as a basis for forecasting future earnings. On this basis he estimated a net income of $5,200,000 for the year 1924. He thought this a very important factor in determining the total value of the property.

Comparisons with Competitors

C. E. Johnston, general manager of the Kansas City Southern Ry., mentioned as elements of value of the property the company's team tracks in Kansas City, which he regarded as the most conveniently located of any in the city; the small branch mileage; the natural location of the district terminals, which he said was "very favorable to the operation of the line, and enables you to handle your power and your trains and distribute your power to the greatest economy." He gave figures for the average mileage per car per day of cars on the Kansas City Southern, the Frisco and the Missouri Pacific. During 1910, before the result of the company's grade reductions was felt, the average car mileage on the Kansas City Southern was 23.6—less than for either of the other roads. In 1914 it was 29.5, more than for either of the others. In 1917 it had increased to 40.8. Similarly the average revenue train loading on the Kansas City Southern increased from 361 net tons in 1910 to 508 in 1914, while those of three competitors were much lower. He attributed these increases to the favorable condition as to balanced traffic.

Other figures given by Mr. Johnston compared the revenue tons carried one mile per mile of the Kansas City with the corresponding figure for three competitors; the ratio of operating expenses; the transportation expense per gross-ton mile; the average number of cars per train—and in each case he found the advan-

tage decidedly with his road. He also gave figures showing his road to have the shortest route to the Gulf of Mexico from Kansas City.

Mr. Davis' Summary

Mr. Davis gave $75,000,000 as his estimate of the total value of the property.

As to conditions affecting estimated value based on earning power, he had the following to say: "A well located necessary railroad has certain cardinal advantages which cannot be eliminated without materially reducing its values, which are:

"A. Its terminals. If it is a single line one of its terminals should be at an important deep-water ocean port and the other at an important inland concentration, storage and distribution center.

"B. Its intersections. It should intersect important trunk lines which serve as feeders from both directions and relieve the company from the maintaining of feeders.

"C. Its traffic. It should have a balanced traffic, the tonnage in one direction being approximately the same as the tonnage in the opposite direction, so that empty carrying capacity would be reduced to a minimum. The traffic should be balanced as to seasons, giving a high annual load factor.

"D. Its territory. The territory served should be rich in natural, developed and potential advantages, including (1) a variety of climate, insuring a variety of agricultural products and consequent traffic at all seasons; (2) important products, and of various kinds, well distributed along the line; (3) manufactures; (4) forests; (5) fertile soil; (6) freedom from snow, and (7) freedom from storms.

"E. Its physical characteristics. A successful railway is dependent also upon the extent, quality and efficiency of its physical equipment."

Cannot Separate Intangible from Tangible Value of the Railroad

As did the other witnesses, Mr. Davis said it was impossible to separate intangible value from tangible value.

"Some of the items of intangible value," said he, "are those relating to the past, the present and the potential connected or developed business as distinguished from and in addition to the bare bones of a physical property completed but not in use, and consist in the main of the following advantages: Excellent strategic location and a natural route of commerce with terminals connecting all important rail and ocean routes; good design, including economy, quality, practicability, size, adaptability and coördination of parts; great undeveloped sources of traffic; an excellent reputation with patrons and other carriers; efficiency of the transportation plant shown in part by (a) a relatively low operating ratio; (b) heavy train and car loading; (c) long hauls; (d) number of car miles per car per day; (e) dense traffic —compact operation without a multiplicity of branch lines, with more than 70% of its revenue derived from interchanged traffic; a well balanced north and south traffic; a well balanced interchange of traffic and a well balanced territory served."

Sinking of Levees Is a Problem in Louisiana

Increasing Trouble Demands Attention—Natural Elevation of Ground and Depths of Borrow Pits Are Factors

Levees on certain parts of the lower Mississippi River have developed a tendency to sink or subside, and within the past three or four years this trouble has reached proportions which call for precautions to prevent or minimize its recurrence. According to the recent report of the Board of State Engineers of Louisiana it is exceptional for the settlement of new levees to be limited to the amount which might be expected from natural shrinkage. This is the case especially below New Orleans. Observations indicate a relation between the natural elevation of the ground and the net height of levee which it will sustain. Thus, ground 5 ft. above Gulf level will carry a 9-ft. levee but not an 11-ft. levee. If the ground has an elevation of only 3 to 4 ft. it will barely sustain a levee 6 ft. high.

As the subsidence occurs mainly where levees have been built by machinery, it is thought to be due to the deeper borrow pits made by the machines. Assuming that under the foundation are strata of semi-liquid material, the excavation may either cut into them and cause them to flow into the pit or it may leave the solid bottom of the pit so thin that the soft strata can rise here and thus cause a subsidence of the adjacent embankment. Muck ditches near the center line of the levee contribute to the movement, even when their depth does not exceed 4 ft. Width of berm is another factor. In a levee having a berm 20 ft. wide in one part and 45 ft. in another the subsidence occurred only with the narrower berm.

Preventive Measures Advised

Preventive methods considered advisable for levees below New Orleans are as follows: Bottom of borrow pit not to be below Gulf level; muck ditch to be eliminated or located at or near the top of the slope; width of berm to be greater than in former practice.

Owing to the higher elevation and correspondingly greater bearing capacity of the ground above New Orleans, the trouble from subsidence was not encountered generally until new leveees began to be built behind the older ones and to the increased elevation as established by the Mississippi River Commission. With this increased height and the naturally lower elevation of the ground 500 to 600 ft. behind the old levee, the net height of the levee is increased 3 ft. to 4 ft. Thus, in the caving banks between New Orleans and Baton Rouge a net height of 20 to 21 ft. is the usual requirement, and above that point the height may be slightly greater.

The weight of an earth embankment of such height is given as 1800 to 2000 lb. per square foot for a width of 5 ft. on each side of the center line. That this does not exceed the theoretical safe supporting limit of the soil is evidenced by the stability of brick chimneys and other structures in the immediate neighborhood. The report points to influence of the borrow pits, as follows: "But Professor Rankine's safe load of $1\frac{1}{2}$ to $1\frac{3}{4}$ tons per square foot, and Professor Baker's recom-

mended safe load of 1½ to 2 tons per square foot for ordinary clay foundations do not presuppose the presence of pits 10 ft. or more in depth within 200 ft. of the point of application of the load."

The conclusion is that deep borrow pits are responsible for subsidence along this part of the river also. This is supported by the fact that even the most obstinate cases of sinking levee have been corrected by loading the berm or the pit, after which the levee is brought to grade easily. This is a costly operation, however. Specifying shallow borrow pits also increases the cost of levees. As the problem is one that must be reckoned with in the future, it is important to determine the economical mean between these two costly methods of curing and of preventing the subsidence of new levees.

Rebuild Underdrains in Toledo Filters

PERFORATED pipes have replaced the strainer system originally placed in the filters of the Toledo purification plant described in *Engineering Record* of Nov. 26, 1910, p. 600. A report of the work done, as given in the annual report of R. W. Furman, chemist in charge, is as follows:

In June, 1916, Filter 5 was reconstructed, placed in operation and run continuously for experimental purposes. During the course of 1917 28 of the 34 filters were reconstructed after the manner of No. 5. The entire drainage, except the center manifold, was removed and replaced by pipe laterals, the bottom of which contained 16 holes spaced on 3¾-in. centers. At a distance of ¾ in. below the laterals a cement floor was placed. Around the laterals, to a depth of 3½ in., was placed assorted gravel with an approximate diameter of 1½ in. Over this were placed four 3-in. gravel layers. The air tubes were placed near the top and a little above the finest grade of gravel. The filter was finished with 24 in. of sand. A portion of the sand was new and of a fine grade, the original sand being of a grade too coarse for the best results. The resurfacing of these filters with a fine grade of sand, when finished, will bring the effective size down to about 0.35 mm. The old gravel was cleaned by being conveyed by an ejector to a system of screens for grading; there much time was saved by the use of a power shaker for distributing the gravel over the screens.

Owing to the fine character of the sediment in the settled or applied water, a very fine grade of sand can be used without reducing the period of service too much. The filters removed on an average 1.34% of the bacteria and 8.1% of the turbidity of the river water. The average number of bacteria applied to the filters was 390 per cc., and the average number contained in the effluent was 235 per cc. This number was reduced by disinfection to an average of 99 per cc. The B. coli index for the water delivered for consumption was 8.42 per 100 per cc. Disinfection was carried on for the greater part of the year.

As a result of the softening treatment used during the previous year, the incrustation on the sand and gravel caused an increase in the total hardness of the filtered water during the times when alum was used as a coagulant. The alkalinity of the effluent was also increased and consequently the calcium and magnesium content of the water.

For the entire month of September the river water was found to abound in algae and microscopic organisms that reduced the period of service of the filters to an average of 20 hours. During this time there was used 1.99% of wash water, the highest percentage used during the year. Much wash water was saved during this month by introducing enough water to break the surface of the sand without allowing the water to waste.

Fifty-Mile Motor Interurban Service Operated

Buses in Minnesota Run on Regular Schedules—Fares Are Not Greater Than Ordinarily Charged by Railroads

LONG-DISTANCE motor-bus routes are a feature of transportation methods in Minnesota, according to the annual report of the State Highway Commission. Inquiry by *Engineering News-Record* shows that a typical route is that operated by the Mesaba Transportation Co. between Hibbing and Grand Rapids, a distance of 50 miles. The company has regular printed schedules which list six round trips each day. The running time is three hours, with 15 intermediate stops, and the fare is $1.50 each way. This rate of 3c. per mile is very close to railroad tariffs.

BUS USED FOR FIFTY-MILE PASSENGER INTERURBAN SERVICE TRAVELS ON COUNTRY ROADS

Service to various points within 50 miles of Hibbing is operated by 18 motor-buses of 30 hp. each. For the main run to Grand Rapids, with a good gravel road all the way, ¾-ton machines are used, each making 100 miles daily. For other routes, with earth and paved roads, 1½-ton machines are used. The service has been in operation for five years, and the company states that no great difficulties have been experienced from bad weather or poor roads. No serious delays have been caused by snowstorms, a small snow plow having been built on a 45-hp. 1½-ton bus.

All these motor buses are made by the White Co., the ¾-ton and 1½-ton cars seating 12 and 22 passengers respectively. Provision is made for parcels and light baggage, but no freight is handled. Pneumatic tires 32 x 6 in. are used, and the operating speed is from 15 to 25 miles per hour.

A 160-mile route from Walker to Sauk Center is mentioned in the highway commission's report, but this

line has been discontinued as the local traffic proved insufficient.

In the opinion of John H. Mullen, engineer and deputy commissioner of highways, the additional highway maintenance cost, resulting from traffic of this kind, should be taken care of by special license for the vehicles. At the present time, Minnesota has no commercial vehicle law which authorizes the collecting of funds from truck companies to pay these extra charges.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Owners Need Education in Contract Practice

Sir—I have read with much interest the articles in your issues of July 18 and 25, regarding new forms of contracts. Allow me to call your attention to the fact that it is the owners that require education. As a rule, they do not offer any inducement to a contractor to do good work, as they invariably award the work to the lowest bidder without regard to his qualifications, other than that he can furnish the required bond. I have 35 years' experience and have worked in many of the states, and this rule with few exceptions I have always found in force. The strongest corporations are generally the worst sinners.

Pittsburgh, Pa. WALTER F. PATTERSON,
General Contractor.

[As stated editorially on p. 159 of this journal for July 25, it fully agrees with Mr. Patterson.—Editor.]

Endurance of Concrete Ships

Sir—Your editorial in *Engineering News-Record* for July 11 *in re* the endurance of concrete ships brought to the writer a sense of disappointment, all the more keen for the anticipation with which its appearance had been awaited. At this time of all others definite, authoritative word on this important subject is particularly needed, yet your editorial mainly concerned itself not with the ostensible thesis as to the performance of concrete in sea water, but rather with the question of whether or not Mr. Wig said or did not say, as reported, that concrete ships would disintegrate in from one to three years' time—a question (aside from the wish to see justice done in all things and to all men) having as much effect on concrete hulls as that which raged in the press of England some five years ago as to whether or not Mrs. Pat Campbell actually did or did not say "bloody" at her initial appearance in Shaw's "Pygmalion."

But aside from accuracy or inaccuracy of statement or quotation, this editorial offers neither affirmation nor denial as to the endurance of concrete in water. Carbonated protective coatings on the surface of concrete are mentioned, as mitigators of sea water attacks, together with the danger of rupturing such coatings. "Revetments of carpentry," to quote from Gillmore, more than 70 years ago, are also mentioned in the same connection and for the same protective purpose, under the newer name of wood lagging.

Density is mentioned, it is true, but the mention put forward this quality not as the true crux of the question but hesitatingly, as partaking of an unattainable perfection, for lack of which panaceas such as carbonated coatings *et al.* are resorted to. Bitumen paints, as ancient as the command of Jehovah to Noah, "Thou shalt make thee an ark of gopher wood and pitch it within and without," are revamped for the same protective purpose.

Yet, granted a bump or a scrape sufficient to pierce either carbonated coat or Father Noah's pitch, the inference from this editorial is inescapable that sooner or later the proud concrete ship must become a heap of ignominious mush, carrying with her to her sulphated grave all men and things on board.

If this be true, must not insurance rates on concrete hulls be at a premium? And may we not expect to see in such policies a clause exempting the insurer from liability "on account of logs, porpoises, whales or other abrading causes" as certain policies in other fields now carry release from liability for destruction through "acts of God?" And may we not learn of some Admiral Percival crying "Damn the torpedoes!" yet, after bumping a floating timber, supplicating Heaven at the cry of a chemist in the bilge: "SO_3 radicals eating the port bow!"

Foolishness? Of course this is foolishness, but logical foolishness, granting the premises on which your editorial rests.

Like the recorder of the "Yarn of the Nancy Bell" I confess that: "It is little I know of lives of men of the sea, but I'll eat my hand if I understand" . . . how any decently good concrete can be expected to behave in this manner.

But, though no sailor, I do know concrete, good, poor, and bad. *All concrete problems are basically problems of good concrete;* and the concrete ship problem is *superlatively* a problem in good concrete. Density (in terms of negligible porosity or absorption) and high strength—almost correlative terms, carrying with them the added values of low mass and correspondingly lessened weight—are the critical qualities to be sought. If absorption and permeability are negligible, disintegration, either in salt water or in fresh water, will be negligible, for it takes, literally, millions on millions of gallons of sea water to sulphate even so much as one-third of a cubic yard of concrete; and obviously the supply to the interior must be constantly renewed for continued action. To realize this latter condition requires passages for water, which means porous concrete. But with such admittance of water, the binder of concrete will dissolve or disintegrate beneath any coating; and iron will rust, just as it has since the beginning of time on contact with moisture and oxygen. "Revetments of carpentry" may hold the softened mass in place so that its state is not outwardly visible, but be sure, if concrete is porous, that decay will go on.

With full appreciation of the magnitude of the task of producing concrete of requisite quality, uniformity and strength throughout a hull, I desire to say again that the ship problem, like all problems in concrete, is first and last and fundamentally a problem of producing

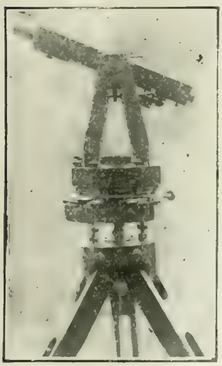
and placing the very best concrete that can be made. Stresses may be analyzed with the greatest care, yet if any part of the concrete, as by the multiphased evil of porosity, falls below the assumed unit strength, the best design can be rendered useless, no less than if the reinforcing bars failed.

Are ship plates of steel made from uncropped or faulty ingots? "Do men grow dates of thorns or figs of thistles?" Concrete hulls will or will not endure not because of any fiat pro or con, but according as to whether or not man in their building has conformed to or disregarded those inexorable natural laws which govern all things in the universe.

New York City. NATHAN C. JOHNSON.

Home-Made Transit Built Mostly of Wood

Sir—Inclosed is a snapshot of a home-made transit made by Fred J. Meyer, Chehalis, Wash. The tripod is of the split-leg type, made of cedar. The plumb bob is made from a 38-caliber revolver shell with a hole drilled for the string and soldered to an old spray nozzle, all topping a lead casting of special design. The bearing plate for the foot screws is a solid piece of 1½-in. fir, bolted through to prevent warping. The bearings for the foot screws are made of wood lined with part of a 12-gage shotgun shell. The instrument has a ball-and-socket shifting head.



The one horizontal motion is attached to an old balance wheel from a sewing machine. This wheel serves to prevent warping of the plate, which is a solid piece of fir, 1½ in. thick, of octagonal shape, 7 in. across. However, this wheel has the bad effect of attracting the needle of the compass, making a difference of about 5½°. The horizontal circle is made from an 8-in. celluloid circle, graduated to ½°, marked as usual from 0 to 360° and in quadrants.

One unusual feature of the horizontal motion is the method of reading angles. Since the transit is used mostly for producing lines in subdividing sections, only small angles are used in avoiding trees, etc. In the work the motion is clamped, a tangent screw brings the cross hair on the backsight, and the telescope is plunged. Then if an object is in the line of sight, a divided arc, independent of the motion, is shifted the required angle from the zero of the horizontal circle. Then the zero of the circle is brought to the zero of the independent arc, thus measuring the angle. This independent arc was made from an old piece of celluloid comb and has its own tangent screw.

There are two plate levels and a 1¾-in. compass. A cap from a dry-cell battery was made use of in the mechanism to lift the needle. The center bearing is made up of a ½-in. gaspipe filled with babbitt metal and then drilled out to receive the solid steel spindle. The standards are of one-piece fir, 1 in. thick and substantially braced with four brackets.

The telescope is 14½ in. long, made up of small lenses from an old telescope, all contained in a 2-in. square piece of hollowed oak. It has a ⅜-in. object glass focused with a home-made rack and pinion. The attached level, like the plate levels, is of the ordinary carpenter's level size, and protected by a wooden case. A tangent screw is attached for leveling work, which has been done with an error of only ¼ in. in a ¼-mile circuit.

Most difficulty was found in putting in the spider-web cross hairs, the eighteenth attempt being successful. The centering of the horizontal circle and the instrument was also one of the hard parts of the work.

To make the instrument as nearly waterproof as possible, all of the wood was dried thoroughly before being used, after which four coats of black paint, two of varnish, three of bronze and two of lacquer, were applied.

Mr. Meyer states that the instrument gives very good results in double centering, and has shown no bad effects from use in the rain.

The total cost for material was $10 and the instrument is valued at $75.

Bellingham, Wash. W. G. PETERS.

How Can Organic Matter Be Removed from Concrete Sand?

Sir—I should be pleased to know whether any readers of *Engineering News-Record* have had successful experience in treating sand that contains a high percentage of organic matter so that the organic matter is neutralized to such an extent as to warrant the use of such sand in high-grade concrete masonry.

The County of McDowell has had considerable highway and bridge work, using sand from outside this state, but on account of the great demand on transportation it is becoming more difficult to get outside sand and sometimes impossible. There is an abundance of local sand, which according to the standard calorimetric test for organic impurities cannot be used in concrete work on account of organic matter. There is a universal complaint in this region that concrete made with local sand deteriorates, and I might say that in many cases it absolutely disintegrates in from seven to fifteen years. The presence of the organic matter may be responsible for this trouble.

I have been experimenting with local sand and slaked lime, using ten per cent. of the lime by weight with sand thoroughly mixed dry. The reaction from the sand thus treated is entirely satisfactory according to the test for organic matter. Apparently, there is a large percentage of tannic acid in this sand, which is neutralized by the lime. There are other organic acids, which it would require the work of a chemist to determine.

The question that I would like to have answered is whether the sand treated with lime in this way will be safe to use in high-grade concrete work. It may be that some future chemical reaction would cause disintegration of the concrete and reinforcing rods.

It may be that this sand can be burned and the organic matter thus eliminated. I would like to know if any of your readers has any suggestion in regard to this proposition. I would also be glad to know if there is any other suggestion for treating this sand, which

will make it safe and economical to use it in concrete. The grains of sand examined under a low-power magnifying glass appear to be clean. There are small particles of wood and bark in the sand; a large percentage of this is removed by screening. The test for organic matter with this screened sand is altogether changed for the better.

I have made tests for organic impurities in sand found at many points in this county, and while they are not complete, they seem to indicate that the sand taken from the bottom of streams is very much better than that taken from the deposits along the shore. I found some sand in the bottom of the stream in which there was a large percentage of coal, that gave an entirely satisfactory test otherwise. S. A. WHITE,

Assistant Engineer, County of McDowell, West Virginia.

Welch, W. Va.

Separate Deterioration of Highways Due to Weather and Traffic

Sir—Your issue of Apr. 18 contains an article of more than usual interest dealing with the cost of highway maintenance, contributed by H. G. Shirley, chief engineer of the Maryland State Roads Commission. This contribution deserves more than passing notice, because it treats of a subject about which there is a serious lack of reliable and exact information, and because it leads to a conclusion at variance with your editorial comment on the article. Your comment sets forth a viewpoint that needs a wider recognition.

The writer hoped that other highway engineers, who have made similar observations and investigations, would discuss Mr. Shirley's article before this. The cost of maintenance is an important factor in the economic theory of highway transportation, and it is highly desirable that data be collected and made available to the engineering profession. These data should lead to the determination of the quantitative relation between the annual cost of maintenance for each type of pavement and the density of traffic carried thereon. As a preliminary to this accomplishment, it is necessary to segregate the data relating strictly to wear due to traffic from those relating to deterioration due to climatic conditions and variations in the weather. To confuse these two groups of data is not conducive to clear and accurate thinking.

Although the chart presented by Mr. Shirley would make it appear that the cost per ton mile for maintenance is a function of the tonnage, yet the shape of the curves, as shown, indicates that other factors than tonnage of traffic are affecting the cost per ton mile. What would become of the curves when the tonnage factor reduces to zero? That other factors are included is shown by the text, which cites an instance of heavy rains causing washouts and thereby increasing the maintenance cost for a road having very little traffic. If Mr. Shirley could separate the deteriorating effect of the weather factor from the wear due to traffic, a distinct step in advance would be made, because then the cost of maintenance, due strictly to the tonnage variable, could be stated in terms of that variable.

Again, it is difficult to see why a ton of traffic at the end of the day should cause a higher unit cost per ton mile than a similar ton of traffic at the beginning of the day. It is conceivable that the cost of maintenance per square yard should increase as the tonnage factor increases, but it would seem to the writer that with a suitable pavement, the wear would be the same for any particular ton of the total tonnage as for any other similar ton of that same total tonnage, unless the weather or temperature changed. In other words, there should be no progressive and cumulative deterioration of pavement due solely to the traffic tonnage. The unit cost per ton mile should remain constant, unless the type of pavement is unsuited for the traffic.

To have a minimum point in the unit cost curve is to invite a curtailment of traffic, which is in direct conflict with the purpose of the highway as the writer sees it. This point of view is aptly expressed in your editorial previously mentioned. We should look for an economical pavement rather than an "economical traffic."

If Mr. Shirley could give us the cost data in such form—and this seems possible because his article indicates that considerable care has been taken to measure the wear due to traffic—that the wear due to tonnage could be separated from the deterioration due to weather variations for particular types of pavements, it would become possible to state the annual cost of maintenance per square yard for a selected type of pavement as a function of tonnage or density of traffic.

It is to be hoped that a continuation of Mr. Shirley's article will appear in your columns.

R. C. BARNETT,

Missouri State Highway Department.

Jefferson City, Mo.

[This letter was submitted to Mr. Shirley, whose reply follows.—Editor.]

Sir—Mr. Barnett's analysis of the subject, I believe, is very clear. It is true that there is a certain cost, which I have termed "climatic cost," that is chargeable to any road whether it has traffic over it or not, and this cost varies largely with the different types of surfacing. The cost on some surfacing is greater than on others, and there are some types of pavement that require a certain amount of traffic to keep them rolled down and well sealed up, while others do not require traffic and do not deteriorate on account of weather.

It would be very hard to segregate the cost of deterioration due to climatic conditions from the actual wear and tear. When you consider the shoulders this cost varies with the character and condition of the soil; some soils being more capable of withstanding wash and heavy traffic than others.

Regarding the studies I made in Maryland, I did not go into enough detail to obtain the data accurately, and I am therefore reluctant to give it to the public. I believe it is possible to obtain such data, and the paper on my studies in Maryland was intended to bring this before the engineers of the country, being something to start with more than anything else.

I know this is a vital subject, and I would like to see it gone into a great deal more in detail. Of course, certain facts could be derived from the studies we made that would be an indication of the actual condition, but not having these before me at present, I am unable to give you the benefit of what this segregation would show. H. G. SHIRLEY,

Secretary, Highway Industries Association.

Washington, D. C.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Gravitation and Two Men Operate Side-Hill Mixing Plant

By John T. Sullivan
Covington, Ky.

SUCCESSFUL adaptation of local topography to plant location is exemplified by the Cincinnati East Side High School concrete mixing plant. A ravine traversed the building site, and a materials spur from the nearby railway was carried across this ravine close alongside the wall of one of the principal buildings. By a trestle and a little grading at the ravine crossing a mixing plant charged by gravity and requiring very little structural work was obtained. The drawings show the arrangement. A wooden wall was erected across the ravine to form the front of the bins, and the bottom was lined with boards which were laid on the sloping grade of the ground. A partition wall was erected to keep the crushed stone and sand separate. The stone and sand were shipped in cars having drop-bottom gates. The cement shed was located on one side of the ravine and was erected so that the floor of the shed was on the same elevation as the track. It was built in this way to make use of a roller conveyor for transporting the cement from the car to the shed. Another advantage gained was that when the cement had been stacked about 5 ft. high over the entire floor of the shed the conveyor was abandoned, a runboard was placed on a level from the car to the top of the pile and a second 5 ft. course was started. This eliminated high lifting in stacking the cement.

The excavation for this plant was extraordinarily small, due to the advantage taken of the natural ravine and to the extra excavation which was required for the broad footings of the power house walls. The previous grade of the deepest part of the ravine and also the extent of the necessary excavation for the power house walls are shown by the drawing of the mixing plant (next page). It can be seen that little dirt had to be removed to set the mixer in its proper low position. The entire pit was drained through the power house sewer.

The procedure of mixing a batch of concrete was as follows: A man standing on the wooden platform above the mixer opened the gates A and B. These gates were in the same line in elevation and were situated in the front wall of the bins and on each side of and close up against the partition wall, which separated the crushed stone and sand. The stone and sand trickled through the gates and dropped into a steel measuring hopper as shown by the drawing of the mixing plant. This measuring hopper had a partition wall to separate the stone and sand and held 6 cu.ft. of stone and 4 cu.ft. of sand. The measuring hopper was filled to a mark indicating 4 cu.ft. of stone and 2 cu.ft. of sand, and the gates A and B were then closed. The lever C was then pushed back toward the bins. This raised the small arm at the bottom of the lever C. This small arm was rigidly fastened to the lever and passed over a lug on the hinged gate of the measuring hopper, and in this way held the gate closed. By pushing the lever C back the small arm raised sufficiently to clear the lug and cause the gate of the measuring hopper to open and the contents to drop into the mixer. Lever C was then pulled back to the original position and the measuring hopper gate closed. The rope D was pulled and rang a gong in the cement shed. A man standing in the cement shed proceeded to dump the contents of two sacks of cement into a funnel which was built into the top of a table at the window as shown on the drawing. This table was large enough for the man who handled the cement to have about eight sacks lined up in reserve. The cement traveled from the funnel through a 4-in. down-spout pipe to the mixer, where it was discharged.

What Are You Doing to Help Win the War?

Buying W. S. S.? Oh, yes.

Paying your taxes? Oh, yes, of course.

Working your head off to make sure YOUR *job won't delay the game? Well, naturally.*

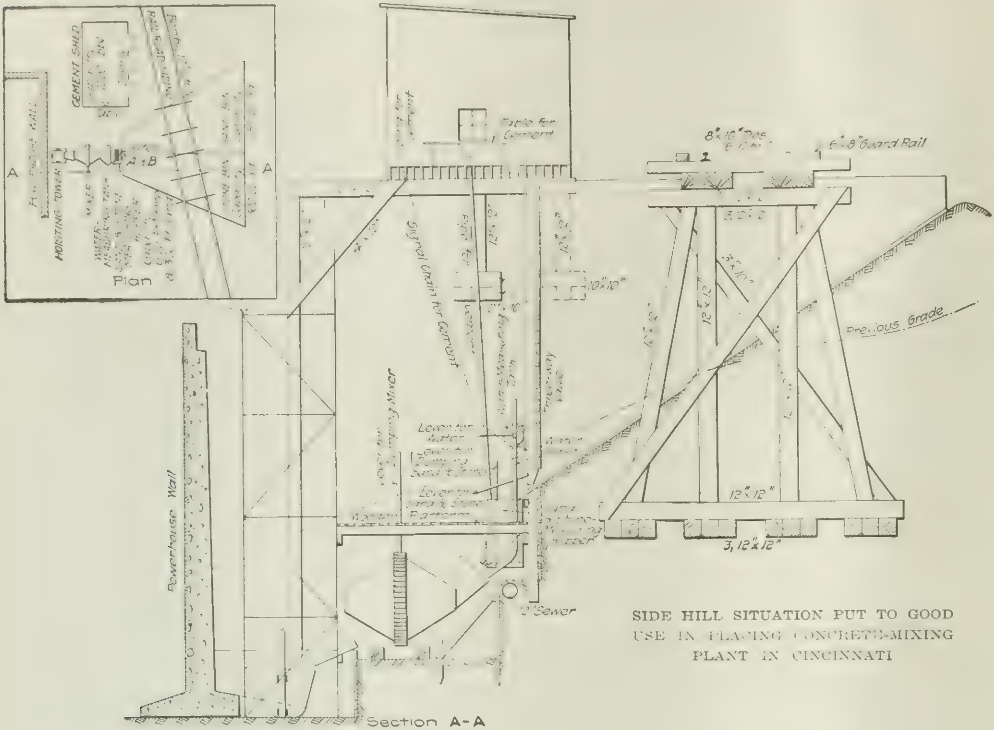
Thinking up new stunts every day to beat the best you ever did before?—so our boys will get the stuff to push the big scrap back across the Rhine? You bet!

But—are you helping the fellows on the other war jobs beat the Kaiser to it by telling what YOU *put across—in*

HINTS FOR THE CONTRACTOR?

The man on the platform proceeded to repeat the process with the levers A and B and to fill the measuring hopper again. The operation of lever C was repeated and the mixer then contained a full charge of stone, sand and cement, for a 1: 2: 4 mix.

The lever E was then pulled down through 90 degrees. This lever was attached to a three-way valve which operated so that when the lever E was in a horizontal position the water came down through the water line and flowed into and filled a steel tank. This tank could be regulated so as to hold just the proper amount of water required for a batch of concrete. While the lever E was in the horizontal position the water could get into the tank but could not get out through the pipe leading to the mixer. When the lever E was pulled down through 90 deg. the water was thereby shut off from flowing from the water line into



SIDE HILL SITUATION PUT TO GOOD USE IN PLACING CONCRETE-MIXING PLANT IN CINCINNATI

the tank, but at the same time a pass was opened for the water, which was in the tank, to drain through the pipe leading to the mixer.

After the water had been added the man on the platform operated the lever F and dumped the batch into the bucket, by which it was hoisted and then distributed by chute to the required place.

The contractors for the work were Roos Bros. Construction Co., Cincinnati, Ohio.

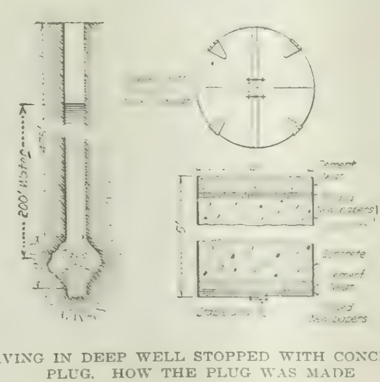
Easy Way of Locking Steel Nuts

A SUCCESSFUL method of locking angler steel nuts is to saw slots in them and then drive the edges of the slot together. The slot should be cut at one of the angles of the nut, at right angles to the bolt, and should extend in nearly to the bolt. When the slot is sawed it is closed up sufficiently with a hammer and chisel to distort the threads and lock the nut. The method was described in a recent issue of *Coal Age.*

Bottom-Dump Bucket Concretes Cave in Drilled Well

A DANGEROUS cave 475 ft. down in a drilled well was recently successfully concreted by the Whitney Well Co., Chicago, by means of an improvised drop-bottom bucket. The bucket consisted of a 5 ft. length of pipe of 13½-in. inside diameter with a ⅜-in. shell. To the bottom of this pipe were hinged four quarter sector doors. As indicated by the sketch, two of these doors on one side overlapped the two doors on the opposite side.

The four doors were held closed by string ties rove through staples. When open they left clear the full diameter of the bucket. In operation the doors were closed and fastened. Then a layer of folded newspapers was placed inside on the bottom and on this mattress



CAVING IN DEEP WELL STOPPED WITH CONCRETE PLUG. HOW THE PLUG WAS MADE

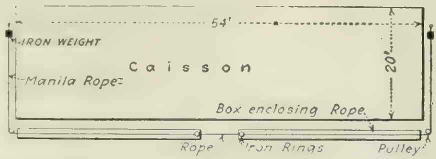
a bag of cement was spread. The bucket was then filled to near the top with a dry mix of 1: 1: 2 concrete using ¾-in. stone. On top of the concrete was placed another layer of newspapers covered with a bag of cement.

The ties which secured the doors were made just strong enough to hold the charge of concrete when the bucket was handled gently; they would break if the bucket were given a jerk. The purpose of the newspapers and neat cement waddings was to keep out the water during the time required to lower the bucket to the cave. About 200 ft. of water had to be passed through. After the bucket was filled it was allowed to stand until the concrete took an initial set. It was then lowered by the well rig until it touched bottom at the cave and then was lifted with a jerk which broke the door ties and let the partially set concrete flow out into the cavity. A total of 130 sacks of cement was required to fill the cave. When the concrete had set, drilling was resumed without any further trouble from caving.

Other Articles In This Issue of Interest to Contractors

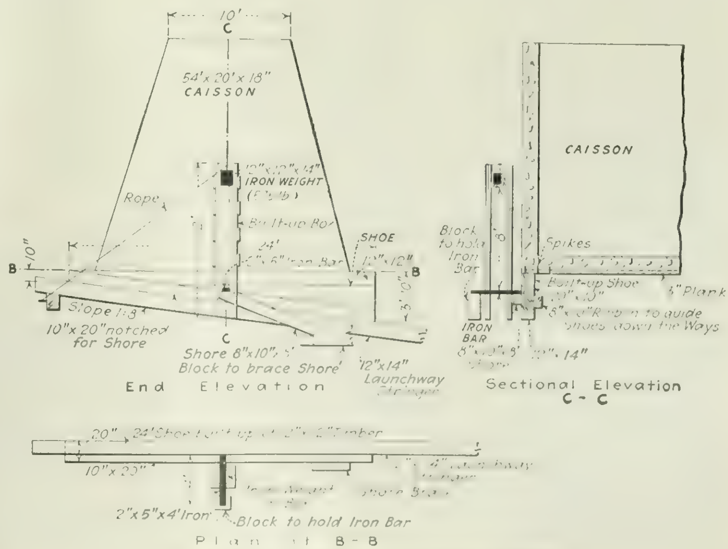
Launch Concrete Caissons Like Ships

SHIPBUILDING practice is followed in the launching of hollow reinforced-concrete caissons which are built at Milwaukee, for harbor work on Lake Michigan. Caissons of 500 tons weight for the Racine breakwater, now under construction, are 54 x 10 ft. on top, with sides sloping 3 on 1 and a vertical height of 21 ft. 3 in., as described on p. 257 of this issue. A 3-in. plank platform constitutes the bottom of the form and becomes a permanent part of the caisson, being bonded to the concrete bottom by projecting spikes. As shown in the drawing herewith, this platform is supported by blocking on shoes which rest on the inclined launchway stringers, there being four launchways to each 54-ft. caisson. Each of the two outer shoes is held against sliding by an inclined shore which has its lower end butted against a heavy block and its upper end against a timber on the outside of the shoe. By knocking away the shores the shoes are left free to slide, carrying the caisson into the water. The launchways are extended to such a depth that the caisson will float free without dropping or plunging. Simultaneous release of the two shares is necessary to avoid any tendency of the caisson to slew if one end should start first. For this purpose an iron block is suspended over each shore by a rope which extends across the rear of the caisson and has a ring at the free end. The two rings are connected by a short length of rope, as shown, and when this is cut the two weights fall 8 ft. and knock out the shores. They do not strike the latter directly, but strike an iron bar which has one end resting on the shore and the other on a fixed block. Each block weighs 575 lb. and is inclosed in a plank box.



PLAN OF ROPE CONNECTIONS OF WEIGHTS WHICH RELEASE THE CAISSON

The ways have a slope of 1 in 8. They are greased before the launching, but usually the caisson will not start without an impulse being given by means of horizontal jacks. This method of launching proves very satisfactory. The construction of these caissons is done



LAUNCHING PLANT FOR CONCRETE CAISSONS

by day labor at a yard established for the purpose and is under the direction of J. A. B. Tompkins, district engineer of the United States Engineer Office, Milwaukee.

Shovel on Road Job Dumps Concrete Mixed at Quarry Plant

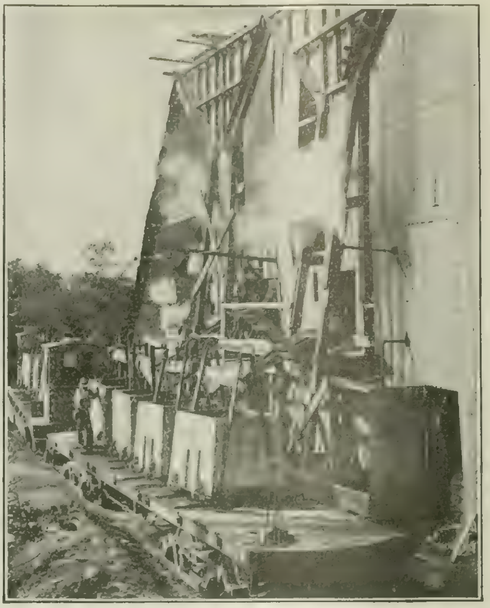
By E. L. Sparks
New England Representative, Erie Steam Shovel Co., Erie, Penn.

By MAKING its revolving steam shovel do double duty and dump the concrete buckets after it had graded the road, the Sperry Engineering Co., New Haven, Conn., was able to mix its concrete on a recent state highway section at a central plant. The handling of material was minimized by locating this plant at the quarry which supplied the aggregate. The electric railway which parallels the road was used to haul the concrete.

The Connecticut Quarries Co. operates a trap rock quarry directly on the state highway from New Haven to Hartford at Mount Carmel. The road job in question is a 7-mile stretch from Mount Carmel to Cheshire. It is paralleled by a double-track trolley line.

Rock is conveyed directly from the crusher to the bins above the mixing plant by belt conveyor. Concrete is delivered to 1½-yd. timber skips which are carried on standard-gage flat-cars handled by standard-gage electric motor cars furnished by the trolley company. Two flats, one of them a motor car, carry eight skips, or 12 cu. yd. of concrete to the train. The concrete work train has to keep clear of traffic, but cars are only operated in one direction at half-hour intervals and there are frequent passing tracks.

Arriving at the front, the revolving shovel which excavated the subgrade is utilized to unload and place the concrete. Stripped of the dipper, the shovel drops its dipper stick, picks up each skip and quickly distributes the concrete. The propelling motion of the steam shovel is brought into play to place the concrete exactly where wanted.



CONCRETE HAULED FROM CENTRAL PLANT AT QUARRY

As an evidence that this long haul for concrete is proving economical, the Sperry Engineering Co. reports that an average day's run of 10 hours on this 18-ft. road of 7-in. concrete amounts to 400 feet.

SHOVEL WITH DIPPER REMOVED DUMPED CONCRETE JUST WHERE IT WAS WANTED

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Open H System of New York City Transit Lines

Trunk Subways Now in Operation—River Tunnels and Brooklyn Lines to Be Completed

Through the opening of the H section of the dual subway system in New York City on the evening of Aug. 1, all of the trunk subway lines in Manhattan and the Bronx and all of the new Brooklyn lines connected to Manhattan by bridge have been placed in operation. None of the new East River tunnels have yet been opened, nor have the Flatbush Ave. and Eastern Parkway subways in Brooklyn. The guests invited to the opening saw the final spikes in the connection to the Lexington Ave. line at the Grand Central station driven by George H. Pegram, and D. L. Turner, chief engineers of the Interborough Rapid Transit Co. and of the Public Service Commission. The party proceeded by special train to South Ferry, returning up the new Seventh Ave. subway to Times Square and proceeding to the Astor Hotel, where appropriate addresses were delivered by John F. Hylan, mayor of New York, T. P. Shonts, president of the Interborough company and others, Charles B. Hubbell, chairman of the Public Service Commission, presiding at the ceremony.

The new system is formed by extending the old upper Broadway subway down Seventh Ave. from Times Square and the old Park Ave. subway on the East side up Lexington Ave. from Grand Central Terminal. Through operation on the 42nd St. portion of the old subway is discontinued and independent north-south through operation of the Seventh Ave.-Broadway line on the west side and the Park Ave.-Lexington Ave. line on the east side of the city established.

Express service was discontinued at 8:45 p.m. and was not resumed until the following morning, by which time all track connections were completed. Local service was diverted with a maximum delay of 7 minutes, which was the length of time the first north-bound local on the Seventh Ave. line was held at Times Square while the old express and southbound local tracks in the Times Square curve were removed and the new track laid. At Grand Central no delay occurred, north-bound locals being run on the express track, and the north-bound local turnout being put in at leisure. The other three tracks have been connected to the old tracks by switches for some time past, the grade of the turnouts making this possible for all but the east one.

The new line of the New York Municipal Co. on lower Broadway having been opened, in successive stages, from

Continued on page 290

D. L. TURNER AND GEORGE H. PEGRAM (WITH MAULS, FORMER AT LEFT) DROVE LAST SPIKES IN H SUBWAY TRACK CONNECTIONS

First Launchings at Bristol and Hog Island

Ship Production Initiated at Two Large Yards—"Watonwan" Sticks on Ways at Bristol

Fabricated-ship construction advanced to a new stage during the past week through the entry of Bristol and Hog Island into ship production. The two yards, both agency enterprises of the Emergency Fleet Corporation, celebrated their first launchings Aug. 3 and Aug. 5, respectively. Bristol's first hull, the "Watonwan," unfortunately stuck on the ways, through a cause not yet explained, and at the time of going to press had not yet been moved. At Hog Island, on the other hand, the "Quistconck" slipped down the ways without incident, in harmony with the good record made in Emergency Fleet launchings hitherto. The occasion was distinguished by the presence of President Wilson and of Mrs. Wilson, who christened the ship.

Vessels of 9000 tons dead-weight capacity are being built on 12 ways at Bristol by the Merchant Shipbuilding Corporation, of parts fabricated in the bridge shops of the American Bridge Co. (85%) and in the corporation's shop at the yard (15%). The present orders are for 60 ships, all of the same size and type. The Hog Island yard of the American International Shipbuilding Corporation, with 50 shipways, is carrying out an order for 120 vessels of 7500 tons and 60 of 8800 tons capacity, of cargo and transport types, respectively. Only the smaller type has been put on the ways up to the present. The yard does assembly work exclusively, all hull parts being fabricated in bridge and plate shops scattered throughout a large section of the United States; more than sixty such shops are now engaged in this fabrication.

Work progressed at both yards closely in accord with schedules planned out months ago, and the launching dates fixed long previously could be held to. No difficulties in assemblying the fabricated parts were reported, although adjustment of molds and minor modification of erection procedure are expected to facilitate construction of the subsequent vessels.

Denver Votes to Buy Water-Works

By a large majority the taxpayers of Denver, Colo., voted on Aug. 6 to issue $13,970,000 of bonds to buy the property of the Denver Union Water Co. in accordance with an agreement already reached.

Open H System of New York City Transit Lines

(Concluded from p. 289)

Times Square to lower Manhattan, all of the Manhattan and Bronx trunk lines are now in operation, but are not yet connected to the Brooklyn and Queens lines by the new tunnels under the East River, of which four pairs are being built. Connections to the Fourth Ave. (Brooklyn) subway over the Manhattan bridge and to the two elevated lines in Queens via the 42nd St. tunnel and the Queensborough bridge, have been in operation for some time.

DATE OF OPENING PRINCIPAL LINES OF DUAL SYSTEM

Center Street Loop (B R T) Subway, Brooklyn Bridge to Williamsburg Bridge and Broadway Elevated in Brooklyn	Aug 4, 1913
Steinway Tunnel (Interborough)	June 22, 1915
Fourth Avenue Subway (B.R.T.)	June 22, 1915
New Utrecht Avenue Elevated Branch of 4th Avenue Subway	1916
Fourth Avenue Subway Extension (B.R.T.) from 65th Street to 85th Street, Brooklyn	1916
White Plains Road Extension of West Farms Branch of old subway (Interborough)	1917
Jerome Avenue Branch of Lexington Ave. Subway (Interborough)	June 2, 1917
Seventh Avenue Subway (Interborough)	June, 1918
Lexington Avenue Subway (Interborough)	July, 1918
Operation of H System	Aug 1, 1918

In spite of ample newspaper notification of the change, and partly, it is alleged, because the change was made in the middle of the week, thousands of persons arriving at the Grand Central and Times Square stations attempted to follow the crosstown route of the old subway under 42nd St. The crowds swamped the shuttle service on the old line and caused what is referred to as the most serious subway blockade New York has ever seen, requiring some hours' work on the part of police reserves before the difficulty could be untangled.

As a result, the shuttle service was ordered discontinued entirely, the object being, according to the Public Service Commission, to force the public to learn the new system, which provides more direct routes for the public in most cases than the old. When this result has been accomplished, it is stated, the shuttle service under 42nd St. will be restored as originally planned.

McAdoo's Approval Necessary for Assessments Against Railroads

Approval in advance by the railroad administration is required wherever street or road construction or other public improvements are contemplated by the authorities in any state, county, district or municipality, for which $500 is to be charged against any railroad under Federal control, according to a circular issued July 29 by the Director General of Railroads. Otherwise the Director General will reserve the right to decide whether or not he will participate in the payment.

"It is not the attitude of the Director General," states the circular, "to oppose construction of this character which is meritorious and essential."

Declares Garbage Reduction Works a Nuisance

Odors from New York City Scows and Plant Detected at Distance by State Health Engineers

Field observations on five different days disclosed "characteristic and very offensive odors" from the garbage reduction works of the Metropolitan By-Products Co., just off Staten Island, which treats the garbage of New York City, declares Theodore Horton, chief engineer of the New York State Department of Health, in a recent report to Dr. H. A. Biggs, commissioner of health. The observations were made by H. B. Cleveland, principal assistant engineer, and C. A. Holinquist, assistant engineer, the former observing on one day only. On all the days of observation the odor from the plant "covered a comparatively extensive area in the path of the wind and was readily discernible and offensive at a distance of 3½ to 4 miles," says Mr. Horton, and possibly at "considerably greater distances."

The plant, which was described at length in *Engineering News-Record* of Mar. 21, 1918, p. 555, was treating 750 tons of garbage a day at the time of the inspection. As to the source of the odors, Mr. Horton says that at the time of his report, which he calls "preliminary," he can make only general statements. These are as follows:

"We were told that two of the boiler units had not been in operation for several weeks, owing to imperfect or faulty construction; furthermore, that only 160 of the 198 reducers were in operation, owing to necessary repairs. In fact, the entire plant seemed to be working to the limit if not in excess of its capacity and several barge loads of unrendered garbage were seen stored on the waterfront.

"As a result of the conditions referred to and possibly to other remediable factors, objectionable odors were found to arise from certain parts of the plant; namely, from the raw garbage before its entrance to the plant; from the discharge of condenser water into the kills; from the open condenser tanks outside the buildings, and particularly from the tankage as it was being dumped from the reducers into conveyors and from which large volumes of gases and vapors escaped into the outside air."

From other sources than the report by Mr. Horton it appears that the reduction works are in the hands of receivers; that they have been declared a nuisance by a Richmond County grand jury and the superintendent has been indicted but not arrested; and that Mayor Hylan hopes to induce the Federal Government to take over the plant, since shutting it down would cut off a large output of grease and fertilizer base greatly needed at the present time.

Strong opposition to the location of the plant on Staten Island (really on a smaller island just off the larger island) led to an investigation by the State Department of Health and a report on probabilities by Prof. George C. Whipple in 1916. Professor Whipple's report on the subject was given in *Engineering News* of Jan. 18, 1917, p. 125. (See also Feb. 22, 1917, p. 329.)

Briefly, some nuisance at times was predicted both from the transportation of garbage in scows and its treatment at the plant, but it was declared that neither would "in any appreciable or material way affect the security of life or endanger the health of the people of Staten Island." These conclusions were endorsed by Dr. Linsly R. Williams, acting commissioner of health, in a report to Governor Whitman, who had ordered the investigation. Later Governor Whitman announced that he had no jurisdiction over anticipated nuisances. Editorial comment on this conclusion, with mention of the 1200 typewritten pages of testimony taken in the investigation appeared in *Engineering News* of Feb 1, 1917, p. 201. It may be added that Professor Whipple stated that from a sanitary standpoint either Riker's Island or Barren Island would have been better sites than Staten Island for the reduction works. The latter was barred by the specifications; the former by the Board of Aldermen. Professor Whipple also declared that "the Cotwell process (the one in question) is the best method now known and available for the disposal of the garbage of the City of New York."

Tribute Paid American Engineers in Pushing Marne Victory

It was stated recently by a prominent officer that the allied victory at the Marne rests largely upon the skill and resources of the Franco-American roadbuilders and other engineer units. It was asserted that an essential element of the allied success was the work done by our engineers in keeping open the highway system over which the reserves and heavy artillery were brought up to support the attacking troops. At the same time great crews of track layers, with thousands of coolies and other hardened workmen, were working night and day repairing the narrow-gage railroad lines worked in conjunction with the highways.

A later report from the battle front makes special note of the work of our engineers in throwing bridges over the Vesle River under heavy artillery and machine gun fire. While the infantry fighting was going on almost at their backs, the engineers did their bridge work, laboring on both banks of the river. Shell fire would destroy a half-constructed bridge, but the work would be resumed by the engineering units and pushed to completion. One detachment of twenty was reduced to fifteen and then to ten, and when relief came up there were only five remaining workers. At this point the Vesle is about fifty feet wide and from 5 to 8 ft. deep, which makes fording impossible and the bridge construction was effected under the most difficult conditions.

Shipping Board Opposes Army Shipbuilding

Water Transport Branch May Be Held Up on Its Small Concrete Boat Program

A decision of the War Industries Board announced Aug. 1 places the control of all shipbuilding in the United States fully in the power of the United States Shipping Board. The decision came as a result of a controversy between the board and the War Department, which through the office of the embarkation service of the war transport branch has been letting contracts for a number of small boats, mostly of concrete. The Shipping Board maintains that the letting of such contracts interferes materially with the progress of the United States shipping program as conducted by the board, and that all such contracts should be cleared through the Emergency Fleet Corporation.

The decision is in effect as follows: Each department ought to prepare its own plans and specifications for such ship or whatever craft it may require, conferring and collaborating from time to time with the Fleet Corporation to the end that uniform standards may prevail, but no contract for the construction of ships is to be placed by any Government agency until it has been cleared through the Emergency Fleet Corporation and through the War Industries Board. In the event of disagreement, the controversy is to be adjusted by the War Industries Board. Provision is also made for coöperation of the Fleet Corporation in the design of any ships supplied by any branch of the Government.

It has not yet been announced how this decision affects the contracts already let and the designs already made by the war transport branch, which is under the direction of General Goethals. This branch has been in existence since the Spanish War and has always built its own vessels. The recent designs have been for water boats to supply fresh water to transports and overseas freighters when in harbor, small river boats for transport service and car floats for harbor work.

The war transport branch appears to be very enthusiastic about the reinforced-concrete ship and is willing to proceed with a large program for their needs. So far there has been no announcement at the branch that they have any desire to build large ships of concrete, although the Emergency Fleet Corporation has under contract a number of steel transports for this branch of the Army.

University of Illinois to Aid in Work of Research Council

The National Research Council, acting as the department of science and research of the Council of National Defense, has appointed Prof. H. F. Moore of the Engineering Experiment Station, University of Illinois, as chairman of a committee to investigate the fatigue phenomena of metals. The committee is charged with the responsibility of developing a knowledge of the strength and durability of metals subjected to stresses, such as metals used in ship structures, crank shafts of aircraft engines and heavy ordnance. It is expected that much of the experimentation required will be done in the laboratories of the University of Illinois at Urbana under the personal direction of Professor Moore.

New Shipbuilding Records Made at Ecorse and Alameda

By launching a 3500-ton steel ship 14 days after its keel was laid the Ecorse, Mich., yard of the Great Lakes Engineering Co. July 26 set a new mark in high-speed shipbuilding. It represents an erection performance about one-fifth better than that made by the New York Shipbuilding Corporation three months ago in launching a 5500-ton vessel 27 days after keel-laying.

On Aug. 4 the Alameda, Cal., yard of the Bethlehem Shipbuilding Corporation launched a 12,000-ton vessel after only 24 working days. The keel was laid July 4, immediately after a hull of the same size was launched. The first rivet was driven July 5, on which date the first shell-plate was placed. All floors were in place and the tank top was started July 8. Fifteen days later the shelter-deck plating was being placed, and the next day testing the tanks was started. All shell-plating was on the vessel and the ways were ready for launching by July 31. About 40,000 rivets were driven daily on this hull, the Shipping Board states. Two days were lost through a strike.

San Francisco Railroad Terminals Consolidated

Western Pacific, Santa Fé and Southern Pacific terminals on the east side of San Francisco Bay will all be combined in the Oakland mole of the Southern Pacific Railway so that after Aug. 15 the regular ferries plying between Oakland and San Francisco will handle the traffic on all three lines as well as local business.

Engineers' Division Employment Service Working

Recent efforts of the shipbuilders at Hog Island, Philadelphia, to obtain thoroughly experienced draftsmen quickly through the Engineers' Division, United States Employment Service, Chicago, were so successful that 40 men were obtained in three days. This was done although practically every engineering office in Chicago to which previous appeal had been made wired back that no men of the necessary training and experience were available. Commenting on the service S. T. Henry, who went to Chicago for the American International Shipbuilding Co. to interview the men, stated that he found the office had at call all the men needed.

Another Step in Ten-Year Water Rate Suit

Court Holds Ordinance Confiscatory but Spring Valley Capital and Return Too High

San Francisco water rates for the eight years 1907-8 to 1914-15, as fixed annually by the city authorities until the control of rates passed to the State Railroad Commission, have been declared confiscatory by United States District Judge Frank C. Rudkin, in a decision handed down July 21. This sustains the general finding of Oct. 1, 1917, by Master-in-Chancery Wright, but the Wright valuation of $39,000,000 is cut to $34,000,000 and the 7% return allowed by Wright is reduced to 6%. Quoting from Judge Rudkin:

"The valuation fixed by the master varies from $32,900,000 in 1907-08 to $39,000,000 in 1913-14 and 1914-15. The net revenue varies from $696,648.74, or 2.1%, in 1907-08 to $1,654,589.87, or 4.24% in 1914-15. The highest rate of return was therefore during the last year, and if the ordinance for that year is declared noncompensatory and void the same conclusion must follow in each of the earlier cases as a matter of course. The valuation for the year 1914-15 has been reduced from $39,000,000 to $34,000,000. A net return of 6% on that valuation is $2,040,000, or approximately $385,000 in excess of the ordinance rates. During each of the years in question a temporary restraining order was granted by the court and the plaintiff was permitted to and did collect approximately 15% in excess of the ordinance rates. The actual net return during the year 1914-15, with this 15% added, was $2,011,904, or less than 6% on the valuation as found and fixed by the court. For these reasons I feel constrained to hold that each and all of the several ordinances are violative of the Constitution of the United States and therefore void."

The $5,000,000 reduction in valuation included about $1,500,000 each for Lake Merced lands and for water rights and some $2,000,000 for going value. The water company contended for the full market value of the Lake Merced lands. The master made a heavy reduction in this claim and the court cut this allowance more than in half, arguing that the company was claiming more than $6,000,000 for lands, reservoirs and water rights which yield less than one-tenth of the total water-supply of the city. The master placed a value of $90,000 per 1,000,000 gallons on the daily available water-supply in 1913-15. The court says: "I am far from convinced that these winter flood waters going wildly to the sea are worth $90,000 per 1,000,000 gallons, or even a small part of that sum." The court's allowance for Lake Merced lands was $1,742,000; for water rights, $1,560,000; and for going value, $1,400,000.

In justification of cutting the master's allowance of return on valuation from 7% to 6% the court said:

"Cases may doubtless be found in which the trial courts have found that public service corporations were entitled to a return of 7% or even as high as 8% on the capital invested in certain enterprises. I have found no case where the Supreme Court has held that a less rate of return than 7% is confiscatory or violative of the Constitution. I deem a 7% return in this case excessive and fix it at 6 per cent."

Altogether, the company is allowed $2,287,675 additional rates, which it appears is 15% in excess of the ordinance rates plus interest on the sum already impounded by court order. Although the case has been pending for 10 years it may yet go to the United States Circuit Court of Appeals.

Cannot Build Garbage Incinerator on Site Chosen

Construction of a garbage incinerator on the particular site chosen by the City of Quitman, Ga., has been enjoined. A suit for an injunction was brought by F. P. Underwood and other property owners represented by Branch & Snow, Quitman. The plaintiffs alleged that the incinerator was being erected in the residence section of Quitman, about 100 yd. from residences and 400 yd. from the heart of the city; that the constant hauling of refuse past the houses of the plaintiffs and the dumping of it at the incinerator would cause flies to congregate in the neighborhood, endanger the health of the residents and cause offense and a deterioration of property values. The plaintiffs contended that the incinerator might just as well have been built on the outskirts of the city, at a distance from the residences. The present decision confirms the judgment of a lower court. The incinerator was being built for the city by the Nye Odorless Crematory Co., Macon, Ga. Copies of the decision, which is short, may be obtained from the clerk of the Supreme Court, Atlanta, Ga.

Engineering Institute of Canada Holds Second General Meeting

The second general professional meeting of the Engineering Institute of Canada, in Saskatoon, Province of Saskatchewan, was scheduled for today. The subject of the first afternoon session of the meeting is "Good Roads." This evening's session is to be devoted to the reading of papers on "Rural Community Water Supplies," and "General Water Supply for Saskatchewan," followed by discussion.

The session of the meeting to be held on the morning of Aug. 9 will be devoted to the reading of papers and discussions on concrete engineering. The session of the afternoon of the same day will be devoted to the discussion of subjects relating to fuels. The fifth session, on the morning of Aug. 10, will be given over to professional and institute affairs, including papers on "Legislation Governing the Status of Engineers" and other subjects of current interest to engineers.

Additional Housing Boards Named

Project boards on two more housing developments have been named by the bureau of industrial housing and transportation of the Department of Labor. One of these is at Staten Island, New York harbor, and the other covers three separate projects in the three cities adjacent to the Muscle Shoals nitrate plant on the Tennessee River. The engineers, architects and town planners are given in the following table, which is an addition to the earlier table in *Engineering News-Record* of July 25, p. 197.

Project	Architect	Town Planner	Engineer
Staten Island, N. Y.	Delano & Aldrich, N. Y.	A. F. Brinkerhoff, N. Y.	C. S. Pollok, N. Y.
Florence, Sheffield, Tuscumbia, Ala. (Muscle Shoals)	Warren & Knight, Birmingham	H. A. Caparn, N. Y.	Julian Kendrick, Birmingham

The same department has announced that the contract for the construction of about 1000 houses adjacent to the navy yard at Portsmouth, Va., has been let to the Hegaman-Harris Co., New York City. Residential hall construction at Washington, D. C., is to be built by the George A. Fuller Co., New York City.

San Francisco Societies to Form Joint Council

Plans have recently been adopted for a joint council to coördinate the activities of the five San Francisco sections of national engineering societies. The societies included are those of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining Engineers and the American Chemical Society. The tendency toward moves of this sort has been felt on the coast for some time, and in some cities, notably Los Angeles and Seattle, it has already taken definite shape and made progress. San Francisco is considered a particularly promising field for such activity because the Engineers' Club constitutes a ready-made nucleus, a going concern with headquarters and organization able to help out materially in the work of a joint council.

At a recent joint meeting of the five sections, mentioned in *Engineering News-Record* of Aug. 1, p. 248, at which the plan was considered, details were touched upon by way of suggestion, but the adoption of a working plan was left to the representatives of the several associations, who will form the first joint council. The purposes of the joint council, however, were clearly set forth. Primarily, they are to foster closer touch and coöperation so that there will be greater efficiency in all five sections in war service matters and in service to the membership. Attention is to be given to all benefits of inter-organization such as economy of time and funds, the elimination of duplication of effort and the calling together of the memberships whenever joint meetings are desirable. Moreover, the joint council is to study the plan and program of joint meetings to the end that these shall have purposeful direction and their tone and spirit shall trend, meeting by meeting, toward the common purpose of closer touch and greater helpfulness.

Additional Water-Supply for Newark Proposed

After four months' study, John R. Freeman, consulting engineer, Providence, R. I., assisted on the ground by R. D. Chase, has reported in favor of an additional water-supply for Newark, N. J., to be drawn from the Wanaque River. In general, the plan appears to be the same as that proposed for some time past, only Mr. Freeman urges that Newark should carry out the work itself, instead of in coöperation with other municipalities, whereas Newark has been considering a coöperative scheme for some time. In any case, a new supply scheme must be approved by the North Jersey Water Supply Commission. The Freeman recommendations are chiefly for storage works supplementary to the present supply from the Pequonnock River. Considerable additional storage might be provided in the present drainage area if litigation brought or proposed by East Jersey Water Co. interests holds up the Wanaque project too long. The Newark City Commission, on July 25, voted unanimously for entering into a tentative contract with the district water commission for the Wanaque scheme. It appears that nothing final can be done until approval by the Capital Issues Committee has been obtained.

New Bessemer & Lake Erie Bridge Rolled Into Place

Successful completion of the new Bessemer & Lake Erie R.R. bridge over the Allegheny River, a continuous-truss steel structure more than 2100 ft. long, was achieved on July 22 and July 31 by rolling the two continuous sections 16 ft. 3 in. laterally to final alignment. The work was done by the erection forces of the American Bridge Co., which had previously taken down the old bridge after erection and adjustment of the new structure alongside the old, on extensions of the piers.

The new bridge, which is a double-track deck structure, consists of two groups of three spans, each group being continuous over the two intermediate piers. The south group is 1140 ft. long, and the north 968 ft. Two approach spans adjoin at the north end.

The south span-group, weighing 6800 tons, was rolled 16 ft. 3 in. into its final position on July 22. On account of the heavy dead-load reactions and the fact that there are only one fixed and three rocker expansion points, it was not considered advisable to carry traffic on the temporary rollers. Therefore all of these rollers, except those

under one truss at two piers, had to be put in place after the track was broken.

Track was cut at 8:30 a.m.; jacking stated at 8:50, and all the rollers were in place and the equipment was ready for rolling at 11. The rolling started at 11:17, and the actual rolling time was 11 min. and 5 sec. The pulling tackle consisted of 20 parts of ¾-in. wire rope leading to 60-ton locomotive cranes at the center piers, and 13 parts leading to standard 50-hp. hoisting engines at the ends. Owing to the length and flexibility of the spans it was necessary to maintain alignment, which was done by means of a transit and range boards. All the engines and piers were connected by telephones to a central control station, from which operations were directed. After the span was in final alignment it was jacked down 8¾ in. Traffic was resumed at 2:10 p.m.

The other group of spans, 968 ft. long, weighing 5400 tons, was rolled in the same way July 31. Owing to the experience gained on the first operation, the time consumed was materially reduced. Track was cut at 9:09 a.m. and traffic was resumed at 1:25 p.m., while the actual rolling time was 5 minutes 33 seconds.

Contracts Let for New York Canal Concrete Barges

Contracts have been let by the inland waterways committee of the railroad administration for twenty-one 500-ton concrete barges to be used on the New York State Barge Canal. The design of these barges is described in detail on p. 271 of this issue.

Eight barges are to be built by the Holler-Davis & Flood Co., at Fort Edward, N. Y.; five by Thomas & Currie, at Detroit, Mich.; four by Caldwell-Marshall Co., at Tonawanda, N. Y., and four by the Cummings Concrete Constructural Engineering Co., at Ithaca, N. Y.

For the 21 barges contracted for the price will average $25,000 each. They must all be delivered before the close of navigation in the canal this year, or approximately Dec. 1, 1918.

New Conduit Bids at Jersey City

Informality of bids for 72-in. steel pipe to duplicate the Jersey City water-supply conduit from the Boonton reservoir to the Watchung tunnel has made it necessary to reject the bids for the pipe and to return unopened bids for pipe laying received July 30. New bids for supplying and for laying the pipe will be received Aug. 13, half of the pipe to be delivered within 2½ months from the date of the execution of the contract and half within five months. This will enable half of the new conduit to be connected with the old one before extreme cold weather, it is hoped, thus adding 10,000,000 gal. to the water-supply. The informal bids received were from the Riter-Conley Co. and the James McNeil & Bro. Co., both of Pittsburgh. Each company inserted in its proposal conditions not in the specifications and the McNeil bid was not accompanied by the required bond.

Study New Mississippi Crossing at New Orleans

The City of New Orleans has recently appointed a board of advisory engineers of the Public Belt Railroad Commission for the purpose of investigating the physical and financial feasibility of a bridge or tunnel crossing of the Mississippi River at or in the vicinity of the city, also the possibilities of united terminal development, both passenger and freight, through the agency of the Public Belt Railroad.

The board consists of four members: Lt. Col. Bion J. Arnold, transportation engineer, Chicago, chairman; Dr. J. A. L. Waddell, bridge engineer, Kansas City; J. Vipond Davies, tunnel engineer, New York, and A. F. Barclay, engineer of the Public Belt Railroad Commission, secretary. The board is working under the general direction of the bridge and tunnels committee of the commission, of which William B. Bloomfield is chairman.

The possibilities of bridge and tunnel construction will be investigated by Dr. Waddell and Mr. Davies, respectively, and the problem of terminal development and general coördination of facilities will be studied by Colonel Arnold. The board as a whole is instructed to submit a report by Jan. 1, 1919.

The field work has commenced, and is in charge of J. R. Bibbins, Chicago; Charles K. Allen, Kansas City, and A. R. Archer, New York, resident engineers and representatives of the respective consulting engineers on the board.

The problem presented is complex not only by reason of the physical dimensions of the crossing project and the foundation difficulties encountered in the bottom lands around New Orleans, but also because of the disposition of present railroad operations, traffic and rates in the Mississippi Valley, and the possible effect in the future of railroad reorganization brought about by war conditions. The project as a whole is to be designed for permanent improvement, having in mind the development of the New Orleans district as far ahead as 1950.

North Carolina Holds Good Roads Convention at Wilmington

The North Carolina Good Roads Association and the Wilmington Highway Association are holding a joint good roads convention at Wrightsville Beach, Wilmington, Aug. 7-9 inclusive. Among those who will deliver addresses are: W. S. Fallis, state highway engineer; L. R. Ferguson, general manager of the Liberty Shipbuilding Co.; H. G. Shirley, secretary of the Highways Industries Association, and John W. Towle, government representative, Emergency Fleet Corporation. One of the topics of discussion is military highways along the Atlantic coast.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

Personal Notes

J. C. SPENCER, consulting engineer, Cleveland, has been admitted to practice as an attorney and counselor at law, and will specialize upon law relating to engineering, architectural and construction work. Mr. Spencer has been engaged in engineering and structural work since 1891, going to Cleveland in 1902 as designing engineer for coal- and ore-handling storage plants for the Brown Hoisting Machinery Co. In 1903 Mr. Spencer became designing engineer for the American Bridge Co., at Pittsburgh. He designed and was consulting engineer for the steel work of the 17-story office building for J. D. Rockefeller at Cleveland.

WILLIAM D'ESMOND, who has been in charge of the waterfront work and pier inspection at Honolulu, T. H., has been appointed harbor engineer of that city. For several years past the legislature has failed to provide an appropriation for salary attached to the position of harbor engineer, and the position was abolished. It has recently been recreated by the Board of Harbor Commissioners.

C. C. SANER, designing engineer, city engineer's office, Chicago, has received leave of absence to become structural checker for the American International Shipbuilding Corporation, at Hog Island.

H. C. BOOZ, assistant chief engineer of the Pennsylvania R.R., has been appointed corporate engineer, in the employ of the company. Mr. Booz has been continuously in the employ of the

Pennsylvania since shortly after his graduation from Lafayette College in 1895. In 1899 he was made division engineer, in 1905, principal assistant engineer and in 1911, assistant chief engineer.

O. E. CARR has resigned as city manager of Niagara Falls, N. Y., to accept the city managership of Springfield, Ohio, from which Charles D. Ashburner resigned to become city manager of Norfolk, Va., as mentioned in *Engineering News-Record* of July 11, p. 105. Mr. Carr has been city manager of Niagara Falls for the past 2½ years, being the first to hold the position.

GEORGE M. ZIMMERMAN, who resigned as city manager of Sandusky, Ohio, as mentioned in *Engineering News-Record* of June 20, p. 1204, has reconsidered his resignation, deciding to remain as city manager upon announcement that the city commission had voted a considerable increase in salary. Mr. Zimmerman was to have taken over the management of the plant of the Hord Color Products Co., Sandusky, in which he is a stockholder.

LINDEN C. TROW, water-works superintendent, Lake Forest, Ill., has been commissioned a captain in the maintenance and repair branch of the Construction Division.

CHARLES GARRETT, Montreal, has been appointed assistant to the administrative commission of that city.

R. BOONE ABBOTT, superintendent of the Harrisburg division, Philadelphia & Reading R.R., and previously division engineer of that division, has been transferred and is now superintendent of the New York division.

J. M. GRANT, engineer maintenance of way of the Chicago, Peoria & St. Louis R.R., has been commissioned a captain in the Engineer Officers' Reserve Corps.

EDGAR M. HOOPES, JR., chief engineer of the city engineering and water departments of Wilmington, Del., has resigned to enter Government service.

R. W. KENNEDY, assistant valuation engineer of the Atchison, Topeka & Santa Fe Ry. at Topeka, Kan., has entered the United States Army.

E. T. AMBACH has been appointed engineer of signals for the Baltimore & Ohio R.R., Lines West, the Dayton & Union R.R. and the Dayton & Union Ry., with headquarters at Cincinnati.

E. J. LORD, civil engineer and contractor, of Honolulu, T. H., has resigned as head of the Lord-Young Engineering Co. of that city. It is reported that Mr. Lord's resignation is the result of the reorganization of the H. Hackfeld Co., which owns nine-tenths of the stock in the Lord-Young corporation and which has negotiated with Dillingham & Co. for the sale of its stock.

ERNEST A. CLARK, associated for many years with George W. Jackson, Chicago tunnel contractor, has been commissioned a captain in the Engineer Officers' Reserve Corps.

L. W. STRAYER, assistant division engineer of the Baltimore & Ohio R.R., has been appointed division engineer of the New Castle division, with headquarters at New Castle, Penn.

J. G. RODGERS has been appointed engineer maintenance of way and equipment for the Pennsylvania Railroad Company.

DEAN O. CARR, designer, Illinois Steel Co., Chicago, has been commissioned a captain in the Engineer Officers' Reserve Corps.

A. E. DOUCET, Montreal, has been appointed consulting engineer to the administrative commission of the City of Montreal.

A. H. GRIFFITH has been appointed engineer of construction for the Baltimore & Ohio R.R., Lines West, the Dayton Union R.R. and the Dayton Union Ry., with headquarters at Cincinnati.

M. L. WORRELL, engineer and manager of the Water Department, Meridian, Miss., has been commissioned a captain in the maintenance and repair branch of the Construction Division and assigned to duty as assistant officer in charge of utilities at Camp Logan, Texas.

DAVID FOWLER ATKINS, for the past four years chief engineer of the Light & Power Co. of the City of New York, has become associated with the Lord Electric Company.

THOMAS W. HULME, real estate agent of the Pennsylvania R.R. and vice-chairman of the Presidents' Conference Committee, has been appointed general real estate agent for the Pennsylvania railroad corporation.

R. C. FALCONER, assistant chief engineer of the Erie R.R. prior to its taking over by the Government, has been appointed chief engineer for the corporation. Mr. Falconer was graduated from the University of Wisconsin in 1895. He began railway service three years later as transitman on the Pennsylvania Lines West of Pittsburgh. In 1905 he entered the employ of the Erie, and was successively assistant engineer, division engineer, principal assistant engineer, superintendent of construction and assistant chief engineer.

HOWARD STILWELL, previously with the firm of Solomon-Norcross Co., consulting engineers, Atlanta, has been commissioned as second lieutenant in the Construction Division.

LELAND P. KIMBALL, assistant engineer, attached to the office of the chief engineer, Illinois Central R.R., has been appointed engineer of buildings for the Baltimore & Ohio R.R., Lines West, with headquarters at Cincinnati. Mr. Kimball entered railway service in the operating department of the Illinois Central in 1904, being transferred to the engineering department a year later, and was subsequently promoted through the positions of rodman, instrument man, inspector and assistant engineer in the maintenance, construction and bridge departments. In 1915 he became chief draftsman in the building department, and in May of this year was appointed assistant engineer in the chief engineer's office.

C. H. MATTIER, assistant engineer, Illinois Central R.R., engaged on terminal work in Chicago, has been appointed assistant engineer in the chief engineer's office, succeeding L. P. Kimball, who has become engineer of buildings for the Baltimore & Ohio R.R., Lines West, as mentioned in the preceding paragraph.

S. J. WILLIAMS, who has been engineer for the industrial division of the Wisconsin State Department of Engineering since its organization, has resigned to become manager of the accident prevention division of the National Safety Council, Chicago.

A. B. SCOWDEN, assistant engineer of bridges of the Baltimore & Ohio R.R. at Baltimore, has been appointed engineer of bridges of the western lines, with headquarters at Cincinnati.

STUART B. MARSHALL, formerly manager of the American Manganese Mfg. Co., Dunbar, Penn., and until recently general superintendent of the Aluminum Co. of America's properties at Badin, N. C., has entered private practice, with headquarters at Roanoke, Va., as consulting engineer and metallurgist for coal and oil lands.

C. H. STEIN, superintendent of the Central R.R. of New Jersey at Jersey City, has been appointed assistant to the general manager of that road, the Philadelphia & Reading and subsidiary lines. Mr. Stein was formerly engineer maintenance of way of the Central R.R. of New Jersey.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Will Localize Purchases of Construction Material

Relief of Railroads, Not Antagonism, Reason for Discrimination in Government Buying

Conservation of freight space is the sole reason given by L. E. Kern of the housing corporation, for discrimination that may occur in the purchase of construction material for the United States Government. There has been some complaint on the part of certain manufacturers that there seems to be antagonism to or lack of appreciation of their products which, they assert, has resulted in greatly reduced sales to the various departments.

The expansion of structural activities throughout the entire Government field and the official and economic restrictions in the private field have produced marked attention on the part of manufacturers to Government business. Those not familiar with the usual official procedure have chafed under what seemed to them unnecessary and hurtful regulations. Furthermore, the housing demand has enlarged so suddenly in certain departments, especially the war and navy, that the Government was forced to produce structures immediately, regardless of kind of material or type of construction. Maj. H. W. Lockett of the construction division of the Army said that in the case of stucco and metal lath construction especially it was not antagonism that has so far restricted the use of this material, but that there had not been time to apply the use of it to its full extent. He stated further that it is his intention to use it wherever possible.

Costs of Wood and Stucco

He has compiled some comparative costs from the work at Camp Eustis, Virginia, which include only the labor and material figures, exclusive of plumbing, electric and heating fixtures, and which show a difference between wood and stucco of from 5 to 10 per cent. They are as follows: For a 66-man, two-story barracks 30 x 60 ft., wood construction \$4302, stucco \$4570, showing a difference of 6% between the wood and the stucco; officers' quarters, two-story, 30 x 77 ft., wood \$6350, stucco \$6661, a difference of 5%; lavatories, one-story, 20 x 49 ft., wood \$1442, stucco \$1550, or 7½%; mess hall, one-story, 20 x 154 ft., wood \$3636, stucco \$3893, or 7½%; storehouses, 20 x 98 ft., wood \$1706, stucco, \$1883, or 10½ per cent. Major Lockett estimated that in the cost of the completed structures, after overhead, plumbing, etc., shall have been added, the margin will be reduced to 5%, and pointed out that the lower maintenance cost of the stucco would soon equalize even the 5% difference. He estimated that in heating alone there will be a saving of 18%.

L. E. Kern, of the requirements division of the housing corporation, Department of Labor, also stated that it was too early in the game to say that any one material would be used in preference to others. This, he said, was especially true in the housing corporation, since it was only three weeks since the first contract was let. He said his greatest difficulty at present was that, no matter what material was specified, he received complaints from dealers in other materials that could have been used for the same purpose. As an illustration, he pointed to the matter of slate roofs, which when specified brought a protest from the makers of composition roofing, and vice versa. He said that this condition arose from a misunderstanding among the material men, in that heretofore the largest part of Government construction was specified by fixed, standard specifications, and that the material men were under the impression that the housing corporation was formulating similar standard specifications and were anxious to have their materials covered. But, he stated that at present there were no standard specifications contemplated, and that before the housing program was complete the demand would be so great that all kinds of construction would be used.

George W. Ginder, superintendent of the computing division of the United States Supervising Architect's office, under whom the specifications are written, said that he preferred and always

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Turbine Industries Controlled by War Industries Board

All orders for turbines rated at 700 hp. and over will be supervised by the War Industries Board. Twenty-one companies manufacturing turbines will be affected by this order, and have agreed not to fill orders for turbines in excess of 700 hp. for either civilian or Government purposes before obtaining permits from the War Industries Board. Orders from the Navy and the Emergency Fleet Corporation are excepted, as well as land type machines, orders for which may be received and filled without permit. Permits are required for all private or nonwar orders, and will be given only when necessity is shown.

Preliminary Rules for Labor Recruiting Outlined

Backed by Announcement of Industries Board of Intention to Withhold Priorities From Offenders

Preliminary rules and regulations under which recruiting of unskilled labor will be conducted under the United States Employment Service have been announced through the chairman of the War Labor Policies Board and the Director General of the Employment Service, backed by the War Industries Board, which, through its priorities division, will in proper cases withhold priorities from employers violating the rules set down by the United States Employment Service. An outline of the employment program of the Government was given in *Engineering News-Record* of June 27, p. 1245, pointing out the probability of the War Industries Board coöperating with the Employment Service through withholding priority assistance to employers who violated the rules prescribed. The intensive campaign for recruiting labor in war industries was outlined in *Engineering News-Record* of Aug. 1, p. 250.

As announced by the United States Employment Service the regulations which govern private recruiting are as follows:

1. Employers may continue to hire workers who apply at the plant without solicitation, direct or indirect.

2. The Federal Director of Employment in each state is authorized to grant permission to employers to use their own field agents for recruiting unskilled workers under his direction and control for war industries located within the state.

3. Permission to recruit unskilled laborers in states other than the one in which the work is located may be secured from the Director General of the United States Employment Service upon the recommendation of the Federal Director of Employment for the state in which the men are needed. Such permission will be communicated by the Director General to the Federal Directors for the states in which the labor is needed and from which it is to be recruited.

4. No unskilled labor may be transported from one state to another without authorization from the Director General, to be secured by application through the Federal Director of Employment for the state in which the labor is recruited. No laborers may be moved from one employment district to another within a state without author-

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Construction Materials Purchases

(Concluded from page 295)

specified either a heavy wire mesh or metal lath, except under unusual circumstances. The choice was always one of economy in the locality where the building was to be built. He stated that owing to conditions terra cotta shortly would be so difficult to obtain as to be practically off the market, in which case, he said, expanded metal and stucco would be extensively used as a substitute.

The housing corporation has reduced to a system the allocation of purchases to conserve freight space and it is the application of this system that has given rise to the complaints of the material men. The country is divided into districts, each of which is supervised by an architect. He is selected with reference to his familiarity with the local conditions of the district to which he is assigned or preferably to his actual experience therein, and among his instructions is a set of multigraphed sheets the subject of which is "Availability of Materials for Industrial Housing Projects" (as determined at meetings held in office of R. L. Humphrey, May 31 and June 1, 6 and 7, 1918, and as revised and added to at a meeting held in the same office on July 18, 1918.)" Under the heading this note says, "Wherever possible architects should so design projects that the material requirements will be equitably divided among the various available branches of the building material industries." The body of the list is divided into sections to cover each locality in which construction will be done and of which a more or less composite example follows:

City of A, State of B.

(a) Frame, metal lath and stucco

(b) Brick

(c) Tile with or without stucco

Lumber: Norway pine by Great Lakes, probably Spruce and hemlock
Brick, T. C. tile, Northern N. J.
Cement: Lehigh
Sand and gravel
Metal Lath, 100,000 yd. in stock in Pittsburgh
Lime: Buffalo and Glens Falls
Gypsum: 200-mile haul
Prepared roofing: 45-mile haul, etc., etc., etc.

The above is disguised at the request of the housing corporation because the list is subject to change at any time, and is for the use of the district supervising architects. It is noted, however, that in almost all the cities of the list, metal lath is specified.

These specifications, Mr. Kern stated, were carefully compiled so that materials produced in or in the vicinity of the cities and localities covered might be used, and were made irrespective of the size of stocks of materials produced in other localities from which there would be a lengthy freight haul. In Norfolk, for instance, wood-lath and nonfireproof construction was specified for immediate economy and because wood-lath was extensively used there previously. This had to be done in spite of the fact that large stocks of metal lath are stored there.

Mr. Kern invites attention to another phase of the housing program in that the type of buildings is more or less determined by the use to which they will be put. For instance, skilled mechanics will demand a house of a much higher order than immigrant labor, he says, and in certain localities custom demands a certain type of construction, and he says a comparison between the houses being built and similar houses built before the war will show an improvement in construction.

Zenas M. Carter, commissioner at Washington for the association of metal lath manufacturers, is of the opinion, however, that the housing corporation might be following custom more closely than the situation requires, and in the matter of economy that Mr. Kern outlines Mr. Carter invites attention to the fact that in many of the brick and tile structures the costs are higher than stucco, and that a much less durable interior finish is obtained with the plaster boards the housing corporation is specifying, the maintenance cost of which will produce in a short time a balance in favor of metal lath. Mr. Carter also states that he has heard that, in some cases, brick and tile were specified in localities in which they are not produced, making freight hauls necessary. Lack of specified instances makes it impossible for the housing corporation to explain the conditions which made this necessary, but Mr. Carter points out that, owing to the wide distribution of sand and gravel, it is possible to maintain economy of freight haul by the use of stucco even if it is necessary to ship the metal lath. In illustration of this the metal lath association has made a study of car requirements for two types of construction, in which a saving of from 36 to 42 cars hauled is shown in two comparisons between wood and stucco.

Business Notes

R. H. Johnston, formerly New York manager, is now vice-president of the White Co., Cleveland, manufacturer of White automobiles. Mr. Johnston's headquarters will be at Washington, D. C., and he will be succeeded in New York by William H. Moore, who has been in charge of the Pittsburgh offices.

The Electric Hoist Manufacturers' Association held its recent meeting at Montour Falls, N. Y., where the members of the association were the guests of the Shepard Electric Crane & Hoist Co. Twenty-two members were present, representing eight companies in the East and Middle West.

Labor Recruiting

(Concluded from page 295)

ization from the Federal Director of Employment for the state.

5. Employers who receive permission to transfer workers from one state to another or from one district to another within any state must file a statement with the nearest employment service office, of the number of men transferred, the wages offered, and other terms and conditions of employment promised to the men.

6. Employers who are permitted to use their own field agents for recruiting labor must in no case use any fee-charging agency, or use any agents or labor scouts who are paid for their work on a commission basis.

7. All advertising for unskilled labor, whether by card, poster, newspaper, handbill, or any other medium, is prohibited after Aug. 1, 1918. This applies to all employers engaged wholly or partly in war work, whose maximum force, including skilled and unskilled laborers, exceeds 100.

The Federal directors of the employment service for the several states are instructed to give every possible assistance to employers engaged in war work who desire to recruit skilled labor.

For the time being no restrictions have been placed upon employers engaged in war work recruiting their own skilled labor, except that they are urged to conduct their efforts so that as little restlessness as possible will be caused among men who are already engaged in other war work, including railroads, mines and farms, as well as work covered by direct and subcontracts for departments of the United States Government.

Trade Publications

The Worthington Pump & Machinery Corporation, 115 Broadway, New York City, has issued the May, 1918, number of the Deane Bulletin, D-702, a 55-p. pamphlet illustrating the single and double acting vertical triplex power pumps manufactured by the Deane Works of the corporation, at Holyoke, Mass.

"The New Era in Street Lighting" is the title of a 36-p. catalog recently published by the Holophane Glass Co., 340 Madison Avenue, New York City. This book describes and illustrates the results of recent research and shows how these results have been applied to street lighting.

Sixty-nine war activities, Federal, state, county, city and private, centering in Madison, Wis., are described in a 36-p. paper-covered booklet issued by the Madison Association of Commerce. Don E. Mowry is general secretary of the association.

Engineering News-Record

Devoted to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC.

August 15, 1918

Derrick Car Sets Deck Slabs of Concrete Bridges at Chicago.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

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E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

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Camp Sewage-Works Ordered Enlarged

PROMPT relief from the nuisance caused by overworked sewage disposal plants at army camps will follow the decision announced on page 336. It was not expected that such conditions as those at Camp Dix, New Jersey, commented on in our issue of Aug. 1, p. 206, would long continue. In fact, they would never have arisen had not the number of troops at the various camps been suddenly increased to send overseas a quarter million of men a month.

New England Water-Works Men to Meet in September

COMMENDATION is due the New England Water-Works Association for revising its announced decision not to hold its usual fall convention and deciding to gather in Boston Sept. 11-12 for a strictly business meeting devoted chiefly to war-time problems. Such a plan is outlined on p. 329 in a letter from C. E. Davis, which mentions other commendable work by the association to meet the needs of this critical time. This journal has maintained that technical associations whose existence can be justified should not abandon their conventions in these strenuous times. Water-works men have many war problems to solve, as the report of the War Burdens Committee of the American Water-Works Association, abstracted on p. 308 and commented on in another editorial, bears witness. The New England association might well join in the work so well begun by its sister organization.

New Orleans' New Harbor Unique in Many Ways

NEW ORLEANS and the State of Louisiana are to be congratulated. In these days, when no city or state undertakes an improvement without first trying to persuade someone in Washington that it is a Federal necessity and consequently deserving of some of the thirty billions of Government war appropriations, it is refreshing to find one community ready to initiate and finance its own development, asking of the Government only permission to float its bonds. But the New Orleans' inner harbor and navigation canal, described in this issue, is more than an example of local enterprise. It is a contribution to harbor design unique in this country, if not in the world. European ports with their wide ranges of tide have inland harbors where constant level is preserved by a lock entrance, and in the United States the Lake Washington canal and lock at Seattle opens up an inland lake to ocean traffic. In these cases the canal or lock is merely a connecting link to the main basin where the docks and warehouses are located. At New Orleans the canal is itself a harbor, with its own wharves and industrial sites, as well as a passageway to a fixed level body of water which may itself some day be developed as a harbor. Furthermore, the construction has novelty as well as the design and financing. Building ships literally in a city street and digging the waterway a mile or so up to the shipyard in time to launch them is war emergency construction with a vengeance.

If Our Meteorological Records Were Extended

SPECULATION on what meteorological extremes would be shown if systematic records went back a few hundred or a thousand years instead of a half century is revived by the intense heat which hung over a large part of the country last week. To take only one city, the record breaking maximum of 102° at New York City on Aug. 7 makes all the deeper impression in contrast with the broken record at the other extreme only eight months ago when the mercury fell to —13°, giving a range of 115° within less than a year. The record at New York is for 47 years. The nearest approach to the 102° of last week within the record was 100° in early September, 1881, or 37 years ago. Continuous rainfall records kept at a few American cities for 75 to 100 years, presented and discussed in *Engineering News* of Nov. 19, 1914, and later, only increase the wonderment as to what our meteorological extremes would be if the records covered thousands instead of scores of years, hundreds or thousands of localities, and the highest altitudes, instead of being restricted so generally to sea level or other relatively low-lying places. Improved as is our Weather Bureau Service over earlier years, the country at large has great need for many more well-equipped observation stations, particularly in the West and at higher altitudes.

A Bullet In the Head

HE HAD lately returned from France, after three and a half years with the British Army—in the fateful fighting of Ypres, in the Somme offensive, in the holding of the lines in northern France. He was observing with the most intense interest the play of the new forces of labor, the evidences of discontent and the sure indication of a future effort of those with force but not ability to usurp the places of those who have managed large and difficult affairs. He talked rather doubtfully about a future that may be filled with

much experimenting by those newly come to power. "What a lesson we can learn," said he, "from the battle line! There every man must do the part for which he is best fitted. The keenest of hearing go into the listening posts. The alert do patrol duty. Those who thrive on excitement man the machine guns. The natural leaders among the infantry officers remain, while those wrongly placed are sent back to the non-fighting bases. The penalty for blundering, for putting the wrong men in a given place, is death—death for the individual if the wrong man be a private, death possibly for a whole company if he be a commander. That is a big lesson of the trenches—each must do that for which he is best fitted. Otherwise, a bullet in the head is the punishment." He did not urge contentment. He did not appeal to patriotism. His was an argument for service—to do the maximum one's powers permits, but not to clog the wheels of life by vain strivings in positions where others can render the better service.

Unwarranted Accident Waste in Construction

CONSTRUCTION lags far behind the manufacturing industries in accident prevention. It is high time that the progress be accelerated. Neglecting entirely the humanitarian factor, construction is paying too high a price for its tardiness. Insurance of construction workers costs considerably more than insurance of factory operatives. Employees-accident compensation laws are taking away from the contractor any chance he formerly possessed of adjusting damage fees by compromise or court action. Construction can no longer escape the penalty of carelessness, and must decrease the accident rate or pay the price for neglect.

Statistics are not complete, but they are sufficiently plentiful to prove construction extra hazardous compared with almost any other industrial employment. The New York Industrial Commission states that more men are killed in construction work than in all the factories of the state, although factory workers are four times as numerous as construction workers. In Wisconsin construction labor is only 5 per cent. of the total number of workers, yet their occupation contributes from 15 to 20 per cent. of the fatal and serious injuries. The Pennsylvania building trades alone, during the first six months of this year, showed an accident record of 111 persons killed and 1600 injured sufficiently to receive compensation. Notice the proportion of deaths. Casualties on the battle front in France exhibit hardly a worse record of fatalities. Certainly no other industry presents such a record.

It is impossible to estimate the cost to the construction business of this needless hazard. This cost certainly is not limited to the damage fees paid. Accidents interrupt the progress of work; they deplete the working force and injure its morale; they frequently involve damage to plant and structure. These indirect results of accident may easily exceed in cost the compensation to injured workmen. And most of this waste is preventable, as the experience of the Fred T. Ley Co., outlined in the *Engineering News-Record* of March 14, 1918, page 523, clearly demonstrates. These contractors, in their second year of systematic effort to reduce accidents, decreased their frequency 55 per cent. and their cost 66 per cent. Any contractor can do as well. It is time for the construction business to set its house in order in the matter of accident prevention. The precedent has been established. The fact has been demonstrated that accident prevention is good business. And it is equally evident, from the statistics quoted, that the lesson of the Ley's experience has made little impression on other contractors.

A means for exchanging experience and securing the benefit of organization is to be afforded by the National Safety Council, which at its congress in St. Louis next month will organize a Construction Section and devote a goodly share of its program to papers and discussion on accident prevention in construction work. Participation by contractors in the activities of this congress will greatly strengthen the new section which can initiate, through coöperation, a movement of the highest value to the construction business. Without a doubt such a body as the proposed national organization of general contractors can also coöperate very effectively in such a movement. Certainly the present fact that construction is the most backward of all industries in such a vital matter as accident prevention is not a credit to the intelligence enlisted in this field.

A Moses for the Highways

RECENTLY Edward N. Hurley, chairman of the Shipping Board, has sent to civic and commercial organizations an eloquent plea for the formation by them of committees on merchant marine. He points out that the lack of interest in shipping by the public caused the decay of the merchant marine of the early nineteenth century, and he proposes that our new-found fleet shall not go the way of its predecessor.

Mr. Hurley should be supported. He is dealing intelligently with one of the problems of reconstruction. He is also dealing with transportation—ocean transportation—the top rung of the transportation ladder.

We wish that a Hurley or a Schwab would be the appointed champion of the first rung of the transportation ladder—the highways. They are a football in Weshington, their care being entrusted to a subordinate branch of a great administrative department. Schwab and Hurley stand for ocean transportation, a Railroad Administration takes care of the rails; highways, after a long struggle, in which they have been kicked and cuffed by the fuel, railroad and financial administrations, are championed by a Highways Council that not only has its acts nullified by the Capital Issues Committee, but is professedly a sorting out and discriminating body. On the one hand, ocean and rail transportation are championed by promotors, by those who possess a large vision and are telling it to the country. On the other, highways are subjected to the scrutiny of a board, not intent on promoting maximum use of a war essential, but rather upon its curtailment to the point where the curtailment will not hurt. The one is a progressive, positive attitude; the other a backward, negative one. Expansion is the one keynote; contraction the other.

We need someone in Washington who sees the true relation of the highways to the winning of the war, who will stand for promotion, who will point the visions, who will not let our Government be blind to

England's war experience with her roads. We need a Moses, and we need him at once. In fact, his coming has been six months delayed.

Co-ordinating Construction Work

EXCELLENCE of construction management can be measured broadly by the degree of coördination of operations. That good management prevailed on the Chicago quartermaster's depot work is, therefore, the first conclusion which one draws from the story in this issue. It is, however, the conclusion of least significance.

Coördination of plant units and of working gangs is nothing new in construction. Every manager who is worth his salt secures coördination. He does it unconsciously. Perhaps it has not been developed with him in most cases to the permanency of a doctrine. When it is so developed, his every effort and action toward coördination is conscious.

Coördination at the Chicago quartermaster's depot was the result of conscious action. The ways adopted deserve attention. Outstanding is the fact that all of them were taken consciously.

Evidence of the economic value of coördinating construction operation furnished by the Chicago work being considered is that it has been the chief instrument in clipping a week a month from a construction schedule set in the first place at a rather high rate.

War Burdens of Water-Works

INCREASED construction and operation costs of water-works in the short period since 1915 is strikingly shown by the War Burdens Committee report to the American Water-Works Association, presented in part in this issue.

Labor costs, or rather the rate of wages paid to labor, have not gone up to any such degree as the costs of materials, but the belief is general that the efficiency of labor is much less than it was three years ago. This is a serious matter—all the more so because the scarcity and inefficiency of labor is more likely to increase than to decrease in the next year or two, just as wages seem bound to rise. Probably the wage increase would be still larger, at least in the case of municipal works, if many cities were not hampered by ordinance or otherwise in raising wages. Possibly complaints of decreased labor efficiency would be less numerous and strong if the wage increase had been larger. This phase of the subject is not considered by the committee.

In fact, the committee has presented a considerable body of data and pointed out the upward trend of prices, but has not blocked out a plan to cope with the problem of increasing war burdens. Perhaps the Executive Committee of the Association will request the War Burdens Committee to carry its good work further into the field of constructive suggestion.

Portions of the report omitted from the abstract because of space considerations dwell upon the bearing of increased costs on rate fixing by state utility commissions. This is a serious matter for privately owned works and their patrons. Some of its aspects were discussed editorially in this journal Aug. 8, p. 255.

It should be remembered that in the water-works field municipal rather than private ownership prevails. This is true not only in the number of works but also and far more markedly in population supplied. Should the work of the committee be continued this fact should be taken into account. True, the municipally owned works have general taxation to fall back on. This makes it easier to let the matter of rate readjustments go by default for a time, but sooner or later there must come a reckoning.

Both privately and publicly owned water-works should give prompt and careful heed to the committee's plea for adequate records to show just how and why the war burdens of the water-works of the country are increasing. Indisputably our water-works are essential industries. Nothing in the municipal or utility field is more vital. It is imperative that they be maintained at a high state of efficiency. With the increased costs shown by the committee's report continued efficiency is impossible under pre-war rates—unless, indeed, those rates were too high, or unless the added burdens are to be shifted from the water consumers. Whether and to what extent stockholders or taxpayers should shoulder these burdens is a question which must be considered in each case in the light of local conditions. If the regulation in the past has allowed only a fair return, clearly the water users should bear the burden.

In any event the efficiency of our water-works must be maintained, with the most even-handed justice possible to the owners of the works on the one hand, and the consumers of water on the other. The more the subject is considered the more evident it becomes that the American Water-Works Association has made only a good beginning thus far in its bounden duty to the water-works fraternity and to the public.

State Your Case Plainly and Briefly

IF THE multitude of men who visit Washington or write to the Federal departments to obtain priorities will base their claims on the same kind of arguments that would be influential with themselves were they sitting in the seats of power, they will be very wise. Every agency in charge of permits is flooded with elaborate arguments in which the little kernel of sound sense is enveloped in such a thick husk of balderdash that the men charged with keeping the wheels of industry and commerce moving in harmony with the great military procession of events are hard pressed at times to find any real reasoning in these appeals. Altogether too many of these arguments resemble the pleas of a criminal lawyer defending a felon known to be guilty but having a chance of receiving a light sentence. The very form in which the request for Government action is often made diminishes the favor with which it is received. The Government is engaged in winning the war and that purpose is gradually absorbing a large part of the efforts of most of the Federal departments and agencies. Everything that is presented to a Government official is tested by the query: "Will this help win the war?" Applications for Government assistance should answer that question clearly, concisely and with absolute truth. This is no time for the verbal enthusiasm of selling arguments, and those who follow the methods of the unscrupulous salesman in their dealings with Washington diminish their chances of success, even with a good case.

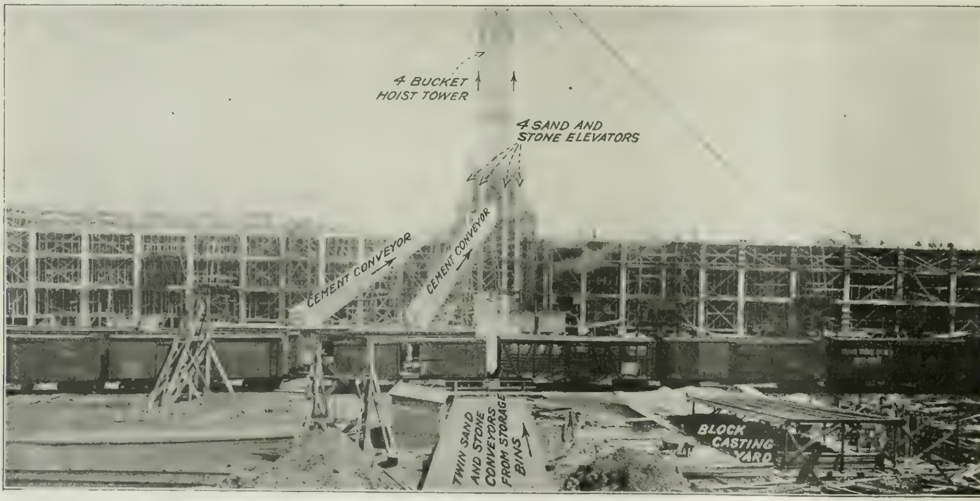
Co-ordination Saves Six Weeks' Construction Time on Big Building

Duplicate Equipment Throughout Eliminates Plant Delays—Manual Operations Proceed on Time Table Schedule—Promoting Esprit de Corps Among Men Is Important Feature

BY EXACT coördination of construction operations, high speed in placing concrete is being developed in constructing the new $3,000,000 quartermaster's depot at Chicago. With a special crew for each operation and all operations carried on in prescribed sequence, and by nearly automatic plant handling of materials, concrete has been put into forms at the rate of 1200 cu.yd. in five hours and a common day's run is 1650 to 1700 cu.yd. The result has been a gain in speed which promises to save six weeks' time on a job scheduled to require only six months for completion.

Quick handling and fabrication of large volumes of materials formed the construction problem. The Chicago quartermaster's depot is a six-story reinforced concrete frame and brick wall building covering, with court included, a ground area of 325 x 600 ft. The floor area is 1,250,000 sq.ft. or approximately 29 acres. Very massive construction is employed. The foundations are 611 concrete piers, 4 and 4½ ft. in diameter, sunk in open caissons to depths of from 23 to 27 ft. With their mushroomed bases the foundation piers contain 11,000 cu.yd. of concrete. Starting with a diameter of 36 in. at pier tops the column tiers decrease in diameter to 18 in. on the sixth story. Columns are spaced 18 ft. in both directions and carry 8-in. slabs reinforced for a live load of 300 lb. per square foot. Between wall columns the slabs for a width of 3 ft. are deepened to 13½ in., thus forming at each floor a shallow belt girder.

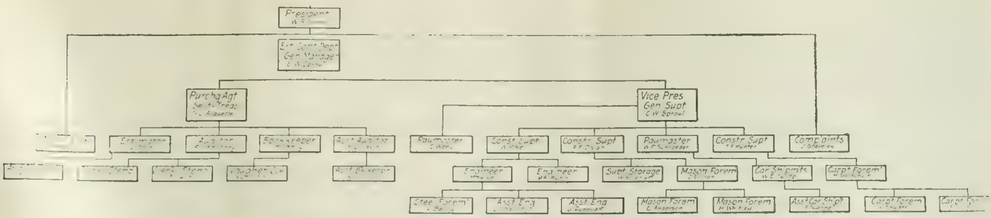
Summarized, concrete work quantities are: 62,000 cu.yd. of concrete; 3500 tons of reinforcing steel, and 4,000,000 ft. b.m. of form lumber. These figures give 64½ ft. b.m. of lumber and 113 lb. of steel per cubic yard of concrete. In columns alone 5½ miles of spiral and vertical rods were used. The volumes of construction materials which had to be handled and fabricated become impressive when figured in these terms, but still more impressive when the speed factor is considered.



MATERIAL DELIVERY AND CONCRETE DISTRIBUTION CONTINUES MECHANICAL PROCESS FROM RAILWAY CARS TO RECEIVING HOPPERS ON BUILDING FLOORS

The construction time schedule as laid down at the beginning of work was: Excavation, 30 days; foundation piers, 30 days; concrete frame, 60 days; brick and terra cotta, 30 days; finishing the building, 45 days; a total of 195 days. The date for completion of the work was set at Oct. 15, 1918. Excavation was begun Mar. 6 and on June 30 the time schedule had been exceeded by 37 days. If the same rate of gain is maintained, the work will be completed by Sept. 1, or six weeks ahead of the date scheduled.

Organized coördination has been named as the means for the exceptional construction speed attained. This coördination began with a carefully drawn schedule of performance. Then the regular arrival of materials and supplies was planned. The plant was laid out in duplicate to prevent interruption from breakdowns, made as nearly as practicable automatic to reduce attendance, and coördinated unit to unit to a set nominal capacity. Plant and manual operations were then meshed closely with one another. Finally, the labor force was broken up into crews to secure the maximum



CONTRACTOR'S STAFF WHICH CLIPPED SIX WEEKS FROM SCHEDULE TIME OF SIX MONTHS

practicable subdivision of duties, and all crew operations were time tabled.

The main plant unit is that for mixing and distributing concrete. It was planned that all operations of this plant should be mechanical, from the first unloading of the material cars to the distribution of the mixed concrete to receiving hoppers on the building floors being concreted.

All materials come in on railway tracks parallel to the front of the building, as indicated by the plant layout diagrams. The building consists of two units separated, except for a narrow connecting structure, by a court 46½ ft. wide. At the entrance to this court, in front, is set a quadruple bucket hoist tower which delivers to four radial chutes. Twin mixers at the foot of the tower are charged by gravity from overhead bins set in a frame structure close in front of the tower. Sand and stone arriving on a track about 250 ft. back of the building are unloaded into a bin paralleling the track and are conveyed thence by a series of belt conveyors to elevator legs at the foot of the bin structure. Four elevators lift the sand and stone to the bins. Cement arriving by car on another parallel track nearer to the building is taken either from cars or from a storehouse to the bin elevation by inclined belt conveyors.

Delivery of materials to the mixer bins constitutes the first series of operations. The storage bins for sand and stone are 1000 ft. long and hold at each end three cars of sand and in the middle compartment eight cars of stone or gravel. They are 6 ft. deep. Cars on parallel tracks on either side are unloaded by locomotive cranes into the bins. In the bottom front of the bin, facing the building, are 52 slide gates which feed onto belt conveyors operating in a pit along the toe of the bin.

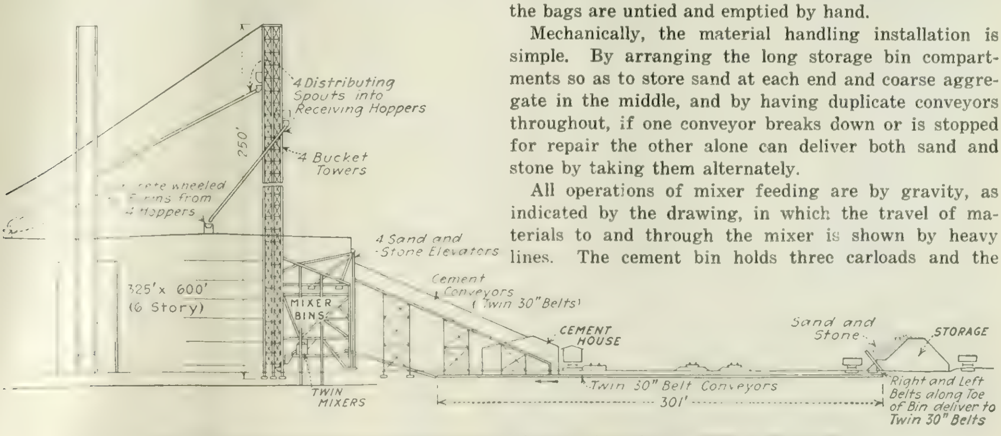
There are two conveyors, each 500 ft. with 24-in. belts. The belts travel in opposite directions toward the middle of the bin, casting their loads into a center hopper which delivers onto two 30-in. belts extending at right angles 301 ft. toward the mixer bins. These 30-in. belts run in a tunnel under the railway tracks and yards. At the end of the tunnel the material is fed onto twin inclined belts which run to the receiving bin located at the bottom of the bin structure, as shown by the large scale drawing. Four 15-hp. electric motors operate the belt conveyor system up to this point.

Four stands of elevators raise the sand and gravel to the elevated bins over the mixers. The receiving bin previously mentioned feeds by gates into troughs which are emptied by chain drags into the elevator boots. Each elevator is driven from the head by a 30-hp. electric motor. The chains carry 8 x 16-in. heavy pattern cups and each set discharges into a hoppered chute leading to the proper storage bin.

Cement delivery is a more simple operation than is the delivery of sand and stone. From the cement storehouse, having a capacity of three carloads, two 30-in. belt conveyors reach to the cement-handling floor over the elevator bins. At the bottom these conveyors are so arranged that the cement bags can be unloaded onto them directly from the cars or from the stacks in the cement house. At the top they discharge onto roller chutes ending on the grid top of the cement bin. There the bags are untied and emptied by hand.

Mechanically, the material handling installation is simple. By arranging the long storage bin compartments so as to store sand at each end and coarse aggregate in the middle, and by having duplicate conveyors throughout, if one conveyor breaks down or is stopped for repair the other alone can deliver both sand and stone by taking them alternately.

All operations of mixer feeding are by gravity, as indicated by the drawing, in which the travel of materials to and through the mixer is shown by heavy lines. The cement bin holds three carloads and the



GRAVITY FEEDS MATERIALS FROM BINS THROUGH MIXERS TO TOWER BUCKETS

sand and stone bins have capacities respectively of 360 and 600 cu.yd. These amounts are sufficient for a half day's run of the mixers should there be a breakdown of the material conveying system. The batch charging hopper is located directly over the mixer and under the bins. Measuring chutes lead from the bins to the hopper, and as soon as one charge is withdrawn from the hopper into a mixer the hopper is filled again for the other mixer. There are two 56-cu.ft. mixers with a rated capacity of 85 cu.yd. per day. They discharge directly into the tower buckets. The mixers are the only steam-operated unit of the concreting plant; two 40-hp. boilers outside of the bin structure furnish the steam.

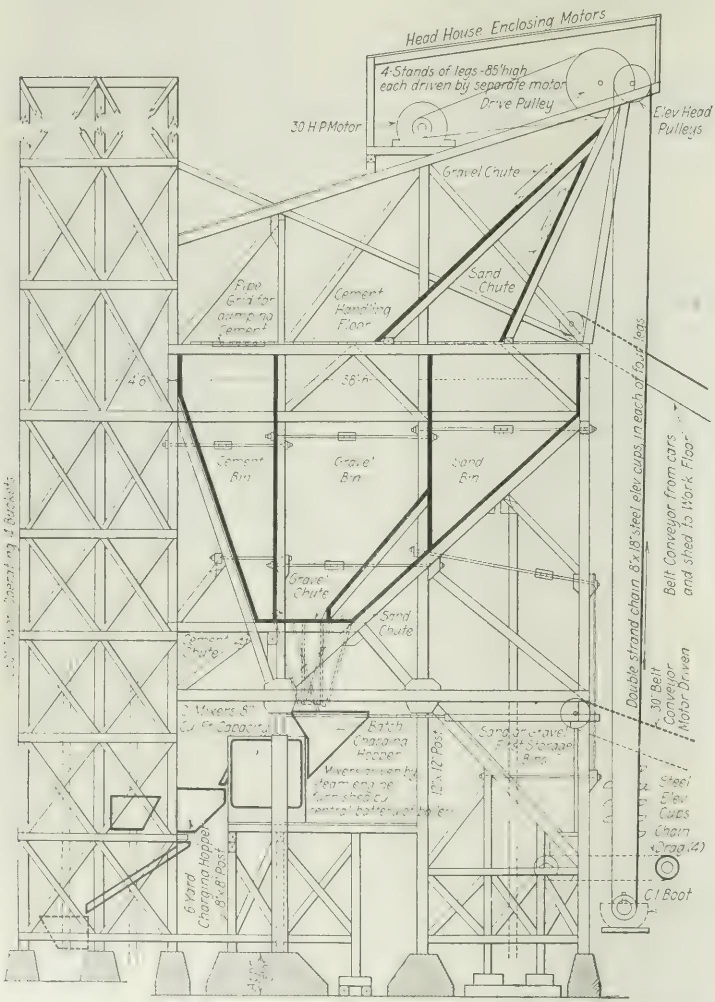
The distributing tower is 14½ ft. square and 250 ft. high. It accommodates four 2-cu.yd. buckets which are handled by electric hoists. Four distributing chutes terminate in receiving hoppers which are moved from place to place on the floor being concreted so as to keep the cart haul short. The longest run of any spout is 500 ft., and in no case so far has the cart haul exceeded 100 feet.

Plant coördination is manifested in the train of mechanism described in these obvious particulars. Machine attendance is reduced to the minimum by employing electric drives. This reduces the chances of any unit being undermanned by workmen laying off and thus cutting down the output of coördinate units. Duplicate units are provided of all moving mechanism so that a breakdown of one unit of a pair does not wholly stop the output. Indeed, each unit of a pair, by a little speeding up, can even maintain the normal output for a period of emergency. Finally, of course the capacities of all units, of conveyors, elevators, charging hoppers, mixers, buckets and chutes, have been regulated to the same nominal capacity, which is 1800 to 2000 cu.yd. per day.

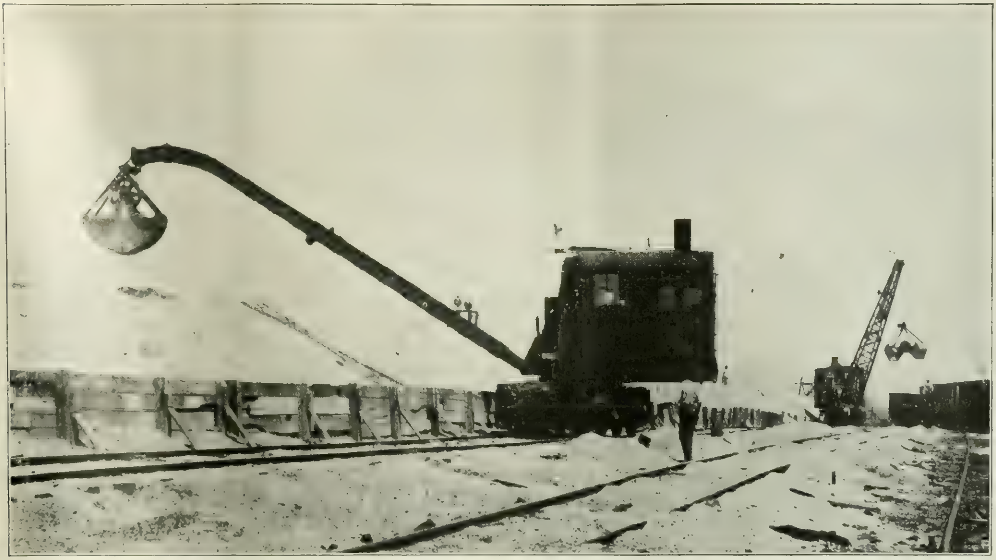
Getting steel reinforcement and form lumber to the workmen was planned with as careful an eye to coordination as were the concreting operations. The first step was field shop fabrication to as great a degree as possible, the next was the planning of special "long-stuff" hoists and the last was gang subdivision, which is considered later.

Field shops were established for fabricating reinforcement and form members and for casting concrete blocks to support floor slab bars. At the steel shops column spirals were assembled complete and bars were cut and bent. The sawmills cut all staging and bracing timbers to exact dimensions for erection, and here also column capital molds and floor lagging panels were fabricated complete. The block yards delivered, precast and cured, more than a hundred thousand 4 x 4 x 6-in. concrete "chairs" for slab rods.

These shops contributed to group handling and transportation. For example, all the reinforcement of a column was handled as a unit. Column head molds were handled assembled as units. Lagging boards were cleated together in three-board panels and one piece was handled instead of three. Furthermore, all reinforcing



CONVEYORS, ELEVATORS, DISTRIBUTING TOWER AND QUADRUPLE CHUTES MAKE CEMENTING CONTINUOUS MECHANICAL OPERATION



LOCOMOTIVE CRANES UNLOAD SAND FROM STONE CARS INTO STORAGE BIN

rods, spacers and chairs for a complete panel were got together, hauled, hoisted and placed in a single sequence of operations. This was repeated for another panel and so on. Many similar methods were followed in handling form members. The handling crews, in a word, moved groups of members, each group containing all the members required for a unit of construction. By this means each handling crew gained the efficiency due to concentration of attention and each erecting crew could proceed from panel to panel without delay in sorting and rehandling and waiting for delayed deliveries of certain members. Special long material elevators, described on page 334, helped materially in speeding the handling of bars and lumber.

Subdivision of Duties Increased Labor Output

Manual operations comprised principally handling and placing reinforcement, erecting and dismantling forms and wheeling and placing concrete. Coördination in these operations followed two principal directions; obtaining maximum practicable subdivision of duties by having a separate trained crew for each operation and scheduling the performance of each crew so that it worked in coördination with other crews, either adjacent or remote.

The general organization of the construction force is explained by the diagram. Actual direction of construction work is in the hands of a general superintendent and a group of engineers, superintendents and foremen. Under these men the working force was so organized that each crew performed only a certain prescribed operation and by repetition became particularly rapid and exact in its work. Two examples will illustrate the system:

On the building the form erection gang comprises the following crews: (1) Sets the uprights and braces them; (2) places the top timbers and establishes levels; (3) sets the column forms; (4) lays the floor lagging; (5) greases the column forms. The reinforcing gang is divided into the following crews: (1) Carrying and laying slab rods; (2) spacing and wiring slab rods and placing concrete chairs; (3) setting column spirals; (4) bending down column verticals to be tied into the slab reinforcements.

Crew operations follow a regular order so timed that the various processes of erecting forms and placing reinforcement mesh with one another. This scheduling of work, though adhering to a general plan, is in the hands of the crew and general foremen, who shift their men and points of operations as need arises, so that all operations will coördinate in time and sequence. In a measure, the task is intricate. The secret of its successful performance lies in each crew having only certain fixed duties to perform and so becoming remarkably quick and accurate, and in centralizing the direction of the crews. This centralization is so close that quick shifts are possible when any operation begins to get out of step with the general march of the work.

Cultivation of Esprit de Corps Increases Efficiency

The great accomplishment in coördinating labor, after all mechanical helps are named, has been the creation of *esprit de corps* among the workmen. A number of things have contributed to this accomplishment. First has been, perhaps, the appeal to patriotism. Universal success has been won in promoting the sentiment that every man's activity is a direct help in winning the war. The methods, as always in such matters, are too intangible to be defined precisely. For example, however, when the Third Liberty Loan campaign was on, competition was started between different groups of workers to determine which could raise the greatest

sum. The iron workers won and as a reward were presented with a flag which was flown from the building. This aroused the spirit of the carpenters, who asked permission to present a permanent building flag and staff to the Government. The offer was welcomed and on June 1 the dedication of this flag was celebrated with speeches and ceremony. This gang rivalry was encouraged in all possible ways and it did much toward speeding up the work.

Another thing that contributed to the morale of the men was the field hospital service. A well equipped operating and dressing room with a trained nurse in constant attendance and a surgeon at call were provided by the contractors. Every hurt was treated promptly and competently. This had a marked inspiriting effect on the men. Economically it was a gain both to contractors and to workmen, as it reduced time lost due to small injuries and kept the men out of the hands of professional "damage case" sharks. Incidentally, the contractor had in his hands a complete record of every case for his own legal protection.

The plans and specifications for the building were prepared under the direction of S. Scott Joy, architect for the Central Manufacturing District and A. Epstein, structural engineer. The district is represented by H. E. Poronto, industrial agent, through whom the United States Government was induced to adopt this location.

Construction was awarded to E. W. Sproul, general contractor, Chicago, who had recently completed the warehouse, just west of the new ones, which contained 900,000 sq.ft. of floor space. The Government is represented by Maj. S. L. Nelson, consulting quartermaster in charge, assisted by Capt. O. C. Waterman, Q. M. C., N. A., and Lieut. F. H. Wyatt, Engineer Reserve Corps.

New Orleans Builds Inner Harbor and Navigation Canal

Rush Construction with State Funds To Provide Ocean Docks and Industrial Sites on Fixed Level Waterway Between Mississippi River and Lake Pontchartrain

AN INDUSTRIAL water terminal along a new navigation canal through the city is being built at New Orleans, La., by the controlling port authority, known as the Board of Commissioners of the Port of New Orleans. The project is unique in its construction and remarkable in its engineering design and in the rapidity with which it is being put through. When it is completed New Orleans will have, well within the city, ocean docks and industrial sites on deep, still, practically fixed-level water, accessible to rail, highway and ocean-going traffic. The long-standing impediments to waterway development imposed by the variable level of the Mississippi will be removed.

The canal, nearly six miles long, will have a depth of 30 ft., a bottom width of 150 ft., a water-level width of 330 ft., and will extend from the Mississippi River to Lake Pontchartrain. In its ultimate development it will be provided with industrial basins and ocean docks all along its length and have a lock with 30 ft. over the sills, a usable length of 600 ft. and a usable width of 75 ft., to preserve the canal level at that of the lake, which varies only a foot or so. The Mississippi has a flood variation of nearly 20 ft. at New Orleans.

The inner harbor and canal project has quite a long history. Its need grew out of two things: the system of Government control of the riparian property under the laws of the State of Louisiana and the physical disqualifications of the Mississippi River as a terminal harbor or for industrial sites requiring water entrance. Under the laws of the state the banks of all navigable rivers are public, and the riparian proprietor can never acquire a complete dominion over the river front, but holds the property subject to the right of public use. This rule has descended from the earliest settlement of Louisiana, all French and Spanish grants having been made with this reservation. Furthermore, in municipalities of more than 5000 population, the Louisiana constitution requires that before the riparian proprietor can erect any structures on the river front he must obtain the joint consent of the Levee Board and the governing authority over the public wharves. In certain court cases it has been specifically stated that private lease of the river front gives only a temporary use. Naturally, under such a law large private interests are reluctant to attempt any extensive construction along the Mississippi River, and while the public control of the waterfront has in every other way been most desirable, it has served to restrict private construction.

Even if this law were subject to repeal or to constitutional amendment, the physical conditions of the Mississippi prevent any extensive use of its banks for industrial purposes. The river varies in its stage between +20 and +39 (Cairo datum), and the main part of the city of New Orleans is at El. 20 to 22. All river property, therefore, has to be leveed and is subject to the danger of overflow with loss of plant and property by the encroachment of the river. Furthermore, it would be necessary to locate any riparian plant far back of the levee and the wharves well out in front of the levee, requiring considerable expense in the handling of material. Any wharf or dock built in the river, too, must be designed to take care of material over this large range of water level and must, at the same time, be of sufficient stability and strength to stand the strain of the swift current of the river or of the drift accompanying the floods.

To avoid these two difficulties, the legal and the physical, it was proposed many years ago to cut through between the Mississippi River and Lake Pontchartrain a wide canal and to utilize the banks of that canal as a still, fixed water terminal. The matter was brought to a head by the crisis of the war and the obvious desirability of locating nearer New Orleans some of the many shipbuilding plants which had to be put up in the United States in a short period.

Consequently, early this year commercial bodies in New Orleans got together and guaranteed the purchase of bonds for the construction of an inner harbor and canal, to be issued by the Board of Commissioners of the Port of New Orleans under an act of the state

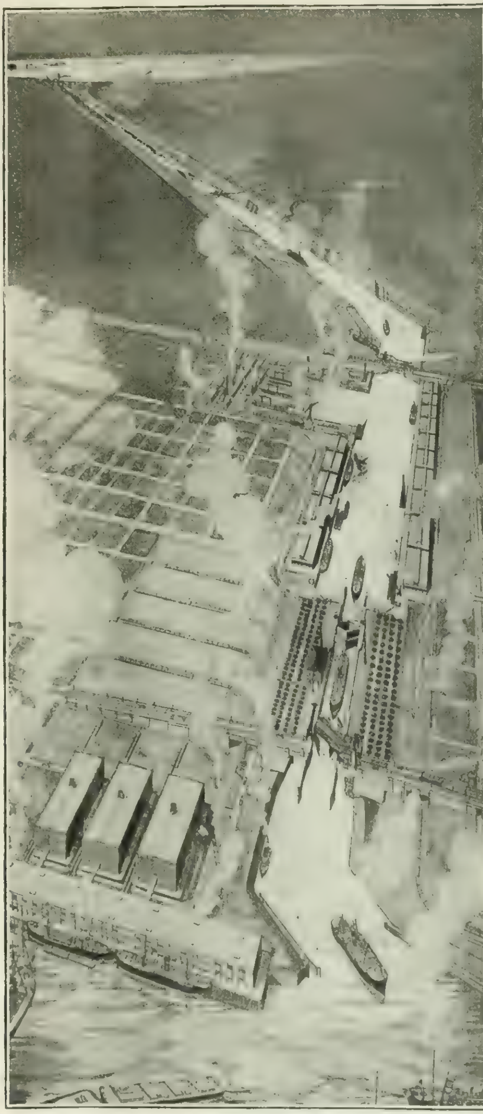
legislature of July, 1914. These bonds, to the sum of $6,000,000, bearing interest at 5%, have been sold, or are being sold, and work on the canal has been started. The United States Government was not asked for any assistance in the matter, except to permit the issue of the bonds. Under the act of 1914 the port commissioners, a state body, were authorized to construct and operate the canal and inner harbor, the location to be fixed upon to lie within the City of New Orleans, and the construction to be approved by the city and by the Board of Levee Commissioners of the Orleans Levee District and by the State Board of Engineers of the State of Louisiana. The Board of Commissioners further receives the right of expropriation of any property, although this right has not generally been exercised because it has been possible to purchase the property on the basis of reasonable valuations. The project is known officially as the Inner-Harbor-Navigation Canal of the Greater Port of New Orleans.

The location of the canal and inner harbor is shown in the accompanying drawing and a general sketch of the work is shown in the perspective sketch. It consists, as there shown, of a 30-ft. deep canal cut on 1 on 3 slopes through the alluvial soil of New Orleans from the Mississippi River to Lake Pontchartrain. The typical section has a bottom width of 150 ft., and a water level width of 330 ft. The trace of the canal, 5⅜ miles long, is practically on two tangents, although there is a comparatively short turn at the river in order to permit easy access into the down current there. The width of the canal is sufficient to allow two ocean-going steamers to pass side by side, but it will be noticed that provision is made in the 2000-ft. restricted area extending 1000 ft. on either side of the center line of the canal for the diagonally placed ocean slips 225 ft. wide, 650 ft. long and 225 ft. apart. These also serve in lieu of turning basins; that is, a vessel in one of these slips backs out into the main channel and over into the opposite slip in order to turn to go out of the canal the same way in which it entered. The perspective also shows warehouses along the canal near the locks.

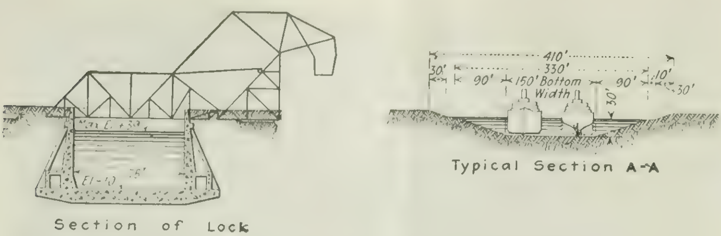
The canal is crossed with four bridges, one of which is at the head of the lock. These bridges each carry two-track railroad lines, two electric car lines, two highways, and two sidewalks and are to be of the Strauss bascule type. In addition, the canal crosses the main outfall drainage canal of New Orleans, which is to be carried under the ship canal at Florida Ave. in a reinforced-concrete siphon, designed for a flow of 2000 second-feet.

The lock is a remarkable structure. Rock here is about 1800 ft. below the surface of the ground, and the soil is extremely low in bearing value. The lock, therefore, had to be designed as a floating structure. A general outline of it is shown on the accompanying drawing. It has reinforced-concrete side walls which act as slabs, the water pressure being transmitted to the base through diagonal struts at the top, and portal box bracing of concrete at the bottom. The base, a thick concrete slab, rests on closely spaced piles driven within a sheet-pile cofferdam with a plan area somewhat larger than the plan area of the base of the lock.

The lock will have several double-skin flotation gates similar to those at Panama, but will be provided with gates mitering in either direction at each end of the lock in order to take care of the reverse pressure of the water due to the variation in the level of the lake and the river. As has been stated before, the river varies between +20 and +39 and the lake between +20 and +26. The pressure, therefore, may vary between 6 ft. against the river to 19 ft. against the lake. In addition to these gates taking pressure in either direction, the lock is provided with exceptional safety protection, because in certain relative stages of the river and lake the failure of the lock gates would precipitate a flood on a large area of the City of New Orleans, by way of the canal. The bridge across the head of the lock is



ARCHITECT'S PERSPECTIVE LOOKING FROM RIVER OVER CANAL AND INNER HARBOR TOWARD LAKE



SECTION THROUGH LOCK AND EXCAVATED CANAL

interlocked with the gates to form a barrier against ships, and there is in addition a revolving bridge mounted on the lock wall which will permit the ready placing of caissons across the lock in case of failure, in a manner similar to the stop log method, as commonly used on a smaller scale.

Long-time leases will be made between the Board of Commissioners of the port and concerns desiring to locate themselves inside the harbor area. Already two shipbuilding companies have located in the site.

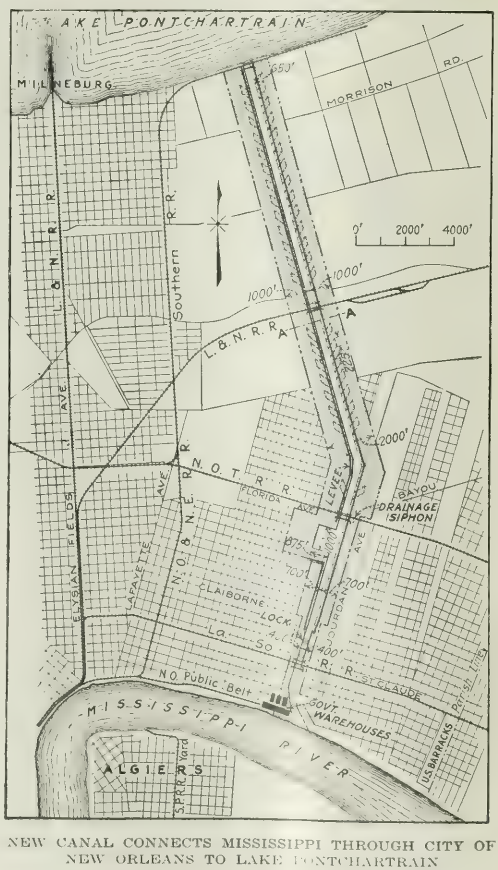
The Foundation Co. of New York has leased the rectangular plot of ground lying just south of Florida Ave. and is already far along on the shops and shipways in which it is to build steel ships for the French Government. A basin 1000 ft. long by 875 ft. wide is to be opened from the canal at this site. At the Lake Pontchartrain end of the canal the firm of Doulutt & Williams has a shipyard in which ten 9600-ton steel cargo vessels for the Emergency Fleet Corporation are being built. The waterway is just reaching both of these plants and it is expected that the latter plant will have sufficient water to permit the launching of its ships sideways into the canal by the time they are ready. These ships will be taken out via Lake Pontchartrain, which has a usable channel of 14 ft., to the ocean. The Foundation Co.'s ships will be launched into the open basin which is being dredged immediately in front of its yard, and may be taken out to sea through Bayou Bienvenu, which temporarily enters the canal about 1000 ft. below the shipyard.

At the Mississippi River entrance to the canal commodity warehouses shown in the perspective have just been started and have been taken over by the United States Government for use as quartermaster stores. The whole canal area, as shown in the drawing, and better in the ideal view of the perspective, is tied up to the belt line railroad of New Orleans, which connects with all of the railroads entering the city.

While it is intended that the canal will be used mainly as an inner harbor, the possibility of its use as a trafficway has also been considered. The route from New Orleans to New York will be shortened 160 miles by the use of the canal and Lake Pontchartrain. At present there is only 14 ft. of water along the inland section of this rout, as compared with the 30 ft. which can be had down the Mississippi to the Head of the Passes.

Construction is being carried on under force account by the Board of Commissioners of the Port of New Orleans of which W. B. Thompson is president and J. Devereux O'Reilley is chief engineer. A report was made on the general project to the board, at the time of the constitutional amendment following the act of 1914, by Ford, Bacon & Davis, consulting engineers. The present location of the canal follows somewhat one of the location indicated in this earlier report. The design under construction was made and the construction is in charge of the firm of George W. Goethals & Co., consulting engineers, New York, and is under the direct charge of George M. Wells, a member of the firm, as consulting engineer. Henry Goldmark, designing and consulting engineer, is in charge of detailed designs of gates and machinery.

Speed is of the essence of the work. Normally, it is about a three years' job, but it is hoped to complete the whole work in 18 months. Work was started May 20, when hydraulic dredges were brought into Lake Pontchartrain and commenced digging toward the river. It is hoped to have the entire channel from the lock location to the lake completed by January, 1919, and the lock completed by a year from that time. Already five



NEW CANAL CONNECTS MISSISSIPPI THROUGH CITY OF NEW ORLEANS TO LAKE PONTCHARTRAIN

hydraulic dredges are working at various points along the canal, having been brought in from Lake Pontchartrain and also through Bayou Bienvenu, which is near enough so that the dredges can dig themselves to the canal. After the lock is completed the short section between the lock and the river will be opened and the canal completed. The total cost at present is estimated to be about $6,000,000.

Derrick Car Places Deck Slabs of Concrete Bridges

Railway Has Powerful Machine for Handling Heavy Construction on Concrete and Steel Bridge Work

FOR handling and placing the heavy deck slabs of reinforced-concrete subway bridges on the Chicago track-elevation work of the Illinois Central R.R., the railway uses an exceptionally large derrick car. These slabs weigh from 18½ to 33½ tons. The derrick, which forms a part of the equipment of the bridge department of the railway, is of steel construction, with heavy plate-girder sills. It is 50 ft. long and weighs about 100 tons. The front end is carried by a special Bettendorf truck of 150 tons capacity, placed directly under the A-frame. A 50-hp. engine at the rear of the car operates the hoists and also operates a chain propelling gear which gives a speed of 12 miles per hour. The engine and boiler space is inclosed by folding panels when the machine is not in use. Fuel and water are carried in a tender coupled to the rear of the car. Box-girder construction is employed for the A-frame. This is mounted in shoe plates over the truck bolster, so that for transportation it can be laid back in an inclined position over the deck of the car. A central steel tie or tension member, which is anchored to the deck framing of the car, takes the strain of the load in hoisting.

DERRICK CAR WITH TIMBERS UNDER A-FRAME PLACES DECK SLABS FOR SUBWAY BRIDGES

A-FRAME OF DERRICK CAR HAS HINGED TENSION MEMBER AND SPUD TIMBERS UNDER CAP

Pin-connected joints in this member enable it to fold up as the A-frame is lowered. A T-shaped head is a special feature of the A-frame. This provides for supporting timbers or spuds which are set on blocking and wedged tightly against the head, thus relieving the load on the car frame and truck when the boom has to make a side swing, as in taking the slabs from the cars. The height from the rail to top of the A-frame when raised is about 28 feet.

Box-lattice girder construction is used for the boom,

the side members being built-up fish-belly girders of channel section, with double lacing inside the top and bottom flanges. The lacing is replaced by solid plates at the middle, where a bolted joint provides for placing a removable section 12 ft. in length. The normal length of the boom is 50 ft., with a hoisting capacity of 25 tons on a reach of 35 ft. There is also a 67½-ft. boom, with a lifting capacity of 50 tons on a reach of 30 ft. For work where the loads do not exceed 35 tons an A-frame of lighter construction is used. During transportation the boom is lowered to rest upon a heavy timber horse on a flat car coupled ahead of the derrick car.

The ponderous hoisting blocks and tackle are a striking feature of the equipment. The blocks weigh from 1 to 1.3 tons each. For the main hoist there is a six-part tackle with ⅝-in. wire rope in heavy steel blocks. The lower block carries an immense hook. The upper one is suspended by bar links from the head of the boom. For the topping lift there is also a six-part ⅞-in. tackle, rove through blocks attached by bars to the head of the boom and the cap of the A-frame. In handling the slabs, a wire-rope sling is used. This has a shackle which is placed on the main hoisting block, while the ends of the sling are attached to stirrups embedded in the concrete.

This derrick car is used in erecting heavy steel structures as well as in the handling of the concrete slabs noted above. The information contained herein has been furnished through A. S. Baldwin, chief engineer of the Illinois Central Railroad.

War Burdens of Water-Works of United States Increase

From a Report to the Executive Committee of the American Water-Works Association, Made by Leonard Metcalf, George A. Johnson and George W. Fuller

Returns from about fifty municipally and corporately owned plants indicate that labor costs were 13% higher in 1916 and 27% higher in 1917 than before the war, while labor has decreased 25 to 35% in efficiency. Construction costs have more than doubled. Coal and fuel oil for water-works operation have also more than doubled and chemicals have gone up 50 to 100%. Normal annual increase in revenue has generally declined. Net revenues, available for capital charges and profits, have remained about stationary, as a rule, instead of showing substantial increases, thus indicating that new investment is not being taken care of and that the divisible revenue is declining.

WATER-WORKS have suffered large increase in construction, operation and maintenance costs, due to war conditions. Marked decline in net revenue has resulted.

These conditions began to be generally felt late in 1916, but it was not until the latter part of 1917 that they became serious. Water-works employees were true to their tasks; the desirability and continuity of their employment tended to stay the advance in their wages, which lagged behind the general advance in wages paid to labor, by a period of eighteen months, more or less. Men working in contractors' forces, in munitions and allied works, had long enjoyed very substantial and, in some war industries, abnormal increase in wages, before the increase came to water-works employees.

But the advance in labor cost to American water-works has gathered force in the last six months, and it is the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held. It is certainly undesirable to replace old well trained forces, familiar with these properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer. Serious and conscientious effort has been made by water-works operators generally to reduce construction and operating forces and expenses to a minimum. These reductions have in many cases gone beyond desirable limits, even to reducing the working efficiency of the properties.

The general situation is a very serious one, from the point of view of the public, and an anxious one for the managers of water-works. Already it has shown itself in increasing difficulty, and in many cases impossibility, of attracting capital to water-works for necessary betterments. Moreover, it is inevitable that the Capital Issues Committee will scrutinize more and more closely the diversion of funds to water-works needs, particularly where those needs are not involved by governmental activities.

Pressure will doubtless be brought to bear to force communities to husband their water supplies, by reducing waste, leakage, and even unnecessary consumption, in order to curtail unnecessary investment in plant thus made necessary. No doubt, here as abroad, there may come a time when the smaller works will be unable to extend their service during the duration of the war, unless government needs be concerned, but it would be most unfortunate if the activities of an important city or of communities with manifold industrial and commercial industries were to be thus circumscribed.

The menace of the situation lies in the increasing difficulty, under such conditions, of maintaining constantly a water service, safe from a sanitary standpoint, necessary for good fire protection service, and adequate to

TABLE I PRICES PAID FOR CAST IRON PIPE IN SEVEN CITIES, F.O.B. DESTINATION, TONS OF 2000 LB.

	1915		1916		1917		1918	
	Tons	Weighted Average Cost	Tons	Weighted Average Cost	Tons	Weighted Average Cost	Tons	Weighted Average Cost
Chicago, Ill.......	27,765	$21.86	20,681	$27.54	15,255	$34.95		
Columbus, O	2,606	21 50	950	30 51	1,238	43 23		
Cincinnati, O	8,500	22 37	4,592	27 71	4,179	41 26		
St. Louis Mo	2,626	22 93	1,764	[illegible]	998	62 00		
Terre Haute, Ind.	47	21 28	357	[illegible]	37	54 35		
Evansville, Ind....	801	21.00	1,152	25 52	676	38.25	...	......
Weighted average of 6 cities.......	.....	21.82	......	28.47	......	45.67		
Indianapolis, Ind	2,150	21 38	1,794	25 58	2,046	45 88	113	$54 78

industrial, commercial and domestic needs.

It appears clear that average pre-war prices will never again be realized and that the purchasing power of money has declined permanently the world over, as a result of the war, and will never be fully recovered. Present prices, which on most water-works materials are double pre-war prices and on labor 25 to 50% greater, will probably not hold permanently after the war. Nevertheless, the old prices for materials and labor will not return as a whole.

Replies received from various municipally and corporately owned properties in this country, show the rapid change in conditions facing water-works in this country from the years 1914 and 1915, which reflect the pre-war conditions, to the early part of the year 1918. All evidence available points to yet more trying conditions for the future.

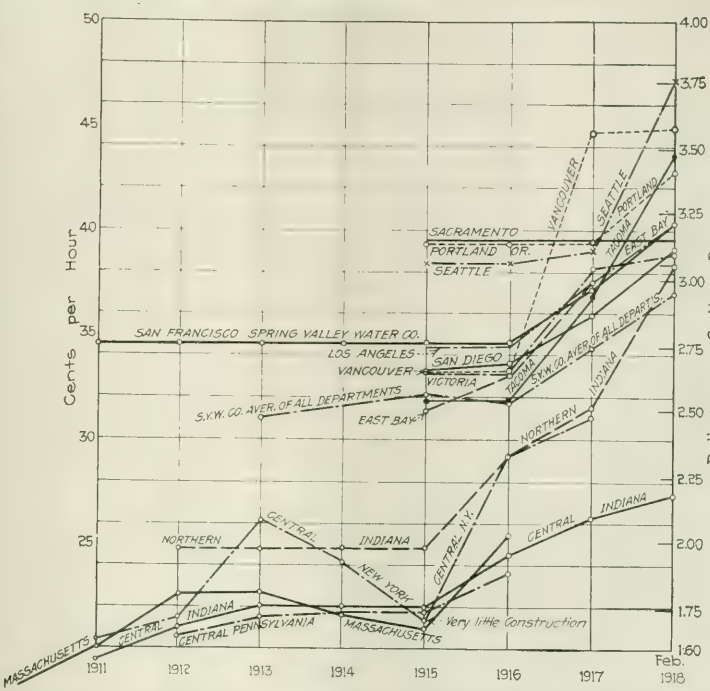


FIG. 1. LABOR COSTS PER MAN-HOUR PAID BY AMERICAN WATER-WORKS

For the works in the West the curves are based upon the actual average cost per man-hour of a gang of 50 men comprising foreman, subforeman, 4 calkers, 6 pipe layers, blacksmith and 37 laborers. For Indiana and the remainder of the East the curves are based on the actual gangs used. No allowance is made for the very serious loss in comparative efficiency of labor of which all making reports speak

The yearly average cost in cents per hour of unskilled labor to 44 American water-works, arranged in four local groups, indicate an average advance over pre-war prices prevailing in 1915 of 13% in 1916 and 27% in 1917, the fragmentary figures submitted for the opening of 1918 showing materially greater increase. It is important to note that comparison of past and present wage scales does not tell the whole story of increase in cost of labor to water works. Unfortunately, there has been marked decrease in efficiency. Your committee has made personal inquiry concerning this, within the last two months, from the managers of municipal as well as of corporate works, from the Pacific Coast to the East, and from the North to the South. In all cases, decrease in efficiency was reported. The estimates of percentage loss in efficiency, comparable with the efficiency of 1915 and prior thereto, varied from 20 to 50%. The consensus of opinion seemed to range between 25 and 35 per cent.

TABLE II WEIGHTED AVERAGE COST OF CONSTRUCTION MATERIALS TO THE INDIANAPOLIS WATER CO., 1915, 1916, 1917 AND THREE MONTHS OF 1918

Item	Unit	1915	1916	1917	1918 Three Months	Increased 1917 or 1918 Over 1915, Per Cent
Cast-iron [illegible]	Ton	$21 38	$25 58	$45 88	$54 78	156
Cast-iron [illegible]	100 lb	2 502	2 75	4 19		67
Pig lead	100 lb	4 469	6 555	10 77		141
Jute	100 lb	6 50	7 75	10 50		61
Valves [illegible]	Each	11.25	13.88	18 77		67
Valves [illegible]	Each	33 00	39 33	52 50	63 00	91
Valve [illegible]	Each	1 60	2 03	2 35	2 72	70
Hyd[illegible] and steamer	Each	33 50	39 44	54 77		63
Corporation [illegible], ½-in.	Each	32		713	84	162
Sto[illegible]	Each	63	75	91	1 27	101
Br[illegible]	1000	8 00	8 50	10 50	13 00	62
Pa[illegible]	1000	35 00				
C[illegible]	Bbl	1 80	1 959	2 207	3 00	66
M[illegible]	Each	6 99	8 40*	9 86	10 50†	50
[illegible]	Each	10 50		14 83		
1[illegible]	Each	14 00		19 50		
2 in.	Each	41 65		62 36	62 50†	
3 in.	Each	70 80		85 00		
Lumber [illegible]	M	26 00	33 00	37 50	44 00	69
Sand and gravel	Load					
Reinforcing steel	100 lb.	2.55	3 15	3 50	4 00	57

*Few purchases †Quotations.

It thus appears that the loss in efficiency of labor is practically equal to its increase in wage. The full increase in cost of labor, due to the combined effect of loss in wages and loss of efficiency, is approximately 50% in excess of the pre-war costs and nearly as much over those of 1916.

Similar data were gathered by one of the members of this committee, at a slightly earlier date, with reference to the advance of labor costs in different parts of this country. (See Fig. 1.)

[Further construction cost data are given in Tables 1, 2 and 5.—Editor.]

Turning now to important typical operating supplies, such as coal and alum, yet greater increase in price has taken place.

Coal. The prices paid for coal by 41 important water-works, indicate an advance in prices in 1916, 1917 and early 1918, over those prevailing in 1915, of approximately 15, 74 and 117%, respectively. It is interesting to note the variation in the different parts of the country. The East suffered in far greater measure

TABLE III. PRICES PAID BY THE SPRING VALLEY WATER CO. SAN FRANCISCO

Material	Price Normal	Price January, 1918	Percentage of Increase Per Item	Percentage of Increase Weighted Average
Oil, fuel, per bbl.	$0 70½	$1.45	106 0	
Oil, cylinder, per gal	.53	86	36 5	
Packing, flax, per lb	.40	.81	102 5	
Tubes, boiler, per ft	.32	84	162 0	99 5
Valves, rubber, per lb	.70	90	28 5	
Waste, cotton, per lb	09	15	66 5	
Oil, dynamo, per gal	36	.531	47 5	
Waste, cotton, per lb	09	15	66 5	50 0
Polish, metal, per gal	85	90	6 0	
Cheese cloth, per yd	03¾	10½	180 0	180 0
Hay, per ton	18 00	30 00	66 5	66 5
Copper sulphate, per 100 lb	5 50	10 75	95 5	95 5
Paint, per gal	65	1 10	69 5	69 5
Hay, per ton	18 00	30 00	66 5	66 5
Asphaltum, per ton	12 50	17 60	40 0	
Coal tar, per bbl	6 00	12 00	100 0	
Oakum, per bale	4 50	8.75	94 5	
Lumber, base	12 50	24 00	92 0	74 0
Nails, per 100 lb	2 35	4 70	100 0	
Paint, per gal	65	1 10	69 5	
Paint, per gal	65	1 10	69 5	
Lumber, base	12 50	24 00	92 0	85 0
Nails, per 100 lb	2 35	4 70	100 0	
Paint, per gal	65	1 10	69 5	69 5
Meter parts			20 0	
Fittings, brass, per lb	35	57½	64 5	
Fittings, galvanized	List less 85%	List less 65 and 10%	110 0	60 0
Covers, meters, per lb	03½	.06¼	78 5	
Leather, per lb	40	70	75 0	
Picks, per dozen	6 50	12 75	96 0	
Shovels, per dozen	11 00	18 50	68 0	
Cutters, pipe, each	1 50	2 75	83 5	
Stocks and dies, each	5 00	8 00	60 0	60 0
Wrenches, each	75	1 50	100 0	
Pipe, cast-iron, per ton	35 00	62 00	76 5	
Fittings, cast-iron, per lb.	03½	06¼	78 5	
Lead, pig, per lb	04¼	07	65 0	
Jute, per lb	06	12	100 0	
Coal, per ton	10 00	13 00	30 0	70 0
Picks, per dozen	6 50	12 75	96 0	
Shovels, per dozen	11 00	18 60	68 0	
Bars, crow, per lb	04	10	150 0	
Fittings, brass, per lb	35	56½	64 5	
Fittings, galvanized	List less 85%	List less 65 and 10%	110 0	
Pipe, galvanized, per cu ft	4 50	10 05	124 0	
Pipe, lead, per 100 lb	6 50	10 75	65 5	
Picks, per dozen	6 50	12 75	96 0	87 5
Shovels, per dozen	11 00	18 50	68 0	
Cutters, pipe, each	1 50	2.75	83 5	
Stocks and dies, each	5 00	8 00	60 0	
Wrenches, each	75	1 50	100 0	
Leather, per lb	40	70	75 0	
Office furniture			40 0	
Stationery			50 0	0 0
Printing			33 0	
Office furniture			40 0	
Stationery			50 0	
Printing			33 0	
Hardware, builders'			50 0	50 0
Shellac, per gal	1 28	3 20	150 0	
Janitor's supplies			50 0	
Lumber, per base	12.50	24 00	92 0	
Nails, per 100 lb	2 35	4 70	100 0	
Fencing, per 100 lb	2 65	5 55	109 5	80 0
Paint, per gal	65	1 10	69 5	

than the South and the West; the Central States in like measure with the Southern and Western states in the years 1916 and 1917, and in greater measure than any of the other groups in 1918. Incidentally, it may also be noted that the prices of fuel oil reported for one large plant in Louisiana and one in California show an advance in price in the opening of 1918 of approximately 150% over those prevailing in 1915.

Unfortunately, in coal as in labor, the advance in unit prices does not reflect the entire increase in cost, inasmuch as decline in quality of the coal has been very generally observed. Effort was recently made to obtain exact information upon this subject by the Indianapolis Water Co. through a study of the relative coal consumption per million gallons of water pumped during the past two years, or thereabouts. The results of this study indicate a decline in quality of the coal of from 10 to 15%, broadly speaking. The results are characteristic, rather than precise.

Carleton E. Davis, chief of the Bureau of Water of Philadelphia, reports that at one of their main pumping stations the increase in coal consumption during the past twelve months or so was 17.3% per million gallons pumped, because of the inferior quality of the coal. At other stations a change in the type of pump or character of fuel used makes a comparison impossible.

Advance in price of alum. The record of prices paid by water-works for alum, in cents per pound, is interesting and significant. It is to be borne in mind, however, that it reflects the leveling effect of long-time contracts under a rising market. This is indicated by comparison of the prices submitted, with the average New York market prices, quoted from the *Journal of Industrial and Engineering Chemistry.*

The figures submitted indicate an advance in 1916 and 1917 over the prices of 1915, of approximately 30 and 34%, whereas the advance in the New York market prices over the 1915 scale was 123% in 1916, and approximately 72% in 1917, the decline in the latter reflecting governmental control.

Some other operation supplies. Table 4 shows prices for sundry operating and maintenance supplies paid by the Indianapolis Water Co., 1915, 1916, 1917 and 1918.

Summary. In Table 5 are summarized the increases in cost of labor and materials, already referred to.

Water-Works Operation and Maintenance Costs

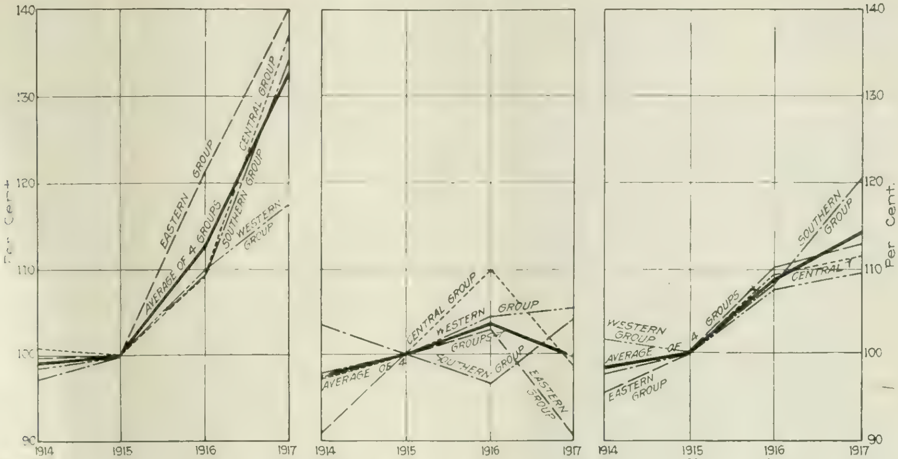
Returns were received from about fifty important water-works concerning their gross annual revenue, operating expense including taxes but excluding depreciation allowance, and the resulting operating revenue applicable to depreciation allowance, fixed charges, dividends and surplus. These records (see Fig. 2) indicate, as do the construction records, that no marked change in conditions was felt until 1916; that the gross annual revenues for 1916 and 1917 were respectively 6 and 9% in excess of those for 1915, but slightly more than those for 1914 on the basis of all of the records received, or 8.5 and 13.5% on the basis of the average of group averages. The normal advance in gross revenue, corresponding to the growth in population and in investment, would probably have exceeded 6% per annum and may have been substantially greater than this amount.

The increase in operating expenses over those of 1914-1915 was 6 and 19% for 1916 and 1917, respectively, on the basis of all the records received, and 12.7 and 32.6% on the basis of the average of the group averages.

TABLE IV. PRICES PAID FOR SUPPLIES USED IN OPERATION AND MAINTENANCE BY INDIANAPOLIS WATER CO., 1915, 1916, 1917 AND THREE MONTHS OF 1918

Item	Unit	1915	1916	1917	1918 Quotations	Per Cent Increase Over 1915
1. Coal	Ton	$1.45	$1 496	$2 439	$3.323	129
2. Alum	100 lb.	.861	936	1 479	1 939	125
3. Chlorine gas	100 lb.	......	12 50	12 50	15.00	20
4. Oil, engine	Gal.	.179	195	25	35	95
5. Oil, hp. cylinder	Gal.	.349	35	44	.555	59
6. Oil, lp. cylinder	Gal.	.234	25	34	.555	137
7. Oil, linseed oil	Gal.	0.84	0.78	0.97	1 50	78
8. White lead	100 lb.	7.50	9 80	11.50	12.25	63
9. Electric power	Kw.H.	.01 .0125	01 0125	.015 0175	.015 0175	50* 40*
10. Brass castings	Lb.	.22	35	45	.50	127
11. Special cast iron casting	Lb.	.0292	0 325	0 411	0522	78
12. Steel boiler tubes 4 inches	Ft.	.1675	2285	55	60	258
13. Printing bills	1000	.76	1 23	1 42	1 91	151
14. Heat (M. H. Lt. Co.)	Year	*Cont.*	*Cont.*	25%	Increase	25*
15. Rags (instead of waste)	Lb.	.05	06	.07	08	60
16. Gasoline	Gal.	.125	175	215	.25	100
17. Coal oil	Gal.	.07	08	10	12	71

*Exclusive of demand charges



	Operating Expenses and Taxes				Operating Revenue applicable to depreciation, interest, dividends and surplus				Gross Annual Revenue			
	1914	1915	1916	1917	1914	1915	1916	1917	1914	1915	1916	1917
(8) Western Group	98.6	100	109.9	117.4	103.6	100	104.3	105.3	101.7	100	107.3	109.5
(18) Eastern "	[illegible]	100	121.9	141.1	90.9	100	103.0	90.4	95.7	100	110.1	112.8
(10) Central "	[illegible]	100	109.3	137.3	97.3	100	110.0	98.5	98.3	100	109.1	111.4
(13) Southern "	[illegible]	100	109.7	134.6	97.9	100	96.3	104.0	97.7	100	107.5	120.3
(49) Average of 4 Groups	[illegible]	100	112.7	132.6	97.4	100	103.4	99.6	98.3	100	108	113.5

FIG. 2. PERCENTAGE OF (1) OPERATING EXPENSES AND TAXES (2) OPERATING REVENUE APPLICABLE AS STATED, AND (3) GROSS ANNUAL REVENUE OF 49 WATER-WORKS IN 1914, 1916 AND 1917, TO SAME FIGURES FOR 1915

Of the 49 works compared, 8 are in the Western, 18 in the Eastern, 10 in the Central and 13 in the Southern group of States. The increase in operating expenses and taxes and the decrease in operating revenue will be still more marked in 1918

The resulting operating revenues applicable to the depreciation allowance, fixed charges, dividends and surplus for 1916 and 1917, were respectively 6 and 2% in excess of those for 1915, all on the basis of the average of all of the records received; and 3.4 and 0%, respectively, in excess of 1915, on the basis of the average of the four group averages.

Broadly speaking, therefore, it appears that the increase in operating expense has substantially absorbed the normal increase in gross revenue and has left no revenue to carry the burden of additional investments. There is marked decline in revenue in the eastern group, however.

Interesting similar data on increase in operating expense of some of the more important water-works in the United States are given in Table 6.

Records received from 50 typically important water-works in the United States, indicate:

(a) That the advance in the cost of labor used by water-works in construction work during the past three years was approximately 13% in 1916 and 27% in 1917 over the pre-war costs in this country. These pre-war costs were fairly reflected by prices prevailing in the year 1915.

Material decrease in efficiency of labor has also been observed in all parts of the country, the consensus of opinion indicating an approximate loss in efficiency of from 25 to 35 per cent.

(b) The important water-works construction materials, pipe, valves, hydrants, etc., have more than doubled in cost.

The more important operating materials, such as coal and fuel oil, have also more than doubled and chemicals for the treatment of the water have advanced from 50 to 100% and more.

(c) The normal annual increase in revenue of the water-works of this country has in general decreased, except where war activities have materially increased the local market for water.

(d) The operating and maintenance expenses have increased approximately one-third, the increase in gravity works being of less serious moment generally, than in the pumping plants.

(e) The net revenues applicable to depreciation allowance, fixed charges, dividends, and surplus have, in general, remained about stationary, instead of increasing substantially from year to year, thus indicating that the new investment is not being taken care of, and that the divisible revenue is declining. The conditions vary markedly at individual plants and in groups, the Eastern group showing the most marked decline in net annual revenues. Unfortunately the conditions are growing more and more serious.

Conclusions

1. That the water-works of the United States have suffered, through war conditions, large increase in construction and operation costs.

2. That marked decline in net revenue has resulted.

3. These conditions did not begin to make themselves generally felt until late in 1916, and it was not until the latter part of the following year that they became serious. The desirability and continuity of employment tended to delay the advance in wages.

4. The advance in cost of labor used in extension and minor construction work, by water-works in this country, has gathered force in the last six months, and it is

TABLE V. SUMMARY OF DATA UPON INCREASE IN COST OF LABOR AND MATERIALS TO WATER-WORKS IN THE UNITED STATES AS REPORTED TO THE EXECUTIVE COMMITTEE OF THE AMERICAN WATER-WORKS ASSOCIATION, MAY, 1918

	Item	No. of Records	Prices Per Unit 1915	1916	1917	3 Months 1918	Per Cent Increase Over 1915 1916	1917	3 Months 1918
1	Unskilled labor*, c. per hr.								
	Western group	7	27.0	28.5	31.4	Still in-	5	16	Still in-
	Central group	12	21.7	25.3	26.9	creas-	17	24	creasing
	Eastern group	15	23.0	26.7	30.4	ing in	16	32	in all
	Southern group	10	17.9	20.6	24.5	all	15	37	groups
	Average of groups (4)	..	22.4	25.3	28.3	groups	13	27	
	Average of all	44	22.1	25.2	28.3		14	28	
2	Cast iron pipe, per 2000 lb.	21	$24.23	$30.70	$51.60		26.7	112.9	
3	6-in. valves	11	11.18	12.64	19.13	$23.20	13.1	71.1	107.6
4	12-in. valves	3	34.78	41.53	65.22	69.00	19.4	87.6	98.7
5	2-way hydrants	6	26.69	32.04	43.13	53.90	$20.1	$61.6	$102.0
6	Coal per 2000 lb.								
	Eastern group	13	2.98	3.80	5.96	7.04	27.5	100.0	136.3
	Central group	11	2.41	2.77	3.75	6.38	14.9	56.4	164.7
	Southern group	12	1.92	2.01	3.03	4.02	4.7	57.8	109.4
	Western group	5	3.97	4.37	6.31	7.89	10.1	58.9	98.7
	Average of groups (4)		2.82	3.24	4.77	6.33	14.9	69.2	124.4
	Average of all	41	2.62	3.04	4.52	5.69	15.3	73.7	117.1
7	Fuel oil, c. per gal	1	1.80	1.80	2.00	4.50	0.0	11.1	150.0
	Fuel oil, c. per gal	1	1.38	1.50	2.57	3.55	8.7	86.2	157.3
8	Alum, c. per lb.								
	Western group	2	1.14	1.21	1.51		6.1	41.4	
	Central group	5	0.91	0.91	1.25		0.0	37.0	
	Eastern group	9	1.12	1.72	1.48		54.0	32.7	
	Southern group	9	1.08	1.38	1.48		28.0	37.0	
	Average of groups (4)	..	1.06	1.30	1.43	......	23.3	35.1	
	Average of all	25	1.07	1.40	1.44	......	30.6	34.4	
	New York market price†	‡	2.08	4.63	3.57	5 mos. 3.15	123.0	71.6	51.4

*Note. It was generally reported that there has been also a marked decrease in efficiency of labor since the year 1914, variously estimated at between 20 and 50%; and that the increase in wages paid to labor by water-works had not kept pace with contract prices owing probably to the advantage of continuity of service.
†See *Journal of Industrial and Engineering Chemistry*. Note that 1915 price was an advance of 34% over the 1914 average price before the advances listed went into effect.
‡Average monthly prices.

the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held.

5. It is undesirable to replace old, well-trained forces, familiar with these water-works properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer and it would not be fair to labor.

6. Serious and conscientious effort has been made by water-works operators generally to reduce construction and operating forces to a minimum. These reductions have in many cases already gone beyond desirable limits, even to reducing the working efficiency of the properties. In other cases still greater economies are possible in better consumption of coal; waste reduction by increased use of controlling meters, pitometer surveys, and more frequent house-to-house inspection, and in quarterly instead of monthly meter readings of small meters.

7. The general situation is a very serious one and has shown itself in increasing difficulty of attracting capital for necessary betterments. While extension of service is likely to be increasingly limited with the conditions of war, it would be unfortunate, if the activities of important industrial and commercial centers, particularly those concerned in governmental activities, should be thus circumscribed.

8. The menace of the situation lies in the increasing difficulty under such conditions of maintaining constantly a water service safe from a sanitary standpoint, necessary for good fire protection service, and adequate for industrial, commercial and domestic needs.

9. Public service commissions and other regulatory bodies have already recognized the danger of the present situation to the public as well as to the utilities, and are likely at least to afford such relief as may seem to them necessary to maintain credit, but it is imperative for water-works operators to keep clear records, showing the actual change in conditions and prices of materials and labor, that these bodies may have incontestable proof upon which to pass judgment as to the necessity for relief.

10. It is imperative, in the interest of good service, that water-works operators of municipally as well as corporately owned plants, should anticipate their construction and operation needs, as far as possible, and should be careful to obtain the necessary priority orders, that the quality of the water and the service rendered may not be seriously impaired in the future for want of construction and operation materials and supplies.

TABLE VI. INCREASE IN OPERATING EXPENSES OF 29 AMERICAN WATER-WORKS

(Figures reported early in June, 1918, to F. C. Jordan, Secretary Indianapolis Water Co., showing increases in operating expenses during the past six months, as compared with the normal pre-war operating expenses.)

Increase Over Normal Operating Expenses

	Reported Increase, Per Cent.
Savannah, Ga.	20
Richmond, Va.	25
Milwaukee, Wis.	36
Brockton, Mass.	28.6
Champaign, Ill.	30
Nashville, Tenn.	25
Mobile, Ala.	30
Philadelphia, Pa.	35
Jamestown, N. Y.	56
Toledo, Ohio	32
St. Catherines, Ont.	25
Elmira, N. Y.	33
Worcester, Mass.	35
Paterson, N. J.	16
Cincinnati, Ohio	25
Springfield, Ill.	20
Springfield, Mo.	25
Springfield, Mass.	17
Peoria, Ill.	25
Jersey City, N. J.	15
Decatur, Ill.	35
Cleveland, Ohio	31
Des Moines, Iowa	47
Schenectady, N. Y.	20
Xenia, Ohio	33
Flint, Mich.	18
Providence, R. I.	52
Colorado Springs, Colo.	25
Atlanta, Ga.	40
Kansas City, Mo.	35
Dayton, Ohio	21
Lansing, Mich.	30
Average	29

[The complete report has been printed in pamphlet form by the American Water-Works Association, whose address is 47 State St., Troy, N. Y.—Editor.]

Small Municipal Garbage Piggery Built

Municipal piggeries for the utilization of garbage are increasing in numbers in England. At Sowerby Bridge a small piggery, built at the site of the refuse destructor after plans made by F. Wilkinson, acting town surveyor, was recently put in operation. It consists of four 8½ x 11-ft. pens together with a 9 x 12-ft. cooking house. The latter is fitted with a steam jacketed boiler of 24 U. S. gal. capacity which is supplied with steam from the destructor. The floors of all the buildings are of concrete. Portions of the floors of the pig sties are covered with wood laths for the pigs to lie on. An outdoor runway 30 x 80 ft. in area is provided. The London *Surveyor* states that the piggery was opened about July 1 with the modest number of 14 pigs bought by the town council.

15,000-Car Hump Yard Near Chicago Planned by Illinois Central Railroad

Terminal for Main-Line Trains, from Which Transfer Trains Will Serve Local Yards, Will Have Power-Operated Switches, Motor-Car Service for Car Riders and L.C.L. Transfer Facilities for 450 Cars Daily

ONE large and entirely new freight yard is to be constructed in the Chicago district of the Illinois Central R.R. to replace several small yards and to eliminate switching work in these yards. It will be made the terminal point for road engines and freight trains, all movements north of the yard being of a transfer and interchange character. The improvement includes a station for handling less-than-carload freight, gravity switching, and a system of motor-car service and subways for the use of the car riders in returning from the classification tracks to the switching humps. The Illinois Central has at present two large yards at Chicago, used more or less both as switching points and as terminals for main-line trains. The plan is to use these facilities in future as freight-collecting and distributing points, served by transfer engines operating between them and the new yard. These engines will also handle the transfer or interchange of cars between this yard and the yards of other roads in the Chicago district.

The new yard will be between Harvey and Homewood, just south of the city limits and about 20 miles from the company's city terminal station. It is to be known as the Markham yard, and it is expected that construction will be started this year.

The possibility of future electrification of the Chicago terminal lines was among the factors considered in the location and design. The general layout is shown in the accompanying plan, but this is subject to change in matters of detail.

Main Elements of Yard

The main facilities will comprise receiving, classification and departure yards for both northbound and southbound traffic, a transfer yard for handling less-than-carload freight, a car-repair yard and an engine terminal. The general plan is a long and narrow rectangular site, having a bulge or extension on one side in which the northbound classification unit is located. This arrangement was governed partly by right-of-way considerations and partly by the fact that the distance between the two towns is too short to admit of an entirely longitudinal layout. With the two sets of classification tracks placed side by side and the spaces between their ends utilized for the car-repair yard and the engine terminal, respectively, the total length is reduced, and a compact layout is obtained.

The yard lies entirely to the east of the four-track main line. It will be 18,400 ft. long between end switches, with an area of approximately 500 acres and a capacity of about 15,000 cars. It will provide for handling a total of 50 trains daily and switching a total of 5000 cars daily.

For northbound or inbound traffic there will be the following accommodations: A receiving yard with 20 tracks and a capacity of 2390 cars; a classification yard with 78 tracks for 2960 cars, and a departure yard with 20 tracks for 1950 cars. This last will be for transfer trains to the local city yards and interchange trains for delivery to other railways. The length of tracks will be from 3600 to 5100 ft. in the receiving yard (80 to 116 cars per track); 1500 to 3000 ft. in the classification unit, and 3600 to 4000 ft. in the departure yard.

For southbound or outbound traffic there will be a receiving yard with 20 tracks of 1950 cars capacity; a classification yard with 40 tracks for 2050 cars, and a departure yard with 20 tracks for 2070 cars. The receiving yard will be for transfer trains from city yards and for interchange trains from the terminals of other roads. The length of tracks will be from 3600 to 3800 ft. in the receiving yard; 1500 to 3600 ft. (27 to 80 cars per track) in the classification unit, and 4500 to 5300 ft. (100 to 118 cars each) in the departure yard.

Lengths and Numbers of Tracks

Difference of service accounts for the fact that in the northbound receiving and southbound departure yards the tracks are longer than those in the southbound receiving and northbound departure yards. The first two yards are for main-line or full tonnage trains handled by the road locomotives. The other two yards are for transfer and interchange trains of the Chicago local district, which naturally will be much shorter than the main-line trains. A considerable proportion of the northbound or inbound traffic is in coal, and there is a correspondingly large proportion of empty cars going south. The northbound or inbound main-line trains have from 80 to 110 cars, while the southbound or outbound trains have from 90 to 120 cars, the difference being due to the empty coal cars. Transfer trains will average 75 to 80 cars.

Difference in the number of tracks in the two classification yards is due to the same condition. The 40 tracks of the southbound yard are sufficient to provide for the outgoing main-line trains. The northbound yard has 78 tracks to provide for the greater number of classifications due to the wide distribution and consequently larger number of relatively short trains for the inbound Chicago district freight. The northbound departure yard will have ample capacity for the transfer service, it is believed, in spite of its relatively small number of tracks, as in many cases these trains will be taken direct from the classification tracks and will not need to be held in the departure yard. The greater length of the departure tracks will allow solid trains to be made up for delivery to other roads.

The 20 tracks in each receiving and departure yard represent the full development of the property or space available. It is planned to construct at present only 10 tracks in each receiving yard. This number, it is

estimated, will take care of any ordinary emergency, such as the blocking of the hump for a time up to six hours.

The arrangement of ladder tracks in the classification yards was worked out with a view to getting the shortest possible distance from the hump to the last switch on the ladder, at the same time eliminating every curve that could be dispensed with. Plans of various other yards were considered, but none of these had the arrangement here adopted.

Gravity switching has been adopted for the classification work. The profiles for the humps conform to the arrangement used in other gravity yards on this road, their design being based on the grades of the main line and the average loading in both directions. Consideration is given also to the elevation required for subways carrying tracks under the switching humps. The grades proposed for the humps and approaches are shown on the profile and in the accompanying table. They are connected by vertical curves 150 ft. in length.

GRADES FOR SWITCHING HUMPS IN MARKHAM

	Northbound	Southbound
Approach	1,900 ft. level	2,700 ft. + 1%
To summit...	500 ft. +2%	1,100 ft. + 2%
Summit.......	75 ft. level	75 ft. level
Accelerating ...	150 ft.—3%	400 ft.— 3.5%
Accelerating ...	400 ft.—2%	450 ft.— 1.5%
Along the leads	1,000 ft. 1%	800 ft.—0.75%

Each hump will have two switching tracks, the one for general use being equipped with a track scale. The other track is provided in order to eliminate as far as possible any chance of the hump being blocked entirely in case of derailment, damaged scales or other accident that would tend to delay the regular movement of cars from the receiving yard to the classification yard. The design provides for access from each of these two hump tracks to every classification track. The scale is located on the 75-ft. level stretch at the summit of the hump, so that the kick off or initial push given to each car as it is uncoupled will carry it over the scale to the accelerating grade. Each track scale will be of 100-ton capacity, with a table 50 ft. long.

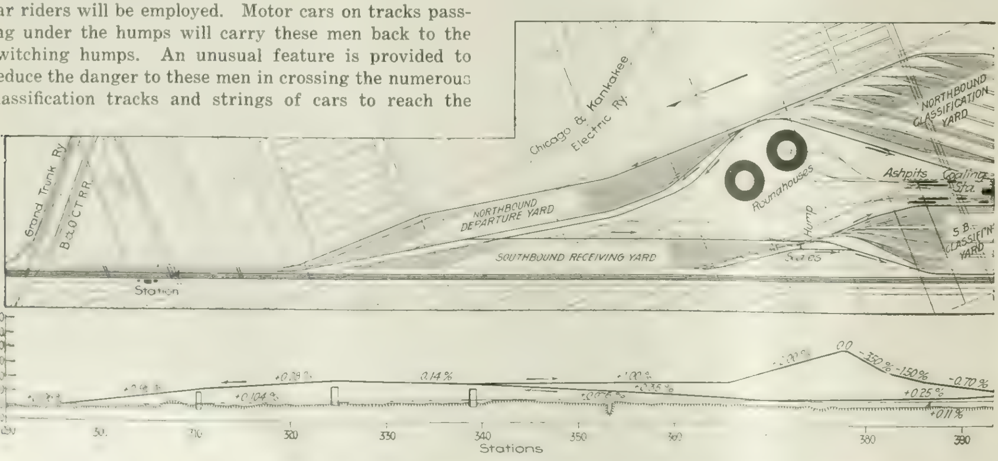
When the yard is worked at full capacity about 30 car riders will be employed. Motor cars on tracks passing under the humps will carry these men back to the switching humps. An unusual feature is provided to reduce the danger to these men in crossing the numerous classification tracks and strings of cars to reach the motor cars. This is the provision of concrete subways extending across the yard and made accessible by stairways at different points.

Spacing of all yard tracks will conform with the requirements of the Illinois Public Utilities Commission, noted in *Engineering News-Record* of May 31, 1917, p. 446; that is, a minimum of 13½ ft. will be used for body tracks and a minimum of 19 ft. for parallel ladder tracks, except that where switches are operated mechanically this latter spacing will be decreased to 17 ft. Tracks will be laid with 90- and 85-lb. rails. The turnouts will have 15-ft. switch rails and No. 8 frogs, on 1:8 ladders. No curves on yard tracks sharper than about 9° will be used.

Through interchange with the Chicago terminals of other roads, many cars entering the outbound or southbound classification yard will be destined for local yards of the Illinois Central north of this main yard. To provide for these there will be connecting tracks permitting such cars to be transferred by way of the lead from the south end of the southbound classification yard to rehumping tracks just west of the northbound receiving yard. Thence they will be passed to the northbound classification yard for arrangement in station order. It is intended that such movements will be made only from the most easterly two units of the southbound classification yard, as indicated by the plan. The two west units, on account of their length, will be used mainly for empty coal cars, empty box cars and grain cars for the South.

Northbound cars which need repair but which have been classified may be taken from the north end of the most easterly tracks in the northbound classification yard by a crossover connection between the switching lead of these tracks and an outer track. Over this track the cars may be moved south, passing under the hump, to the repair-yard leads located between the transfer station and the southbound departure yard. A second crossover connects the two repair-yard leads. From this point the cars will be switched into the south end of the repair yard.

Cars damaged to such an extent that it is not ad-



PLAN AND PROFILE OF PROPOSED MARKHAM YARD, FREIGHT TERMINAL TO REP
MAIN AND THOROUGHFARE TRACKS SHOW HEAVIER –

visable to pass them over the hump will be taken out of the south end of the receiving yard and over the repair-yard lead to the repair yard. When repaired, these cars may be pulled directly from the south end of this yard to the rehumping tracks west of the northbound receiving yard. Southbound cars requiring repair will be taken from the south end of the classification yard and passed through crossovers connecting with the two repair-yard leads.

Less-than-carload freight from local yards will be consolidated into full carloads according to destination and shipper, thus insuring full loads to cars in outbound main-line trains. For this service a transfer station is provided, having 12 tracks in pairs separated by five covered platforms 17 ft. wide and about 700 ft. long. This will provide for rearranging freight for loading about 450 cars per day. The Illinois Central has already a small layout on the same general plan, but the new design embodies several of the features of the large transfer station on the Pennsylvania R.R. at Northumberland, Penn.

Repairs to cars will be made on a group of 21 tracks, having a total capacity of 660 cars. The tracks will be 700 ft. long, and spaced 20 ft. on centers. For light running repairs there will be two tracks adjacent to each classification yard, so that a car can be hauled back and repaired and then again be passed over the hump for classification.

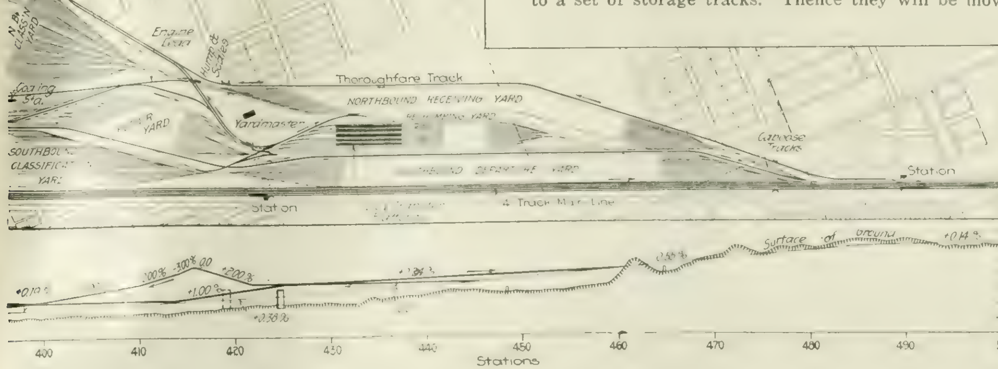
Repair shops and storehouses will be located near the yard. An icing station for the supply of ice to refrigerator cars will be placed east of and adjacent to the northbound classification yard. Piping for compressed air in the departure yards will provide for the testing of car brakes before the engines are coupled to the trains.

A thoroughfare track or engine lead passes on each side of each unit of the yard, except the west side of the southbound receiving yard. The tracks passing under the northbound hump are thoroughfare tracks, one of them to be used in moving cars from the northbound classification track to the transfer station or the repair yard. The track under the southbound hump is to allow southbound transfer locomotives to reach the locomotive terminal when it is impossible to use the regular inbound lead over the hump on account of the hump being occupied by trains.

Engine-terminal facilities will be provided sufficient for 40 road engines, 20 yard switching engines and 16 transfer engines. There will be two roundhouses, each forming a complete circle of 428 ft. outside diameter and having 40 stalls on tracks radiating from a 100-ft. power-operated turntable. The width of the house will be 114 ft. The coaling station will serve four engines at a time. Water will be pumped from the Calumet River to two elevated steel tanks and thence distributed to the shops and water cranes. For cleaning fires there will be two ashpits 320 ft. long. Inbound engines may sometimes be sent out again without going to the roundhouse. For this purpose a loop track of 626-ft. radius enables an engine to take coal and water and then pass to the outbound side of the yard, ready to take out a train.

Direct movement of inbound locomotives from the northbound receiving yard to the engine terminal is assured by a third track over the hump, so that these engines will not have to wait until the hump engine is clear of the regular switching track. This additional track is not necessary on the southbound hump, as an alternative means of access to the engine terminal is provided for the transfer engines which come in at the north end of the yard. This consists of the engine lead shown just west of the scale and connecting with the track which passes under the hump. Ordinarily the transfer engines will move over the hump and enter the south end of the engine terminal. In this movement they will use the lead or engine track provided specially for this purpose outside or east of the two light-repair tracks in the southbound classification yard. This lead connects with the corresponding lead over the northbound hump.

Gravity handling of main-line cabooses has been considered, but grade conditions seem to make this inadvisable, except that they will be delivered by gravity to the outbound trains. These cars are to be handled at the south end of the yard. When trains have entered the receiving yard the road engines will be cut off and sent to the engine terminal, and the cabooses sent to a set of storage tracks. Thence they will be moved

LACE SEVERAL SMALLER YARDS OF ILLINOIS CENTRAL RAILROAD AT CHICAGO — TRACK SCALES ARE LOCATED AT TOP OF EACH HUMP

to a small gravity caboose yard north of the southbound departure yard, and from this they may be dropped into the trains standing in the latter yard.

Electro-pneumatic operation of switches of the classification tracks is provided for, with control from towers built over the humps. The yard entrances will be equipped with electro-pneumatic interlocking plants, For lighting the yards there will be electric lights of 500 cp. on poles about 26 ft. high and spaced from 200 to 400 ft. apart.

Preparation of the site will include a considerable amount of filling, as it is to be elevated about 10 ft. above the street level. This will be done by contract. A number of long subways will be required to carry streets under the yard, and some streets will be closed and diverted in order to clear the property lines of the new yard. A few of the subways will be for pedestrians only. All will be of concrete construction, with decks of precast slabs.

The design of this terminal yard has been made under the supervision of A. S. Baldwin, chief engineer of the Illinois Central Railroad.

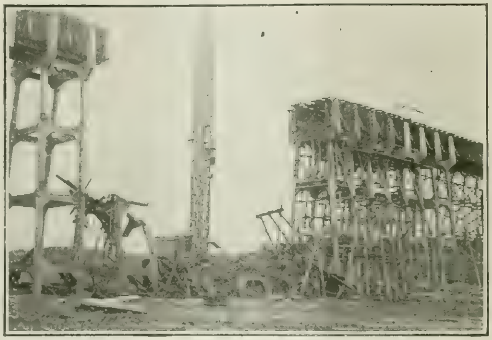
Temporary Timber Bents Rapidly Repair Destroyed Flume

Irrigation Trestle Being Replaced By Concrete Bents Collapses in Old Section But Is Soon Repaired

A 108-FOOT section of the high flume in the South San Joaquin Irrigation District system, California, collapsed during a windstorm on Feb. 19. The section destroyed was a portion of the old wood trestle 70 ft. high, the entire 2000-ft. length of which is being replaced a section at a time by a concrete structure, as described in *Engineering News-Record* of May 2, p. 869. A temporary wood section was put in place in 17 days.

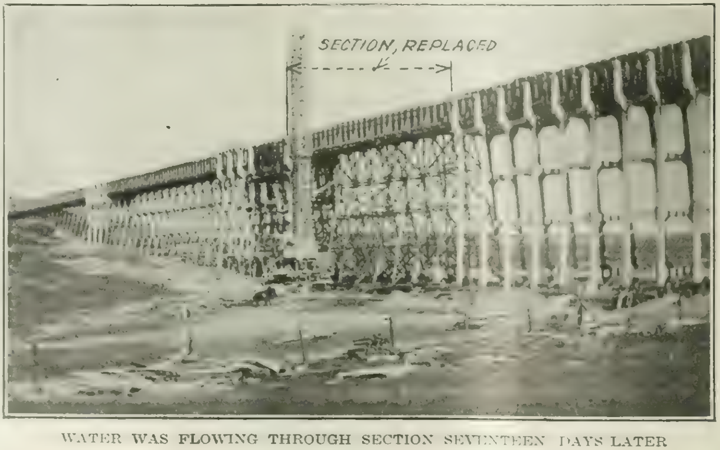
It has been suggested that the staging in the old flume may have increased the area exposed to wind pressure so that with only a light water load the longitudinal bending of the posts at the joints was more than the cross-bracing could withstand. It had been known for some time that the old wood trestle was insecure, however, and the section where the failure occurred was, in fact, under reconstruction at the time, having been selected as the weakest point in the flume.

When the break occurred, 125 sec.-ft. were flowing in the flume, which has a capacity of 1100 sec.-ft. Concrete replacement work was going on directly under the break, and some of the concrete which was still green was carried away by the sections that collapsed. It is notable that the break occurred between two sections of completed concrete towers, or bents, which stood firm under the impact of the water falling 65 ft. almost on the footings. Men were working on the trestle at the time it collapsed, but having the few seconds' warning given by the bending posts they escaped in safety by a narrow margin. The water was turned out of the flume by the dynamiting of a spillway gate above the trestle. At the section where the wood trestle collapsed three concrete towers had just been started, and the fourth had reached a height of about 25 ft. The impact of the falling timbers and water destroyed practically all of the green concrete work. The concrete work on the downstream side of the break had been completed just three days before the break, but it remained intact. Practically all of the members in the timber sections which collapsed were so broken up as to be unfitted for further use.



HIGH WOOD TRESTLE CARRYING FLUME BREAKS CLEAN FROM NEW CONCRETE SECTION

Nine bents spaced 12 ft. c. to c. were required to fill in the gap. The first four of these were framed on the ground in such locations that they needed only to be raised to a vertical position to rest on the concrete footings previously occupied by the bents that collapsed. After these four were in place and cross-braced, the other five were framed one on top of the



WATER WAS FLOWING THROUGH SECTION SEVENTEEN DAYS LATER

other on the ground in the remaining portion of the gap. A-frames were erected in the flume and a cable was strung across the gap. By means of tackle from this cableway, operated by the gasoline engine hoist on the mixer plant, the five bents were then raised to a vertical position one at a time and lashed to the concrete section. The last one was hoisted clear of the ground and shifted along the cableway to its footing 60 ft. downstream. In the same manner the other four were then shifted to their locations, 12 ft. apart.

These temporary bents were designed to permit of being replaced by the concrete supports with the minimum interference. The timber sizes in the temporary bents were the same as those in the original wood structure, except that 8 x 16-in. stringers, 32 ft. long, were put in, and twice the original amount of cross-bracing was used. Altogether, the repair of the break required about 50,000 ft. b.m. of selected pipe and redwood. Water was turned back in the flume 17 days after the day of the break. This time included delay, caused by bad weather, in asphalting and battening the seams. The force consisted of 25 men working 10 hours a day, and the cost of the work was about $4000.

The work has been carried out under the direction of R. W. Olmstead, chief engineer of the South San Joaquin Irrigation District.

Proportioning Concrete by Surface Areas of Aggregates

Tests Tend to Prove Theory that Concrete Strength Depends on Relation of Cement to Total Aggregate Area—Abstract of Paper Before American Society for Testing Materials

VOLUMETRIC proportioning of concrete is notoriously unsatisfactory. Many investigators have been studying other proportioning methods which will at the same time be practical and will insure a maximum strength of concrete with any given material. The latest of such methods and one which in the tests gives promise of some success is that devised by Capt. L. N. Edwards, U.S.E.R., testing engineer of the Department of Works, Toronto, Ontario, which was explained in some detail in a paper entitled "Proportioning the Materials of Mortars and Concrete by Surface Areas of Aggregates," presented to the American Society for Testing Materials at its annual meeting in June.

Briefly, Captain Edwards' principle is that the strength of mortar is primarily dependent upon the character of the bond existing between the individual particles of the sand aggregate, and that upon the total surface area of these particles depends the quantity of cementing material. Reduced to practical terms, this means that a mixture of mortar for optimum strength is a function of the ratio of the cement content to the total surface area of the aggregate regardless of the volumetric or weight ratios of the two component materials. As a corollary to his investigations, Captain Edwards also lays down the principle that the amount of water required to produce a normal uniform consistency of mortar is a function of the cement and of the surface area of the particles of the sand aggregate to be wetted. Some of the tests deduce the fact, already demonstrated in a number of previous tests, that strength of mortars and concrete is a definite function of the amount of water used in the mix.

In demonstrating the cement-surface area relation, the test procedure was as follows: First, a number of different sands were graded through nine sieves, varying from 4 to 100 meshes per inch, and the material passing one sieve and retained on the next lower was separated into groups. From each group, then, an actual count was made of the average number of par-

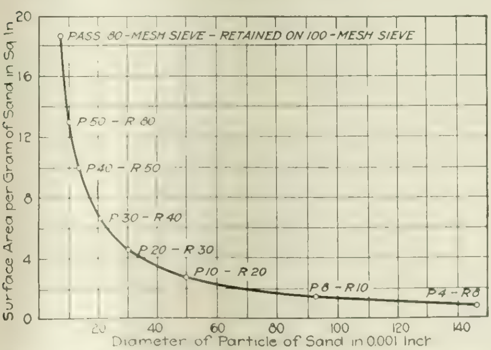


FIG. 1—SURFACE AREAS AND DIAMETERS OF PARTICLES OF SAND GRAINS OF DIFFERENT SIZES

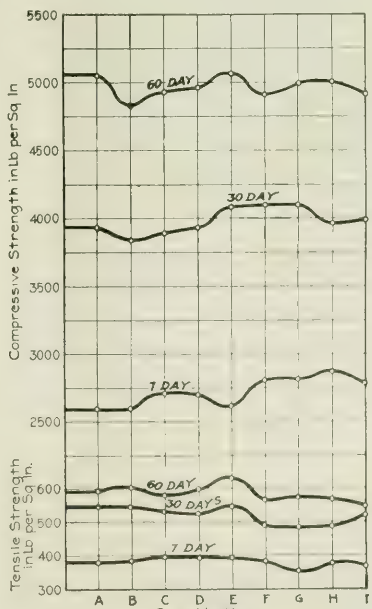


FIG. 2. STRENGTH TEST OF MORTARS OF SAME CEMENT-SURFACE AREA RATIO BUT DIFFERENT VOLUMETRIC PROPORTIONS

ticles of sand per gram. For the larger sizes 8 to 10 grams or more, medium sizes 3 to 5 grams, and for the smallest sizes ½ to 1 gram were counted. For six sands counted, including a standard Ottawa which is composed of grains passing a 20 and retained on a 30-mesh sieve, the following averages were obtained for the number of sand particles per gram:

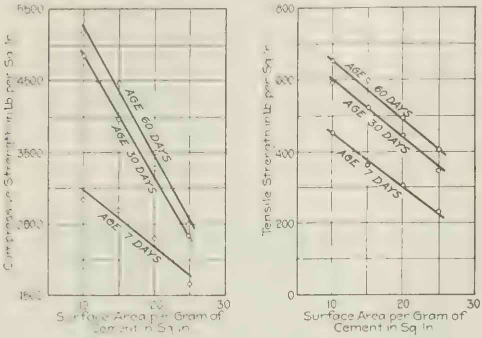


FIG. 3. STRENGTH TESTS OF MORTARS OF VARYING CEMENT-SURFACE AREA RATIO BUT SAME SAND

Passing 4, retained on 8	14
Passing 8, retained on 10	55
Passing 10, retained on 20	350
Passing 20, retained on 30	1,500
Passing 30, retained on 40	4,800
Passing 40, retained on 50	16,000
Passing 50, retained on 80	40,000
Passing 80, retained on 100	99,000

With a specific gravity of sand of 2.689, which had been determined by a number of tests, the average volume per particle of sand was determined for each group, and assuming that the shape of the particles of sand was spherical, which is approximately correct, the surface area per gram of sand was determined for each group. The results are shown in Fig. 1. This gave a basis of surface areas for the various groups of sand in hand.

The sands were then regraded to different granulometric analyses in order to get representative and different kinds of aggregate for the tests. Using these sands for the aggregate, numerous briquets and cylinders were made up and tested in tension and in compression, varying the mix according to the ratio of the weight of cement to the surface area of the sand aggregate. The bases of the ratio of grams of cement

TABLES SHOWING MIXTURES OF TEST MORTARS

Test Series No. 1 Cement Content—1 G.: 13 Sq.In.

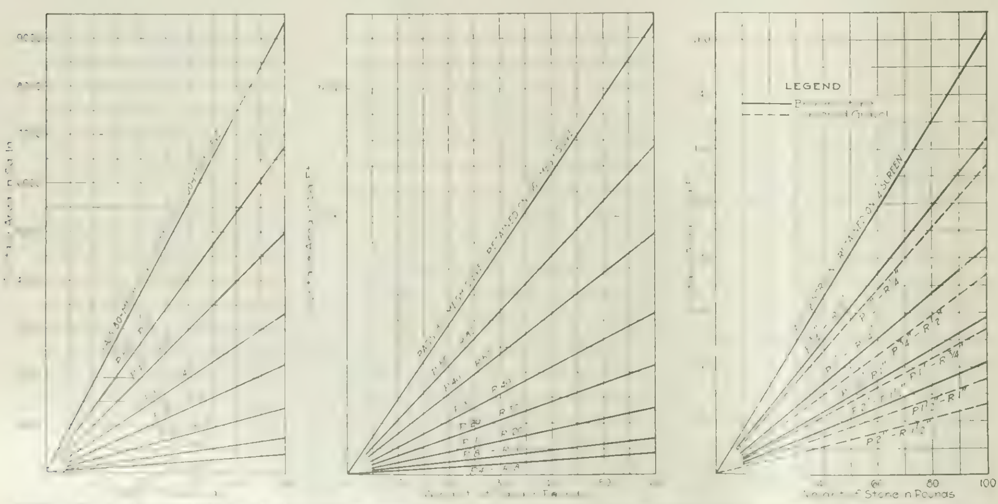
Sand Letter	Surface Area per 1,000 g., Sq In.	Cement, g.	Water, cc.	Ratio of Cement to Aggregate by Weight
A	5,856.6	450.5	128.0	1:2.22
B	5,106.1	392.0	111.5	1:2.55
C	7,683.7	591.0	134.5	1:1.69
D	6,758.4	520.0	148.0	1:1.92
E	12,816.4	986.0	280.5	1:1.12
F	6,769.1	521.0	148.0	1:1.92
G	4,182.0	321.5	91.5	1:3.11
H	6,564.6	505.0	143.5	1:1.98
I	6,564.6	505.0	143.5	1:1.98

Test Series No. 2 Cement Content—1 G.: 10, 15, 20 and 25 Sq.In.

Sand Letter	Surface Area per 1,000 g., Sq In.	Cement, g.	Water, cc.	Ratio of Cement to Aggregate by Weight
F	6,769	677.0	183.0	1:1.47
	6,769	451.0	132.5	1:2.21
	6,769	338.5	105.5	1:2.95
	6,769	270.5	92.5	1:3.61

to square inches of surface area were 1:10, 1:15, 1:20 and 1:25. The consistency throughout was controlled so that the water content would not affect the relative strengths of the different specimens.

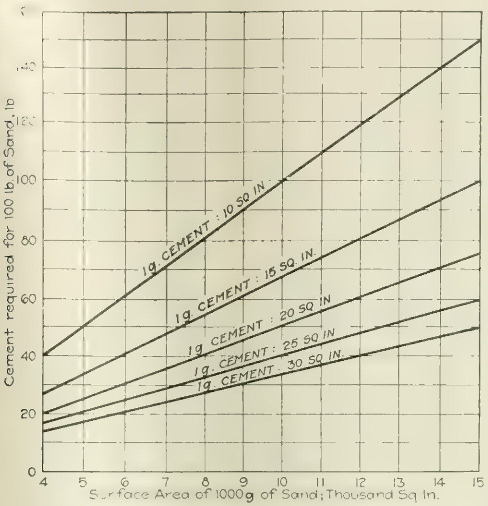
Test mortars were then made, first, by keeping the cement-surface area ratio constant and varying the kinds of sand; second, by varying the ratio and using the same sand. These two series are shown in the accompanying table. As will be noted from the table, in test series No. 1 the cement content is 1 gram per 13 sq.in. of surface area, but the sand has such a different grading and therefore total surface area that the ratio of cement to aggregate by weight varies from 1:1.12 to 1:3.11. In spite of this wide variation in weight and therefore in volumetric relation of the cement to the aggregate, the strength values, as shown in Fig. 2, were markedly constant. In series No. 2 the cement constant varied from 1 gram to 10 sq.in. to 1



[illegible] MADE UP FROM TESTS OF ACTUAL SANDS AND STONES FROM WHICH NEW METHOD OF PROPORTIONING MAY BE DEDUCED

gram to 25 sq.in. of sand surface, and, as shown in Fig. 3, the strength curves are proportionate to the cement-area ratio.

Further tests were made by Captain Edwards extending this investigation to concrete, and while these show the same general results, the tests were not sufficiently elaborate to warrant an abstract of them here.



CONVERSION DIAGRAM TO DETERMINE AMOUNT OF CEMENT TO GIVEN SURFACE AREA OF SAND

It might seem offhand that there is no practical application to the method. Certainly, the very considerable labor involved in counting 125,000 sand grains for one sieve group alone would deter anyone from contemplating such a program for practical work, if such a count had to be made very often. However, Captain Edwards points out that this elaborate counting is required only as a preliminary to his method and once done need not be repeated. He says:

"The adaptation of the surface area method of proportioning mortars and concretes to both laboratory investigation and field construction operation presents no serious difficulty. The outstanding feature of this method, in so far as its practical application is concerned, is the importance of knowing the granulometric composition of the aggregate. The securing of this all-important information involves a comparatively small amount of labor and by way of equipment the use of only the necessary scales, standard sieves and screens. The time element involved is comparatively negligible, since the computation work of determining areas and quantities of cement may be largely reduced to the most simple mathematical operation by the use of tables and diagrams."

Diagrams for Laboratory and Field Use

For use in the laboratory and in the field, diagrams drawn to a large scale increase accuracy and reduce labor. Fig. 4 is designed for use in determining the surface area of sand aggregate. It is intended for laboratory use. Fig. 5 is the same sort of diagram intended for both laboratory and field use. The diagrams are derived from information obtained in the tests. Fig. 6 is designed for use in determining the surface of stone aggregate, and is intended for both field and laboratory use, and Fig. 7 shows the conversion diagram for determining the relative quantity of cement in pounds per 100 lb. of sand, and the corresponding relation of cement in grams to the surface area of 1000 grams of sand, and vice versa. The author then gives the following example of how the diagrams shown in Figs. 4-7 may be used:

Example No. 1.—Required to find the composition of a batch of mortar using 1000 g. of sand A and a cement content proportioned: 1 g. cement to 15 sq.in. sand area.

SAND AREA

Sieve	Grading, per Cent.	Weight, g.	Area (Fig. 4), Sq.In.
P 4 - R 8	15 0	150	142
P 8 R 10	5 0	50	75
P 10 - R 20	25 0	250	694
P 20 R 30	15 0	150	676
P 30 R 40	15 0	150	997
P 40 R 50	10 0	100	992
P 50 - R 80	10 0	100	1,348
P 80 R 100	5.0	50	932
Totals	100 0	1,000	5,856

$$\text{Cement (g.)} = \frac{5856}{15} - 390\ 5$$

$$\text{Water (c.c.)} = \left\{390.5 \times 22.25\% \text{ (normal consistency)}\right\} + \frac{5856}{210} = 115$$

The author does not give anywhere what he considers to be the proper ratio of the cement to the sand surface area. That would presumably have to be determined by investigations of the aggregates involved in any case.

Complete Chicago-St. Louis Waterway

IMPROVEMENT of the Illinois & Michigan Canal between Lockport and La Salle, Ill., is now under way, and will provide the missing link in a waterway route between Lake Michigan and the Illinois River. Contracts were let in June for dredging, repair of locks and renewal of aqueducts. Much of this work has already been done, and it is expected that by September water may be turned in the entire length of the canal. West of Ottawa, until further dredging is accomplished, the water depth will be about 4 ft.; through other portions of the canal it will be 6 feet.

Boats 100 x 16½ ft. can pass the locks and when there is a 6-ft. depth of water the entire length of the canal from Joliet to La Salle boats can navigate with a draft of 4½ ft. A transportation line for the construction of power boats and barges to be operated on this canal has already been organized. The Government is reported to be interested in the construction of barges and power boats for the Illinois River and will probably include some boats of a size to go through the Illinois & Michigan Canal, so that shipments may be made directly between St. Louis and Chicago. From Joliet to Chicago the Chicago Drainage Canal would be used.

For this improvement the United States Government has allotted $150,000. The work is in charge of the United States Engineer Office at Chicago, under Col. C. S. Riché, Corps of Engineers, U.S.A. The Illinois Department of Public Works and Buildings is coöperating, through W. L. Sackett, state superintendent of waterways.

Railroad Utilizes Old Steel Spans in Road Bridges

High Cost and Uncertain Delivery of New Steel Leads to Economical Combination Design—Open Abutments Used

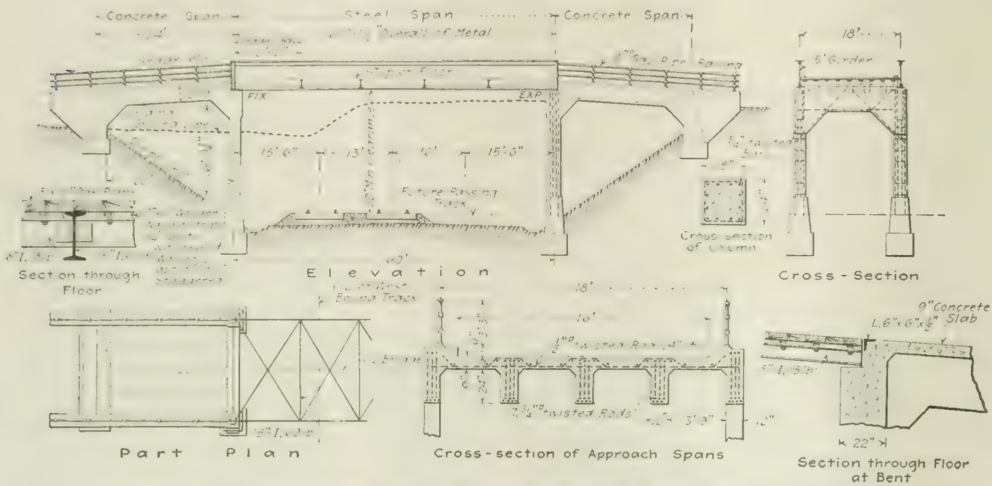
IN BUILDING five highway bridges on the Erie R. R. in Indiana, old steel railway spans were utilized to good advantage. The bridges were built in connection with the double-tracking of that part of the road, described in *Engineering News* of Feb. 8, 1917, p. 224. Four of the five bridges have concrete side spans over the slopes of the cut and one or two steel girder spans over the tracks; the other bridge has two steel lattice truss spans carried by the abutments and a center pier. Two and three tracks are spanned, and since, in consequence of revision of alignment and grade in double-tracking, the tracks were not in all cases close together or at the same elevation, the structures vary considerably in their span arrangement.

Conditions made it desirable to provide against delays in the construction of the bridges. Two of them were to be put in service shortly after the railway improvement was begun, and the others were required to be ready at fixed later stages of the work, so that prompt delivery of material was essential. Steel was uncertain in delivery and very high in price. Under these circumstances it was found most economical and satisfactory to cut apart and build over for these highway bridges several steel railway bridges which the company had released from its tracks as too light for heavy railway traffic. This bridge material was immediately available and was well adapted for the use made of it.

Although the roadbed at all five crossings was in cut, it was necessary to raise the grade of most of the highways on earth approach embankments either side of cut, in order to get 22-ft. railway clearance. To reduce the cost of these fills 6% approach grades were adopted, continuing onto the end spans of the bridges. In some cases transition grades of 2½% were introduced before the level portion of the center of the bridge was reached.

In the steel spans over the tracks the longitudinal girders are spaced 18 ft. on centers except in one case (16 ft.); the clear width between the 6 x 6-in. wheel guards is 2 ft. less. Floorbeams consisting of 15-in. or 12-in. I-beams are riveted between the webs of the girders. Diagonal lateral bracing is provided in each panel.

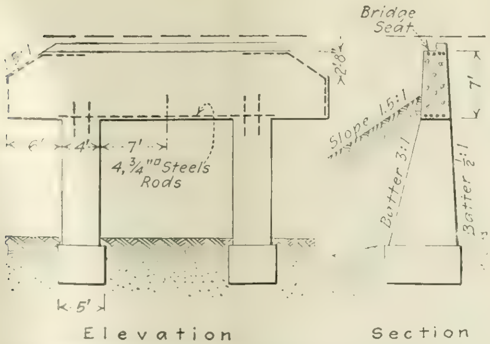
Timber floors were used on the steel spans, instead of concrete, to save in first cost and in time required for construction, as in some cases the second-hand girders would have had to be reinforced in order to carry concrete floors. When the wooden floors must be removed, they can be replaced with concrete if desired, without loss. No preservative treatment was applied to the wood.



HIGHWAY OVERCROSSINGS BUILT OF CONCRETE WITH STEEL CENTER SPANS

In one span (see drawing) steel stringers were used, on request of the town authorities. Wooden stringers were used in the others, being supported on shelf angles riveted to the webs of the floorbeam webs instead of being set on top, to make the floor as shallow as possible. In all cases the deck is of 3 x 10-in. long-leaf yellow-pine planks. At the ends of the steel spans, the ends of the stringers rest on timbers on the concrete bents or abutments. A sidewalk of 4-ft. clear width is provided at one bridge. To carry it, cantilever brackets are attached to the side of one girder; three lines of 4 x 8-in. wooden stringers support 2 x 8-in. floor plank.

Reinforced-concrete construction is used in the end spans on four of the bridges. It consists of a 9-in. slab on longitudinal beams 12 in. wide and 24 in. deep below the slab. The slab forms the wearing surface of the roadway and was made 1 in. thicker than required by the design, to allow for wear. A hardening liquid was also applied to the surface after the concrete had set. The beams are spaced 4 ft. 3 in. and 4 ft. 9 in. centers. They are reinforced longitudinally with seven ¾-in. square twisted rods. The slab has ½-in.



CONCRETE ABUTMENT HAS BRIDGE SEAT CARRIED ON PIERS EMBEDDED IN APPROACH FILL

square twisted rods spaced 4-in. centers transversely, and a few longitudinal rods to provide for temperature stresses only.

Concrete bents at the foot of the railway-cut slopes carry the spans. A typical bent, as in the bridge illustrated, has two columns each 18 x 24 in. and a concrete cross-girder 22 in. thick by 6 ft. 3 in. deep. Substantial concrete brackets are provided on the columns under the cross-girder and the outer longitudinal beams of the end span. The end of the concrete roadway adjoining the wooden floor of the steel spans is protected by a steel angle anchored by bent bolts.

Railings of 1½-in. gas pipe guard the side of the roadway, except where the longitudinal girders project 39 in. or more above the road surface.

At two of the bridges, where the tracks crossed are at different grades and considerably separated, each track is bridged with a separate span, the adjacent ends of these being supported on two square piers having a height of 37 ft. The other ends of the spans are supported on concrete abutments.

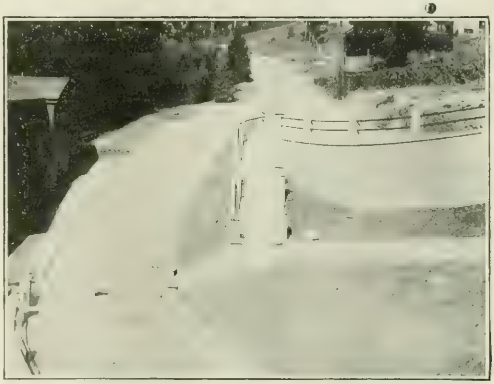
Abutments of an unusual form are used—open type, illustrated by sketch herewith. The type is standard on the Erie for use in highway bridges where the height from the roadway to the top of the original ground level at the face of the abutment is greater than 10 ft. The abutment consists of two or more piers built up to within about 8 ft. of the roadway and a reinforced-concrete capping beam which is anchored to the piers with steel rods. As the fill for the highway approach is made it runs under the beam and buries the piers. Considerable saving over the solid type of abutment is accomplished, under favorable conditions.

In the bridges described, 1:2:4 mix was used for reinforced concrete and 1:2½:5 for plain concrete. The columns and cross-girder of a bent were concreted in one operation, up to the underside of the concrete stringers, and the entire floor of the end span was placed in another operation. Care was taken to get a good surface and finish on the concrete and a good cover of concrete over the rods in the top of the floor slab.

While the designs were worked out for a live load, including a 12-ton road roller, and a distributed loading of 100 lb. per square foot, the bridges will carry 20-ton rollers with safety and thus should prove adequate for all probable traffic demands. They were designed by F. A. Howard, engineer of bridges. The work was under the general direction of R. S. Parsons, chief engineer, and R. C. Falconer, assistant chief engineer, of the Erie R.R. The concrete work was done by the Robert Grace Contracting Co., of Pittsburgh, Penn., and the steel spans were remodeled and installed by the railway company's forces.

Reduce Grades By Spiral Development of Hillside Streets

A SPIRAL street layout which is composed of curves and inclines, as shown in the accompanying drawing and view, avoids excessive grades in a steep hillside residence district of Berkeley, Cal. The 16-ft. roadway is partly in cut and partly on fill, the latter being supported by concrete retaining walls. At the top and bottom turns the width was increased to 25 ft. and 20 ft. respectively, and an outside radius of 20 ft. was used at the top, while 21½ ft. was used at

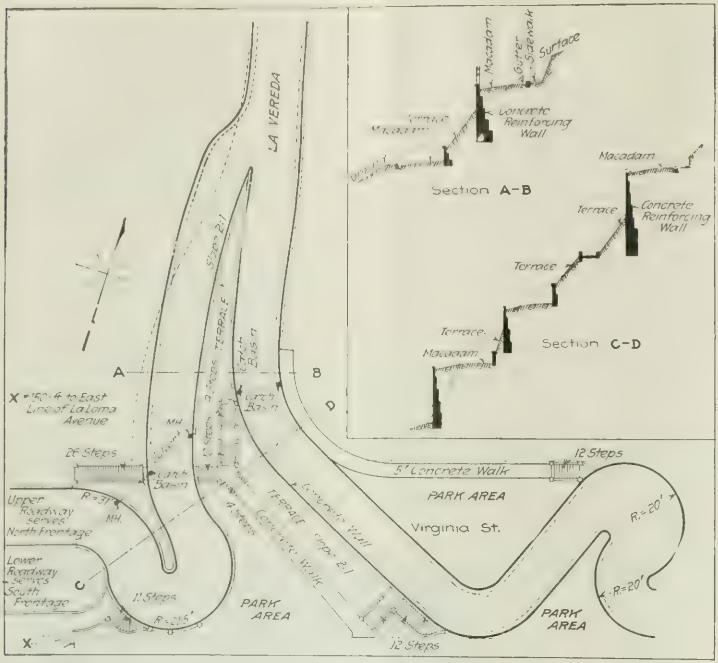


ROADWAY AND SIDEWALKS ARE SEPARATED IN HILLSIDE LAYOUT

the bottom. Each of these turns covers an angle of more than 200 degrees.

An independent and more direct location is used for the 5 ft. sidewalk, the steeper grades thus resulting being overcome in part by stairways. The steps are of 7-in. rise and 11-in. tread, except that those on the turns have a rise of only 6 in. The whole layout is treated in a decorative manner, with concrete parapets and curb walls, and parked or terraced slopes. Drainage is taken care of by concrete gutters, intercepted at five points by catchbasins opening into a pipe culvert which crosses the street layout diagonally.

As Berkeley is built on the abrupt foothills of the Coast Range, it has a variation of about 1000 ft. in elevation, 700 ft. of this being in the eastern ½-mile width. Originally, this district was cut through by numerous ravines, so that in laying out the streets many special treatments and methods have been employed in order to secure adequate facilities without



SPIRAL LAYOUT OF STREET AVOIDS HEAVY GRADES IN HILLSIDE DISTRICT

excessive damage to frontage property. The plan shows that the lower left-hand street has two separate roadways to serve the different elevations of the opposite sides of the street. Split roadways and contour street layouts have been used extensively to obviate steep grades, but in spite of this there are several streets with grades of 10 to 15% and a few of more than 20%. The original water-bound macadam has not been satisfactory, but has been maintained by surface applications of oil and screenings. Recent experiments have been made with concrete and brick, with the results favoring the latter where grades are more than 8 to 10%. The information in regard to these exceptional conditions of street layout and paving was furnished by C. C. Kennedy, city engineer.

Better Operators for Water and Sewage Treatment Plants

New Jersey Law Provides for Examination and Licensing Under Direction of State Department of Health

THE legislature of the State of New Jersey has passed and the Governor has signed a bill which provides that hereafter all water-purification plants and all sewage-treatment plants in the state must be in charge of superintendents or operators who hold licenses granted under the direction of the State Department of Health. On its introduction in the legislature the bill was accompanied by a statement of its purpose which is well worth quoting, as follows: "The purpose of this bill is to secure the employment of attendants at water-purification and sewage-treatment plants having a higher degree of intelligence and more familiarity with the operation of these plants than is now the case. There are a large number of water-purification plants and sewage-disposal plants now in operation in this state. The experience of the State Department of Health has shown that many of these plants, particularly the smaller ones, are operated in a very unsatisfactory manner. This results, in the case of water-purification plants, in imperfect purification of the water at times, and the consequent exposure of the people who use the water to danger from water-borne diseases. In the case of sewage-treatment plants not properly operated, the streams into which effluents from these plants are discharged are polluted, in some cases to the extent of causing gross nuisances. The unskillful and careless operation of these plants also results in their rapid deterioration, which ultimately entails upon the municipalities owning them the expenditure of funds for repairs and replacements which would not be necessary were the plants properly operated."

As this bill appears to be pioneer legislation, the body of it is given in full:

"1. In order that municipalities, corporations or individuals owning or operating water-purification or sewage-disposal plants may secure the services of capable superintendents or operators, the Department of Health of the State of New Jersey is hereby authorized to cause examinations to be made, by such persons and at such times and places as it may appoint and under such rules and regulations as it may adopt, for the purpose of determining the qualifications of applicants for licenses as superintendents or operators in charge of any water-purification or treatment plants purifying or treating water used for potable purposes by this state or of any sewage-treatment plants discharging an effluent into any of the waters of this state. Every such examination shall be in such subjects and conducted in such a manner as the Department of Health of the State of New Jersey shall direct, and every applicant whose examination shall be approved by said department shall receive a license as superintendent or operator of public water-treatment plants or public sewage-treatment plants, as the case may be.

"2. No municipality, corporation or individual shall appoint any person as superintendent or operator in charge of any water purification or treatment plant

purifying or treating water used for potable purposes by inhabitants of this state or of any sewage-treatment plant discharging an effluent into any of the waters of this state, or permit any person to discharge the duties of superintendent or operator in charge of such plant who is not the holder of a license issued by the Department of Health of the State of New Jersey under the provisions of this act; *provided, however,* that nothing herein contained shall prevent any municipality, corporation or individual from continuing in office any person now occupying the office of superintendent or operator in charge of any water-purification or treatment plant or any sewage-treatment plant, and the Department of Health of the State of New Jersey, upon certification from the proper municipal officer, corporation or individual, that such person held the office of superintendent or operator in charge of such water-purification or sewage-treatment plant at the time this act became effective, shall issue a license to said person in the same manner as if he had passed an examination held by the aforesaid department.

"3. The Department of Health of the State of New Jersey may revoke the license of any superintendent or operator in charge of any water-treatment or sewage-treatment plant if, after a hearing held by said department at which said superintendent or operator shall have had an opportunity to be heard, either in person or by counsel, said department shall determine that the said superintendent or operator in charge is incompetent to manage said plant, or that he has wilfully neglected his duty in supervising the operation of said plant, or that he has disregarded or disobeyed the lawful orders, rules or regulations of said department."

Violators of the act are liable to a penalty of $10 per day, to be recovered in an action of debt by the State Department of Health. The department is authorized also to apply to the Court of Chancery for an injunction to restrain any violation of the act.

Engineers Advocate Hard Paving on Steep-Grade Streets

Practice in Several Cities Throughout the United States To Use Stone, Brick and Concrete Either for Full Width or for Strips in Combination with Asphalt

HARD-SURFACED pavements such as concrete, grouted stone block and brick are preferred by engineers for use on steep grades, while macadam, which heretofore has been used so extensively, is rapidly being discarded. This appears to be the conclusion to be drawn from an inquiry made in several cities as to their practice in paving steep grades. The fact that horse-drawn traffic is rapidly being replaced with motors is given as a reason for changing from the old methods.

The inquiry indicated that the engineers consider the design of paving for steep streets a special problem, involving the combination of efficiency with safety. With horse traction, a rough surface and open joints were essential to afford a foothold. With motor vehicles, however, open joints are not necessary, and the main point is to avoid slipperiness of the surface while affording sufficient grip for traction and braking. The minimum grade which may be called steep seems to be about 5 or 6%. The maximum reported is 50.1%, but grades of 10% to 20% are found in a number of cities. That various combinations of construction are being adopted to meet local conditions of grade, traffic and available material is also shown. A review of the information gathered is given in the following pages.

LAYING CENTRAL STRIP OF BRICK ON STEEP GRADE AT SAN FRANCISCO, SIDE STRIPS TO BE OF ASPHALT

Cobblestone paving on a grade of 50.1%, vitrified brick on 26.2% and a limit of 18% for asphalt when used as a side strip, are illustrative of steep-grade paving conditions in San Francisco. Until a few years ago the standard construction of grades of more than 20% consisted of cobblestones set upright on a sand bed, having the joints filled with gravel. This afforded good foothold for horses, but was unsightly. As automobiles and motor delivery wagons replaced horse traffic, there came a demand from property owners and tradesmen for a more modern type of paving.

Limiting grades for different paving materials have been established by ordinance as follows: Asphalt up to 6% within the heavy teaming district, and 8% in other parts of the city. Where a central strip of block paving is prescribed, the asphalt limit is extended to 18 per cent. For basalt block and the various types of vitrified brick paving, no grade limits have been established. From experience with paving on steep grades, and taking into account the question of cost, availability and present traffic requirements, the following six types have been adopted as the most satisfactory: Basalt blocks on concrete; basalt block central strip with asphalt side strips; basalt block side strips with central strip of asphalt; standard vitrified brick, hillside style, on concrete; rough kiln-marked brick, local type, on concrete; vertical-fiber brick on concrete, of modified monolithic type.

"We have full confidence in the basalt and standard vitrified brick types," says James M. Owens, assistant engineer in the Department of Public Works, "but do not consider that the limited time the other types have been down entitles them to the same consideration. A service test of proper length will be necessary to decide their fitness. However, so far they have stood up remarkably well, have given no signs of failure and apparently will work out satisfactorily."

Basalt-block paving is built under specifications which require a 6-in. concrete base and a 2-in. sand cushion. Blocks are $3\frac{1}{2}$ to 4 in. wide, 7 to 9 in. long and 6 to $6\frac{1}{2}$ in. deep, with no projections exceeding $\frac{1}{4}$ inch. They are matched so as to have those of the same width in a row. The joints are $\frac{1}{2}$ to $\frac{3}{4}$ in. wide and before the paving is rammed they are partly filled with gravel of sizes from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. After the ramming is done, the joints are filled with gravel to within 1 in. of the surface, and then finished with 1: 2 cement grout mixed to the consistency of thin cream. As soon as this is stiff enough not to flow, it is swept out to a depth of 1 in., and the joints are filled to the top with gravel.

Vitrified-brick paving is built to specifications requiring a 4- or 6-in. concrete base with a $1\frac{1}{2}$-in. sand cushion and 1: $1\frac{1}{2}$ cement grout filler. For grades of more than 6% and where machine-mixed concrete is used, the thickness may be 4 in., and the bricks must be rough and irregular on the exposed surface.

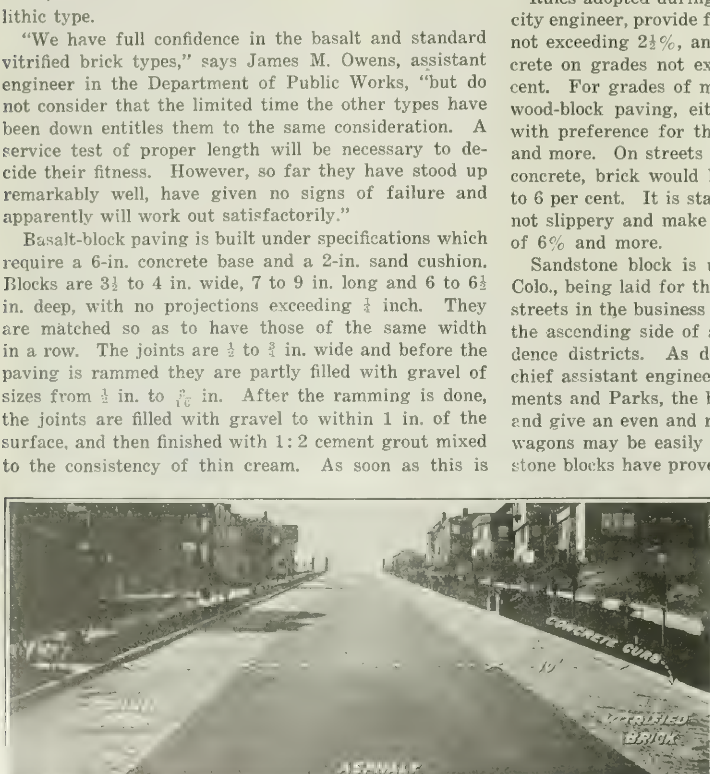
St. Paul Experiments with Wood and Concrete

Sandstone block and vitrified brick paving have given successful results in St. Paul, Minn., but during 1917 experimental work with concrete and wood block for paving grades was inaugurated. One-course concrete was laid on a 7% grade on Mounds Boulevard. Creosoted wood-block paving, with courses separated by transverse strips and the open joints filled with pitch, was laid on a 6% grade on the Summit Ave. approach to the Mississippi River boulevard. Creosoted wood block with lugs was laid on a 3% grade on Minnesota St. in the heart of the business district.

Flattening the crown of streets on grades, so that on very steep grades the crown is almost imperceptible, is practiced in St. Paul with various kinds of paving. Thus, the storm water is carried in a thin sheet over the surface of the pavement, instead of being diverted quickly to the sides and thereby flooding the gutters.

Rules adopted during recent years by Oscar Claussen, city engineer, provide for creosoted wood block on grades not exceeding $2\frac{1}{2}$%, and sheet asphalt or asphaltic concrete on grades not exceeding 5% or preferably 4 per cent. For grades of more than $2\frac{1}{2}$%, in streets having wood-block paving, either sandstone or brick is used, with preference for the former when the grade is 6% and more. On streets having sheet asphalt or asphaltic concrete, brick would be recommended for grades of 4 to 6 per cent. It is stated that the sandstone blocks are not slippery and make an excellent pavement on grades of 6% and more.

Sandstone block is used on steep grades in Denver, Colo., being laid for the entire width of the roadway on streets in the business district, and for an 8-ft. strip on the ascending side of asphalt-paved streets in the residence districts. As described by H. F. Meryweather, chief assistant engineer in the Department of Improvements and Parks, the blocks are laid on a concrete base and give an even and regular surface over which loaded wagons may be easily drawn. At Duluth, Minn., sandstone blocks have proved the most serviceable and satisfactory paving for steep grades. The city engineer, Lyonel Ayres, states that the gritty quality of the stone prevents it from becoming slippery, and the uneven surface enables the horses to get a good foothold. The foothold is assisted also by using sand filler, as grout filler makes the pavement too smooth. For a width of 4 ft. to 5 ft. at each curb, however, at 1:2 cement grout is used to form a surface for carrying storm water.



COMBINATION ASPHALT AND BRICK PAVING ON SAN FRANCISCO STEEP GRADE

Granite block and vitrified brick are used on steep grades in Louisville, Ky., the former use of water-bound macadam having been abandoned. Cement filler is advisable for permanence of brick paving, but if this is filled flush with the top of the brick on grades of more than 5% the surface becomes too slippery for ordinary horse-drawn traffic. On grades of 5 to 8%, therefore, the filler is brushed out of the joints so as to be about ⅛ to ¼ in. below the top of the bricks. Special "hillside" brick is used on grades of more than 8 per cent.

The modern type of monolithic brick paving is preferred in Berkeley, Cal., after two years' experience with brick and concrete, as shown by the following statement from C. C. Kennedy, city engineer:

"From an experience of the past two years, taking into consideration the questions of ease of manipulation in construction, freedom from slipperiness and appearance, I consider that brick of the monolithic type of construction, using vertical-fiber brick burned on edge and laid flat so that a minimum of variation exists, represents the most desirable construction for hillside streets with grades in excess of 8 or 10 per cent."

Numerous streets have grades of 10 to 15%, and a few in excess of 20 per cent. These were paved originally with water-bound macadam, like the other streets, but they eroded during the winter rains and raveled under traffic during the dry summer season. Surfacing with a mat of asphaltic oil and screenings was tried about 10 years ago, but while it remedied these troubles, it made the surface smooth and slippery. On curves the mat could not resist the shear, so that corrugations developed, particularly with the rapid increase of motor traffic. However, by scarifying, reshaping, light re-oiling and rescreening these surfaces, it has been possible to utilize the full wearing life of the street material.

Reconstruction of the oldest of the hillside streets was done in 1916 and 1917. For the first part of the work reinforced concrete was used, with slabs about 20 ft. square and having corrugated surfaces for grades in excess of 12 per cent. In 1917, monolithic brick paving was laid, using hillside brick on a 4-in. base of 1:3:6 concrete with a 1:3 surfacing mixture ½ in. thick placed on the fresh concrete. For the 1918 work, the same type of construction has been adopted, but with 2½-in. vertical-fiber brick on a 4-in. base, making a total thickness of 6½ inches.

Concrete paving is used with satisfactory results on grades as steep as 16% at Sioux City, Iowa. When this paving began to be used in 1911, there was an impression that it would be slippery, and on grades of more than 5% corrugations were formed in the surface to give a foothold. It soon became apparent that these were of no assistance to traffic and formed an element of weakness in the pavement. In subsequent work, therefore, they were omitted.

While concrete may be slippery if finished with a smooth float when there is an excess of water, it is the opinion of T. H. Johnson, city engineer, that a surface affording a good foothold can be obtained readily. This is accomplished by finishing with a heavy wood float until the surface mortar becomes sticky and adheres to the float. This leaves the surface with the desired roughness, but at the same time with all pores properly sealed. For the latter reason, this method is considered superior to brooming, which ruptures the surface, making it sharp and subject to abrasion readily.

MACADAM ROADWAY ON STEEP STREET AT BERKELEY, CALIFORNIA, SURFACED WITH OIL AND SCREENINGS

Concrete for grades up to 10% on country roads, where the traffic consists largely of heavy motor trucks, is advocated by H. Eltinge Breed, first deputy commissioner of the New York State Commission of Highways. He considers that, if well constructed, concrete will be less slippery than bituminous macadam, oiled water-bound macadam or brick (except hillside brick), and not more slippery than open-joint granite-block paving. Care must be taken, however, to use proper aggregate and proper finish.

The concrete should be fairly dry and receive as little screeding as possible to avoid bringing the finer material to the surface. He favors brooming the surface, giving a roughness which will last for awhile. Results from scoring or marking the surface have not been found worth the cost of such treatment. Expansion joints should be perpendicular to the surface, with the expansion strip kept about ½ in. below the top, so that the concrete may be floated over it and make a smooth surface. When cracks appear at these joints they can be filled with tar and sand. To prevent the slabs from creeping downhill, Mr. Breed is experimenting with a curtain wall or stop across the down-hill end of the slab. This is 9 in. wide and extends 12 in. below the bottom of the slab.

Concrete paving on streets having grades of 8 to 29% is noted by the Portland Cement Association. Some of the examples are as follows: 29% on Baxter St., Los Angeles, Cal.; 22% on East Mercer St., Seattle, Wash.; 18% on 23rd St., Kansas City, Mo.; 16% on Pearl St., Sioux City, Iowa, and 15% in Milwaukee, Wisconsin.

Combinations of two materials on steep streets have been employed in some cases, as noted above. Asphalt-paved streets at Denver, Colo., have an 8-ft. strip of sandstone blocks next to the curb on the ascending side. In San Francisco the combination paving includes 20 ft. of asphalt flanked on each side by 10 ft. of vitrified brick; 14 ft. of basalt block or monolithic vertical-fiber brick flanked by 12½ ft. of asphalt.

At Sioux City, Iowa, the combination paving laid for the benefit of traffic was not appreciated by the drivers. Some years ago asphalt-paved streets, on grades of about 10%, were made with a 10-ft. strip of brick paving on each side, to afford a good surface when the asphalt was slippery. According to T. H. Johnson, city engineer, the traffic did not use these strips, and the practice was not continued.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Some Broad Features of Flood Relief

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

RELIEF FROM FLOODS: The Fundamentals of Flood Prevention, Flood Protection and the Means for Determining Proper Remedies—By John W. Alvord and Charles B. Burdick, Members Am. Soc. C. E., Chief Engineers, Franklin County Conservancy District, Consulting Hydraulic Engineers. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 169; illustrated. $2.

This is not a complete treatise on floods, much as a comprehensive work on this subject is needed, nor does it even cover completely the subject of flood relief. The purpose, as stated in the preface, has been "to outline briefly the general flood problem in all its many phases, to show what remedies can be applied and to point out the way to the selection of proper works." For the most part it is of the nature of an essay, touching briefly on the broad features of flood relief. In places it goes considerably farther, giving fragments of technical data and methods which would properly form the nucleus of a treatise on floods and flood relief. The book is not highly technical, neither can it be called popular in the ordinary sense. It contains a number of tables useful to the consulting engineer and designer, but much of the descriptive text and most of the illustrations seem better calculated for use in the promulgation of flood relief propaganda.

While the reviewer feels—and no doubt the reader will feel—that the book is somewhat sketchy, yet it is a book that will broaden the mind of the business man who lives in a flood-menaced region and probably also that of the average engineer who has not specialized in the peculiarly difficult problems of hydrology, particularly those in relation to floods.

Chapter III relates to flood investigations and includes among other things concise, well phrased remarks on the psychology of technical reports. These remarks, while pertinent to flood investigations, apply with equal force to every project in which the engineer is called upon to advise the public. This and the paragraph on "Conservation" are eloquent sermons on professional practice which engineers, old and young, will do well to read and reread. The futility of half-way measures or partial flood protection is strongly emphasized—too strongly, it seems, since the extent to which the public can afford to go to safeguard itself completely against the rarest flood calamities is an open question, to be solved on its merits in each case. The authors have not drawn clearly enough the distinction between partial flood protection works on the one hand, such as the old Dayton levees, that are ordinarily beneficial, and yet may aggravate a rare maximum flood; and those, on the other hand, such as reservoirs, which are nearly always beneficial so far as they go.

In Chapter IV the various classes of investigation needed as a basis of flood reports are concisely outlined, including the important subject of ex post facto determinations of flood discharge. Here again the discussion seems too concise; elaboration and detail would have greatly enhanced the value of the subject matter. Methods of gathering records of flood heights on a stream undergoing investigation are further discussed in Chapter V, but very little is given with reference to the utilization of such data.

In Chapters III and V and elsewhere appears discussion of the related questions whether flood magnitudes are increasing or not, and what is the greatest flood magnitude to be expected on a given stream in the future. The psychology of the popular belief that floods are increasing is well explained. The danger of basing conclusions on records of short duration is pointed out, the value of continued stream flow records is emphasized, and a few examples are cited to illustrate the point that floods as great as those of recent years have occurred as far back as records are available.

In Chapter V, under the heading "Fundamental Data," the subject of rain intensities receives a scant five pages of discussion. The authors seem rather to disparage the utility of rainfall data in flood studies.

While it is properly pointed out that estimates of flood volumes based on gagings or flood heights are usually to be preferred to those based on rainfall alone, yet it often happens that the latter have to be mainly depended upon. Recent well authenticated maximum flood heights are often not as readily available as they have been in connection with the studies made by the authors in the Ohio flood district. Furthermore, in determining the probable frequency and magnitude of future floods to be provided for, rainfall records are commonly available, running back much farther than records of stream flow or flood heights, and since for the solution of that problem duration of records is of primary importance, as the authors have pointed out, it appears that the use of rainfall records and especially of rain intensity records in that connection is worthy of much more inclusive treatment than it has received.

The subject of economics of flood protection works is briefly treated, but the relation of frequency of occurrence of excessive floods to the justifiable expenditure for flood relief is barely mentioned. In fact, the matter of determining flood frequency is kept in such shape that the reader remains in doubt as to how much may be accomplished along this line and how the results should be applied.

No doubt there has been a tendency in the estimation of flood discharges to use ready-to-hand general formulas as a basis of conclusions as to maximum floods and flood frequencies, rather than to carry out the far more laborious operation of compiling and analyzing the most complete data obtainable for the stream in question. The authors seem not to have gone as far as they should in emphasizing the fundamental principle of hydrologic work, namely, that one should make the best possible use of all the available information, and that, in general.

an ounce of actual data is worth a pound of inference.

Subsequent chapters relate to different methods of flood prevention and flood control, and the broader features of channel improvements, storage and detention reservoirs are well covered. The examples and illustrations are mainly drawn from reports on the Ohio floods of 1913.

An appendix contains an excellent table of maximum flood discharges on about 120 streams for which there are continuous records for 10 years or more. The date and magnitude of the maximum flood and its relation to the average flood is given in such form as to be generally more useful than similar tables heretofore available.

The perfect book on an engineering subject has not yet been written, and in spite of the apparent sins of omission, the authors have produced a book which provides useful material for thought even to those best informed on the subject treated.

Bridge-Column Tests Finally Published

TESTS OF LARGE BRIDGE COLUMNS—By J. H. Griffith, Associate Engineer Physicist, and J. G. Bragg, Assistant Physicist, Bureau of Standards. Technological Paper No. 101. Washington, D. C.: U. S. Bureau of Standards. Paper; 7 x 10 in.; pp. 139; illustrated. 30c. from Superintendent of Documents, Washington, D. C.

Four years' waiting for a report on the tests of large bridge struts carried out by the Bureau of Standards is rewarded now by a full and well-argued presentation of the results. The struts were replicas of members of the new Memphis bridge, the Metropolis bridge, and the St. Louis Municipal bridge; cross-sectional areas from 42 to 119 sq.in. were represented. The objects of test were built of various high-strength steels, and most of the ultimate loads realized were above 40,000 lb. per square inch.

Attention is directed to the fact that one set of columns in particular failed throughout in smooth curves, proving integrity of action of the riveted assemblage in high degree. All the test members were open-section riveted structures, about half of them being fitted with continuous longitudinal diaphragms. For this reason, and because of the fact that one end of each column bore on a pin, a large amount of highly valuable detail information is contained in the test records.

Interpretation of such complex tests necessarily involves so much personal judgment that the document bears the character of a technical article rather than that of a mere matter-of-fact report on observed phenomena. Correspondingly, the bridge engineer in reading through its 139 pages will need to apply his own analysis to the test figures and the reported behavior of the columns, and he is likely to be led to views diverging from those of the authors, in more than one detail.

In welcoming a report of the excellence of this one, every engineer will be impressed with the fact that so long a delay in publication as four years is unfortunate. Data of great importance to professional men all over the country should be laid before them with the utmost promptness. However, since the attention of the bureau has for more than a year been almost wholly taken up by war work, it is not hard to understand that many things delayed getting the report into print.

Special credit is due the authors for their painstaking study of column action in connection with the analysis of the test results.

Resolving Power of Small Telescopes

TESTS OF SMALL TELESCOPES AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—By E. Deville, Surveyor General of Dominion Lands. Bulletin 41, Topographic Surveys Branch, Department of the Interior, Canada. Ottawa, Ont.: Address the Deparment. Paper; 6 x 10 in.; pp. 20; illustrated.

A fundamental question for every user of transit or level is discussed in this pamphlet. Telescope quality is of exceptional importance in the Dominion land survey work because daytime star observations must be made, and stadia measurements are made at distances up to one-half mile with rods divided to tenths of links or about ¾ in. Resolving power of the telescope is a critical feature in such work. It was studied by laboratory work conducted by W. C. Way, and enough was learned, as set forth in the present pamphlet, to give the surveyor direct guidance in the choice of telescope characteristics for a given class of work. One remarkable fact, determined by special measurements, is that in close-range work and at very low magnifications the resolving power is likely to exceed the magnification by amounts varying up to 10% as maximum. Certain phenomena also led to the conclusion—not fully verified by experiment—that the eye is keener when looking at an image through an ocular than when looking at the object itself with the naked eye. It developed also that an objective had one-fourth greater resolving power photographically than visually.

Recommendations based on the experiments are so framed as to carry out the principle, "The best size for a surveyor's telescope is the smallest that will just meet his requirements." It is shown that the same resolving power can be had with telescopes of different sizes—magnification and brightness varying at the same time, of course. Formulas given enable the required resolving power for such reading as is done in leveling to be computed from distance and rod interval.

Studies of Municipal Problems

A new series of publications designed to aid officials and employees of the City of New York has been started by the Municipal Reference Library of the city named. The first of these, by Dorsey W. Hyde, Jr., librarian, is entitled "What to Read on New York City Government" (5 cents) and contains a list of references to pertinent books, pamphlets and periodicals.

Vibration Measurements in High Chimney

In Japan earthquakes are fairly common and precautions must be taken in design to care for the stresses induced by movement of what should be terra firma. As a part of the study of such stresses, Dr. F. Omori, the well-known Japanese earthquake expert, has made a number of measurements of the movements of high reinforced-concrete chimneys, particularly of the record Saganoseki chimney, which is 567 ft. high. These measurements and their importance to earthquake-re-

sisting design are made the subject of a paper by Dr. Omori, published in English by the Imperial Earthquake Investigation Committee, as Vol. IX, No. 1 of its bulletins. Presumably, copies may be obtained by writing the committee at Tokyo.

Change of Name and Size

Highway Transportation is the new name adopted for the *Motor Truck Club Bulletin*, which is the official organ of the Motor Truck Club of America, Inc. Coincident with the change in name, the size and the number of pages have been increased. The July issue contains reading matter of interest to all those concerned with motor trucks or motor truck transportation. The Journal is published monthly from the offices of the club, 1790 Broadway, New York City. Theodore D. Pratt, executive secretary of the club, is editor.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

ANALYSIS OF MINE AND CAR SAMPLES OF COAL COLLECTED 1913 to 1916—Washington, D. C.: U. S. Bureau of Mines. Paper; 6 x 9 in.; pp. 478; mostly tables.

CALENDAR OF LEADING EXPERIMENTS—By Wm. S. Franklin and Barry MacNutt. South Bethlehem, Penn.: Franklin, MacNutt & Charles. Cloth; 6 x 9 in.; pp. 210, illustrated. $2.50 postpaid.

Deals primarily with lecture demonstrations in physics. Contains many allusions to engineering and much to stimulate thought by thoughtful engineers. Sharply personal in the views expressed, and in large part polemic in character as much as didactic. What the authors have to say on instruction in Mechanics is of direct importance to engineering teachers.

CONCRETE COTTAGES: Small Garages and Farm Buildings—Edited By Albert Lakeman, M.S.A., M.G.I., Honours Medallist Construction. London: The Concrete Utilities Bureau. Cloth; 6 x 9 in.; pp. 170; illustrated. 5 shillings net.

THE DIFFUSION OF OXYGEN THROUGH STORED COAL—By S. H. Katz. Washington, D. C.: U. S. Bureau of Mines. Paper; 6 x 9 in.; pp. 47; illustrated.

Gives results of part of an extended study "of the conditions affecting deterioration and spontaneous combustion of stored coal." Effects of sizes of coal and percentage of voids are considered.

FOREIGN COMMERCE AND NAVIGATION OF THE UNITED STATES, 1917—Washington, D. C.: Superintendent of Documents. Cloth; 9 x 12 in.; pp. 930. $1.50.

FUEL ECONOMY IN THE OPERATION OF HAND-FIRED POWER PLANTS—Circular 7, Engineering Experiment Station, University of Illinois. Prepared Under the Direction of a Committee Consisting of A. C. Willard, Professor of Heating and Ventilation (Chairman), H. H. Stoek, Professor of Mining Engineering [and others]. Urbana, Ill.: University of Illinois. London: Chapman & Hall. Paper; 6 x 9 in.; pp. 94; illustrated. 20c.

GOVERNMENTAL WAR AGENCIES AFFECTING BUSINESS—Second Edition. New York: National Association of Manufacturers, 30 Church St. Paper; 6 x 9 in.; pp. 196.

Contains much useful condensed information regarding Federal legislation and agencies "which directly affect American business."

HANDBOOK OF MATHEMATICS FOR ENGINEERS—By Edward V. Huntington, Ph.D., Associate Professor of Mathematics, Harvard University. With Tables of Weights and Measures by Louis A. Fischer, B.S., Chief of Division of Weights and Measures, U. S. Bureau of Standards. Reprint of Sections 1 and 2 of L. S. Marks' "Mechanical Engineers' Handbook." New York: The McGraw-Hill Book Co. London: Hill Publishing Co. Flexible Leather; 5 x 7½ in.; pp. 191; illustrated. $1.50.

HELP WIN THE WAR BY PREVENTING UNNECESSARY SICKNESS: A Series of Important Wartime Messages to the People of Texas—Prepared by the Committee on Sanitation And Medicine of the Texas State Council of Defense; Charles [illegible], Secretary. Paper; 6 x 9 in.; pp. 31.

Reprints of weekly leaflets on health and sanitation issued weekly from November, 1917, to July, 1918. Typhoid, privies, swimming pools, hog raising for garbage disposal, and health protection of shipbuilders are among the subjects treated.

INSECTS AND DISEASE: A Statement of the More Important Facts, with Special Reference to Everyday Experience—By C.-E. A. Winslow and Frank E. Lutz. Guide Leaflet No. 48, American Museum of Natural History, New York City. Paper; 6 x 10 in.; pp. 73; illustrated.

Sufficiently popular to be understood by any intelligent person and yet thoroughly scientific, this is a remarkably compact, useful and entertaining review of disease-bearing insects and their control. Twoscore diseases, as many parasites and nearly as many carriers, are listed. Most attention is given to the fly as carrier of typhoid, the mosquito as the disseminator of malaria and yellow fever and the flea (together with the rat) as bearer of the bubonic plague.

INTERNATIONAL MINING LAW—By Theo. F. Van Wagenen, E. M., President and General Manager, The American Potash Co., Denver, Colo. New York: McGraw-Hill Book Co. Flexible cloth; 5 x 8 in.; pp. 342; $3.50.

Chiefly devoted to a review of mining law by countries of the world. A third of the volume treats the subject under such heads as "The Prospector," "Leasehold vs. Licensed Prospecting," etc. It is stated in the preface that practically all the basic material for the book was gathered to enable its author to pass judgment on the need for a revision of American Federal mining law. His conclusions on this subject are embraced in a chapter of five pages, entitled "Defects and Deficiencies of the American Law." The title seems to be a bad misfit. "Mining Laws of All Nations" would have been more correct.

MICHIGAN STATE BOARD OF HEALTH: Annual Report of the Secretary for the Fiscal Years ending June 30, 1916-June 30, 1917—Lansing, Mich.: State Board of Health. Cloth; 6 x 9 in.; pp. 237; illustrated.

MINISTER OF MINES: Annual Report, 1917; Being an Account of Mining Operations for Gold, Coal, Etc., in the Province of British Columbia. Victoria, B. C.: Minister of Mines' Office. Paper; 7 x 10 in.; pp. 457; illustrated.

MODERN MANAGEMENT APPLIED TO CONSTRUCTION—By Daniel J. Hauer, Construction Economist; Consulting Engineer. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 187; illustrated. $2.50.

NEW JERSEY STATE DEPARTMENT OF HEALTH: Report for 1916-17. Trenton, N. J.: The Department. Cloth; 6 x 9 in.; pp. 373; illustrated.

Contains tabular information regarding New Jersey water-supply and water-treatment and sewage-treatment plants, besides vital statistics and many other data.

NEW YORK CONSERVATION COMMISSION: Annual Report, 1915—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 517; illustrated.

Among other matter this belated report contains results of water-storage and power studies and stream-gaging data.

OKLAHOMA SOCIETY OF ENGINEERS: Transactions, 1918. Oklahoma City, Okla.: H. V. Hinckley, Secretary. Paper; 6 x 9 in.; pp. 77; illustrated. $1.

PLATINUM AND ALLIED METALS IN 1917—By James M. Hill. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 21.

PORTS AND TERMINAL FACILITIES—By Roy S. MacElwee, Ph.D., Lecturer in Economics and Foreign Trade, Columbia University; Associate Member, Society of Terminal Engineers and American Association of Port Authorities. New York: McGraw-Hill Book Co. London: Hill Publishing Co. Cloth; 6 x 9 in.; pp. 315; illustrated with 117 line cuts and halftones. $3 net.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE UNITED STATES COAST AND GEODETIC SURVEY IN 1917—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 64. 10c.

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY NEAR HONOLULU, HAWAII, 1915-16—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 9 x 12 in.; pp. 101; illustrated. 30c

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT SITKA, ALASKA, 1915-16—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 9 x 12 in.; pp. 96; illustrated. 40c.

SUBMARINES: A List of References in the New York Public Library—Compiled by Mary Ethel Jameson, Science Division, with a Foreword by Simon Lake. The Library. Paper; 7 x 10 in.; pp 83.

WATER COMMISSION OF THE TERRITORY OF HAWAII: Report to the Governor, January, 1918—Honolulu, T. H.: The Commission. Paper; 6 x 9 in.; pp. 53; folding map and diagrams.

Contains report and recommendations for legislation by A. E. Chandler, member California Water Commission, and considerable data on artesian wells in Hawaii.

WATER-SUPPLY COMMISSION OF PENNSYLVANIA: Report for 1916. Harrisburg, Penn.: The Commission. Cloth; 6 x 9 in.; pp. 203.

Chiefly hydrographic data. Some rainfall figures. Also text on navigation and other subjects.

WET LANDS OF SOUTHERN LOUISIANA AND THEIR DRAINAGE—By Charles W. Okey, Senior Drainage Engineer. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 67; illustrated. 20c.

ZONING SCHEME FOR ST. LOUIS, MO.: Height, Area and Use Districts and Restrictions—Prepared by the City Plan Commission. [Harland Bartholomew, Chief Engineer.] Paper; 21 x 18 in.; 5 pp. text and diagrams, 11 maps. St. Louis, Mo.: Address the Commission. $2.11 postpaid.

Contains zoning ordinance which went into effect Aug. 15, 1918. The text is accompanied by numerous diagrams and by large colored sectional maps.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Philadelphia and New England in Water and Fuel Saving Campaigns

Sir—I have been much interested in the attitude of *Engineering News-Record* on the water meter situation in Chicago, as recorded July 18 and 25 and Aug. 1, pp. 111, 205, 241. Perhaps the situation in Philadelphia may be of value and prove an aid to the campaign in Chicago.

By an ordinance passed in December, 1916, all manufacturing establishments, business houses, hotels, saloons, and practically everything except residences, were placed arbitrarily on meters. By an ordinance passed last winter all connections made to the mains after May 31 of this year must be provided with a meter.

A committee has been appointed and is about to hold hearings to consider the question of universal metering for the city and to prepare an ordinance adopting such a policy and establishing a program for the introduction of the meters.

As far as I can learn, there is no opposition to this proposition and widespread sentiment in favor of it. The Real Estate Board of the city has come out in favor of it, provided only that one or two details, such as the collection of the water charge from the tenant instead of the owner, are adjusted.

Such a program, if adopted, would include some 300,000 residences not yet metered. I cannot forecast details but I think the fact that a committee has been appointed to consider the question, that no opposition has thus far developed, and that the principle has been indorsed by the Real Estate Board, which is the organization most vitally affected, is significant of the probable result.

You may likewise be interested in a proposed meeting of the New England Water Works Association to be held in Boston, Sept. 11 and 12, in lieu of the regular September convention. It is to be a business meeting, devoted principally to war-time problems, with the most emphasis laid on the fuel situation.

The association has had printed 10,000 posters, a copy of which I inclose. These are being sent to the various New England members, with the request that they be posted up in conspicuous places. It seems to me that advertising of this nature is rather an innovation with the New England Water-Works Association and perhaps is significant. The whole matter has been cordially indorsed by the Fuel Administrator of New England.

I have just received a communication from the Washington office of the Fuel Administration with suggestions that the matter might very well be more widespread among water-works organizations.

Philadelphia is putting up several hundreds of these posters, modified to meet local conditions. Perhaps Chicago could use them as an aid in the meter campaign.

Approved by U. S. Fuel Administration for New England

You Can Have
More Coal for Your Cellar,
Water Consumers

Stop All Waste **Look** at Fixtures **Listen** for Leaks

Hoover says Save Meat, Sugar and Wheat

We Say

Save water also

Because

Saving Water Means Saving Coal.

In the Pumping Stations
150,000 Tons of Coal a Year
in New England
Will Be Saved if Waste of Water
Is Stopped.

Remember the Zero Weather of Last Winter and Stop Waste Now.

NEW ENGLAND WATER-WORKS ASSOCIATION

It is the thought of the New England Water-Works Association that this is a year when excursions, entertainment, etc., should be omitted and the convention be made a business session only. Naturally, Boston is the logical place to hold such a meeting.

C. E. Davis,
Chief, Bureau of Water.

Philadelphia, Penn.

Committee on Development, American Society of Civil Engineers

Sir—It was a stimulating pleasure to me to read the preamble and resolutions adopted by the board of direction of the American Society of Civil Engineers, June 18. I believe these resolutions must meet with the unanimous and hearty indorsement of all members.

It is generally conceded that the American Society of Civil Engineers has been conservative; sometimes too conservative. This is a virtue rather than a fault. A tendency toward ultra-conservatism was the fault to be feared. The society has always stood for standards. Its work has been a dominant influence both for American engineers and for the American public.

Times are now wonderfully changing, just as was the case a century ago in the flux of the French revolution. It is only natural, therefore, that we should suddenly feel an impelling need for "a broad survey of the functions and purposes of the American Society of Civil Engineers." Indeed, I think development and readjustment are to be demanded, not only in other na-

tional engineering societies, but in every human organization dealing with the problems of society. "Surveys" will surely be made in the learned professions, in business, in government and in the great questions confronting capital and labor.

The conservative American Society of Civil Engineers has become a pioneer grasping leadership in a great social movement.

Who would have predicted ten years ago that in 1918 there would be 22 local associations of members of the American Society of Civil Engineers? Even before the great world war brought its tremendous influences engineers were feeling the need for correlation and combination. Our national societies must be knit more closely together. Happily this is being accomplished now with rapid strides through the medium of an Engineering Council.

The applications of applied science are complex and manifold. We will always have many societies representing specialties. Such societies must be recognized; but in dealing with the public, with government problems, with war work, all engineers must coöperate, for no one man or no one society of engineers can be a specialist in everything. Great gain will come to the engineering profession and still more gain to the public when engineers of every branch act more in unison.

This is to be accomplished by coöperation of the great national societies. To the public the engineering profession must present one solid front.

We may confidently expect that the committee on development of the American Society of Civil Engineers will not only revise the constitution of that society but will do a pioneer's share toward framing "the purposes, field of work, scope of activity and usefulness, organization and methods of work" of the great engineering profession as a whole.

Berkeley, Calif. C. DERLETH, JR.,
Dean, College of Civil Engineering,
University of California.

[In connection with this, this journal calls attention to the letter in the *Journal* of the American Society of Mechanical Engineers for August, by Louis C. Marburg of Philadelphia, in which he suggests the appointment of a similar committee by that society, and urges joint activity by national societies when general and identical aims are to be achieved.—Editor.]

Co-operation in Industrial Research

Sir—In your issue of June 20, p. 1161, there is a timely editorial entitled "Concentrate Engineering Talent and Experimental Facilities on the War." Doubtless it is the desire of all American engineers to do just that, including the engineers employed by the Government in military service, and otherwise those employed by manufacturing concerns and those in a consulting capacity.

The difficulties of concentrating facilities are largely due to the fact that the man who wants information or assistance does not know just where to go to get it. At the meeting of the American Society for Testing Materials in June, during the topical discussion on coöperation in industrial research, it seemed worth while to say a word on one phase of this situation, wherein the writer's observations led him to believe that engineers in the producing class are not afforded an opportunity to be of the greatest possible assistance to engineers in the Government service.

In the development of the military program especially, there are many research problems which must be worked out in the laboratories of the various and numerous Governmental departments and bureaus. These problems cannot always be placed in the hands of investigators who are thoroughly familiar with the materials to be dealt with, and they will, therefore, turn to the producers of materials for information and for samples. Often, in asking for this information, the Government representatives do not give the manufacturer much indication of the purpose for which the material is to be used. Circular letters are frequently sent out asking for samples, prices, quantities available, etc., and it is frequently impossible for the manufacturers to answer such letters intelligently without knowledge of the technical purpose and relative urgency of the proposition.

The writer urges that better facilities be afforded producers to give full service in such matters, and suggests that wherever circumstances permit the responsible technical heads of well-recognized producing organizations be approached in person by well-accredited representatives of Government departments, so that a mutual feeling of assurance may be had regarding the confidential character of the information exchanged.

S. R. CHURCH,
New York City. The Barrett Company.

Owners Backward in Matter of Contract Practice

Sir—I have read with much interest the article in your issue of July 18 by your managing editor, Henry D. Hammond, under the caption, "New Contract System which Stimulates Efficiency Gaining Favor."

The system which he recommends is an important move in the right direction, and is the only method that can produce proper results. In my practice I have advocated this very system for a number of years, but have found it very difficult to convince clients that this was the best method for them to pursue, as in most cases they favored the straight out competitive system, for the reason that it gave them an opportunity to take advantage of any attractive low bids they might receive, notwithstanding the fact that they are advised that the work cannot be performed properly for the lowest figure.

It is difficult to convince them why they should not take advantage of this low figure. If they can obtain from the contractor a bond for the faithful performance of his contract, they feel assured that this will protect them against any delinquency of the contractor, and that by virtue of this bond they will secure the same efficiency and standard of work that would be obtained had a fair value been paid for the work. This they consider good business, believing that they are receiving something for nothing, or at least getting work below cost.

It is needless to remark, however, that is just where they are being deceived. They are not making the saving that they think they are, but merely putting a premium on inferior work and stimulating the efforts of the contractor in that way to even up his losses, and also in many cases inviting legal complications. But

the temptation is so great to take this advantage that it is difficult in many cases to overcome it by argument.

The unfavorable conditions, friction and legal complications surrounding the competitive contract methods, in many cases, demonstrate the fact that the principle underlying this method is wrong. A system that creates antagonism between contractor and owner, permitting unfair advantage to be taken by either party, thereby producing possible failure for the contractor and endless trouble and litigation for the owner, certainly proves that it lacks in some essential point.

The method advanced by Mr. Hammond, and which I have advocated for so many years, eliminates all of these objectionable features, is equitable, and places all concerned—owner, engineer and contractor—in harmony, thereby producing the best results.

A system or method employed in carrying out the work of any contract that makes the interests of the owner and contractor identical, and whereby the owner and contractor work together as a unit for one common end, devoid of all friction and suspicion, is the only method that can succeed, bring the best results and complete the work with entire satisfaction.

A responsible contracting engineer with experience knows what work will cost when letting contracts, and if the work is being carried out under this system is able to effect savings, from time to time, which will accrue to the benefit of the owner. The owner is at all times kept informed as to the status of the work; knows that he is buying right; has the knowledge that the materials and labor are being paid for, and is free of all legal entanglements, for the reason that under this method he receives clear records of all transactions; and the contractor, being relieved of the financing, is free to give his full energy and best efforts to the prosecution of his work. There is consequently the greatest freedom from friction and worry, and the greatest pleasure in the gratifying results achieved by this coöperation.

It is hard to believe, and I regret to say it, but there are some business men who by using the usual competitive method take advantage of the contractor who has omitted something from his estimate, or who has not had enough experience to know what the work he is bidding on will cost. Such men will receive the lowest bidder with open arms, and, regardless of his ability to do good work or of any consideration of its real value as it should be performed, will expect to obtain first-class and efficient work. Such procedure mostly carries its own penalty.

The method advocated in Mr. Hammond's article avoids these entanglements—you get what you pay for and pay for what you get, making a square deal for all concerned. This system adopted, but with a positive, agreed sum for services, is preferable and an improvement over the percentage system, for the reason that it eliminates from the mind of the owner the suspicion of an incentive on the part of the contractor to increase the cost so as to increase his profit. This is one serious objection the owners make in adopting the percentage system. But where the owner and contractor agree on a fixed sum at the outset, this objection is overcome. I am aware that there are legal difficulties in the way of using this system for public work, owing to the laws prescribing competitive bidding and the straight form contract with the acceptance of the bid of the lowest bidder, if he is able to qualify.

The Government, however, is now letting contracts for war emergency work on a percentage basis, which is a move in the right direction, but has not as yet reached the point where the temptation is eliminated for unscrupulous contractors to increase the cost so as to increase their profits. COL. F. J. AMWEG.

San Francisco.

Record for Continuous Pile Driving

Sir—I note in the press of recent date claims of record for driving piles by the Raymond Concrete Pile Co. based on a one-day performance at Hog Island of 165 piles, another claim by Siems, Helmers & Schaffner of St. Paul for the same honor, one of this firm's crews having driven 168 piles in nine hours, and a further one-day record at Hog Island of 220 piles.

I do not like to see a record claimed by others when I believe the real record, at least for sustained performances, was made several years ago by A. F. Chapman & Co. of Buffalo on work for the Buffalo & Susquehanna Iron Co., under the supervision of the writer, when 1200 piles 35 ft. long were driven every week for 5 weeks with one machine using a No. 1 Vulcan hammer, working 9½ hours per day and half a day Saturday. These piles were driven 3 ft. below ground, necessitating the use of a set on each pile. This means one pile driven in less than three minutes from Monday morning until Saturday noon.

CHESLEY, EARL & HEIMBACH, INC.,

Buffalo, N. Y. J. B. CHESLEY, President.

Survey Desert Highway Route at Night

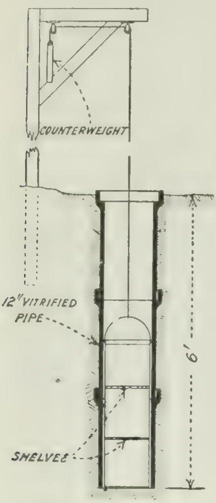
So great are the difficulties encountered in locating the 17-mile tangent of the Lincoln Highway crossing of the Utah desert in the daytime that the work has been carried on at night. The sunlight, reflected from the fields of glistening salt and alkali, is so dazzling that it blinds the eyes, unless they are protected by dark-colored glasses, and the rising heat waves distort the shapes of objects sighted and produce fantastic effects. These factors and the familiar mirage would result in inaccuracy and confusion unless proper methods were employed for establishing the lines. Under George F. McGonigale, state engineer and a member of the State Road Commission, this tangent was established by signal fires at night. The connecting levels and transit lines have been run during the twilight hours. Construction of the new direct route, which will eliminate 50 miles of extra travel around the south point of the salt marsh, is under way. A force of convicts is also improving the Fisher Pass section. C. V. Gardner, field engineer, is installing 6000 ft. of pipe from Cold Springs to the route. Ira R. Browning, state road engineer, writes that the final location of the Utah desert section is nearly completed. Trucks and caterpillar graders have been furnished to R. E. Dillree, construction superintendent, for the grading and gravel surfacing of this section. Shortage of labor is the greatest handicap, but this is made up for as far as possible by the use of machinery.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Drain Pipe and Tin Bucket Provide Iceless Refrigerator

CONSTRUCTION camp refrigerators consisting of three lengths of vitrified pipe set vertically in the ground and forming a well into which a food container is lowered by rope and pulley are designed to help solve the problem of the iceman on the Dayton flood prevention work. Three lengths of drain pipe make a well 6 ft. deep as shown by the drawing. At this depth the ground is as cool as the inside of the ordinary refrigerator. To contain the food, a tin bucket 11 in. in diameter and 3 ft. high is fitted with shelves and a full-length hinged door, and provided with a bail for handling. Two pulleys, a length of rope and a counterweight complete the outfit. Ordinarily, the pulleys are fastened to the kitchen shed roof, but a post and bracket like those illustrated may be employed. Any tinsmith can make the bucket, using inch boards for the shelves. This iceless refrigerator was devised by H. H. Rupe, superintendent of carpenters at the Englewood reservoir.



TILE LINED COOLING WELL

Sewer Invert Forms Hung from Tunnel Sets by T-Square Rig

By R. W. Stewart

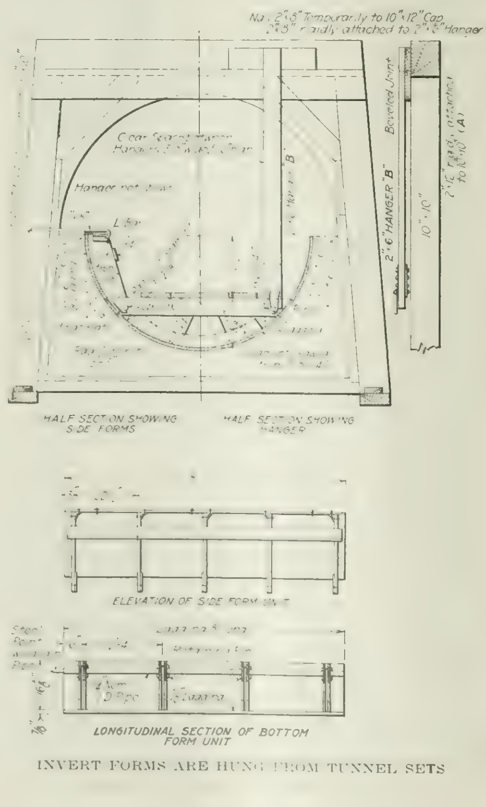
Engineer of Bridges and Structures, City of Los Angeles, Cal.

FORMS for the concrete invert of a new 4000-ft. sewer tunnel at Los Angeles were of standard wood sections carried on a specially designed rig which was suspended from the cross-frames of the tunnel sets. The forms were used over and over, and were readily moved along the line of the tunnel.

As shown in the drawing, at A, 2 x 12-in. strips with one beveled edge were nailed across the timber sets. These were set by a level party on a grade exactly parallel to and a constant distance above the grade of the sewer. Hangers B in the illustration), shaped like T-squares, with 2 x 8-in. crossheads beveled on the lower edge to fit the bevel on the strips A, were then suspended, one on each side of the center line, the crossheads being also nailed lightly to the caps of the tunnel sets in such a manner that the nails could readily be withdrawn to move the hangers ahead. The bottom of each hanger was reinforced by a 6 x ¼ x 11-in. steel plate in order to make a suitable tension joint for bolting on the U-hanger (or clevis) as shown. The nuts for the clevis bolts were "box rod handle nuts" which could be quickly applied or removed without a wrench.

From this hanger were suspended the invert forms. They were built of wood in 8-ft. sections, a complete assembly consisting of one bottom form unit and two side form units. These units were light enough to be readily carried along the work. The 1¼-in. pipes which pass through the crossframes of the bottom form units were each equipped with an iron point welded in one end. By inserting the projecting points of the pipes at one end of a form unit into the open ends of the pipes of the next form ahead a rigid coupling was immediately established between adjoining forms which prevented their lateral or vertical displacement with reference to each other at abutting joints.

Passing the clevises under the pipes and bolting them to the bottom of the hangers suspended the bottom form units at the correct grade. The 2 x 6-in. stem of each



INVERT FORMS ARE HUNG FROM TUNNEL SETS

hanger was cut to a contact fit with the pipe so that the form could not rise from the upward pressure of concrete underneath.

When the concrete was poured to the level of the tops of the bottom form units, the side form units, the construction of which is readily understood from the drawing, were set upon the pipe. The ribs of the side form units are staggered with reference to the crossframes of the bottom form units. The tops of the side forms were quickly and easily aligned by means of steel rods each having one end bent down into a hook which was passed around the edge of the 1 x 8-in. wale at the top of the side forms and the other end bent out horizontally into a spur which was driven into the side of the tunnel post or to projecting pieces. Two hundred linear feet of forms were built. The nominal progress made in laying concrete was 35 ft. per day. While concrete was being poured at the front, forms were being detached at the rear. A night shift carried the loose forms from the rear and erected them in front for the next day's pouring. The original forms lasted until the work was complete, and the metal fixtures are now in storage. Since the design of all of the metal parts is independent of the diameter of the sewer they are well adapted to repeated use.

Other Articles In This Issue of Interest to Contractors

Reline and Waterproof Mine Shaft With Cement Gun

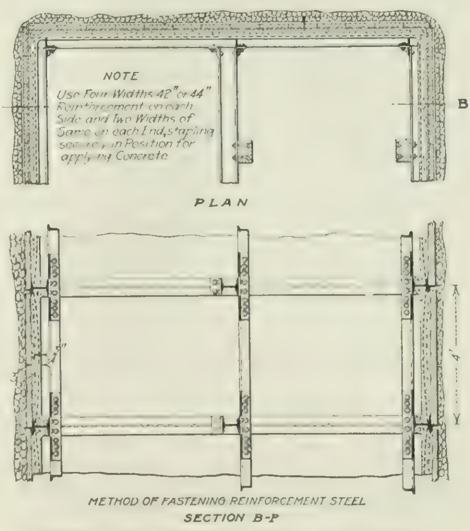
TEN mine shafts on the iron range in Minnesota have been relined with precast concrete lumber in the past four years, and in many others monolithic concrete has been placed. Recently the cement gun has been employed to reline the Penobscot pump shaft of the Oliver Iron Mining Co., at Hibbing. This shaft, built up of steel sets and 2-in. wood lath, was put down in 1911. It was finished in 1912 to a depth of 231 ft. All of the water from the Hull-Rust pit, one of the largest open-pit mines in the world, is pumped out through this shaft. Originally the pumps handled 1000 gal. per minute, but now the total is only 400 gal. per minute.

The shaft is about 11½ x 6 ft., with two compartments 5½ x 6 ft. Steel sets are made up of 6-in. H-beams while dividers are 6-in. I-beams. Sets are spaced on 4-ft. centers.

Work was started at the top and proceeded at the rate of two sets per day, making a total of 8 ft. Concrete was placed in two layers, each 2 in. thick. Sollars or temporary platforms were put in every 15 to 20 ft. in order to catch the rebound which dropped into the shaft, and to prevent accidents from falling materials. Permanent ladders were removed as the work proceeded, in order to give the men space in which to work. Sets were concreted in order, except those in which the sollars were placed. After the concrete had hardened in the sets around the sollar sets, the sollar was dropped and the set concreted.

Reinforcing was put all the way down the shaft, as the first step. This was wire mesh, cut into lengths of 4 ft. so that when placed between the sets it would curve out, forming tension reinforcement near the interior face. To hold the reinforcement in place hook spikes made from ¼-in. rods were driven into the timbers, close to the sets. As the sand and cement mixture left the cement gun, it dropped down into the shaft through a 1¼-in. hose. Wear on the rubber connections from the gun to the delivery hose necessitated its replacement several times. Otherwise no repairs were needed. Six men were employed besides the foreman, who gave only a part of his time to this job. Three men measured the sand and cement, mixed the materials and carried the mixture to the cement gun. One man attended to the gun and two men were down in the shaft handling the nozzle. While one was busy with the nozzle the other would be trimming. Sand was obtained from a bed in an open-pit mine, brought to the job in 7-yd. wooden dump cars, screened through ¼-in. mesh and dried with steam coils.

Though the workmen had no experience to begin with, they were of an intelligent laboring class and were able to do the work satisfactorily after a little training. For a 10-hour day the ordinary work of six men was three sets or 12 ft., applying a layer of one coat 2 in. thick. The best results were obtained when the sand was thoroughly dried and mixed with the cement before being placed in the cement gun, and batches of 1 to 1½ cu.ft. were handled by the gun much more satisfactorily than larger batches. With these precautions the flow to the hose could easily be regulated,



METHOD OF FASTENING REINFORCEMENT STEEL
SECTION B-P

CEMENT GUN MORTAR LINES MINE SHAFT

making it possible to place the concrete smoothly on the walls of the shaft.

Sand was heated in a specially built drier seven coils wide and seven coils high and 12 ft. long, made of 1½-in. pipe. It would sift down through these coils and be perfectly dry when it reached the bottom. A double ¼-in. mesh screen, placed on a slant, was used directly above the coils. Experience with this improvised drier showed that it would have been more efficient if the pipes had been shorter. Steam was obtained from the stationary plant at Penobscot mine, while the air used in operating the gun was furnished by a Westinghouse air pump, furnishing about 220 cu.ft. a minute, carrying 70 lb. pressure. At the nozzle the air pressure was from 20 to 22 lb., and water pressure 100 pounds.

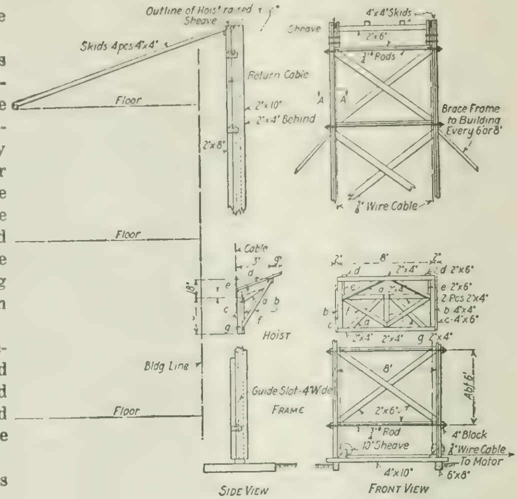
In experimenting it was found that if the sand and cement were placed in the gun separately and then mixed there was considerable waste material from the rebound when the concrete was shot on the wall. After the dried sand and cement were mixed before being put into the gun, this waste material decreased decidedly.

Sollars which were put in every three or four sets were cleaned up every day. They were made of 2-in. plank extending 4 in. on either side of the compartment so as not to slide out. At the end of each day's work the hoses, nozzles and gun were completely cleaned out. Every effort was made to protect the men from injury.

After the shaft was lined no trouble was encountered from water, and the mine officials were so pleased that they decided to use the cement gun in pointing up joints in the Philbin shaft where precast lumber has been used for the lining. Below the 75-ft. level water was entering, but was stopped by a single coat of cement-gun concrete which prevented any further infiltration.

"Long-Stuff" Elevators Handle Reinforcing and Forms

ELEVATORS built specially for hoisting "long stuff" in a vertical position helped materially in building the new quartermaster's depot at Chicago, described on page 300. The drawings show this elevator, which can be readily rigged up with the means at hand on any fair-sized job. The guides are made by bolting or nailing a 2 x 4- and a 2 x 8-in. timber to a 2 x 10-in. plank, leaving a groove 4 in. wide and 2 in. deep, which receives the hoist. The hoist or carriage is built of 2 x 4-in. material and is 8 ft. wide. For reinforcing material a cradle long enough to accommodate the longest iron is attached to the short carriage. In erecting the elevator, the guide pieces are set out from the building at a distance of 2 ft. 8 in. Two cables, one on either end of the carriage, are led over 6-in. sheaves at the top of the frame, through 10-in. sheaves on the base and thence to the drum of the hoist. In the present case the hoist was an electric motor attached to a regular hoisting rig. The tops of the guides are carried far enough above the point at which it is desired to deliver the materials to place a skid of four 4 x 4-in. timbers at an incline sufficient to slide the load off the carriage onto the floor. The material is loaded onto the carriage, which is built on an incline, and in the hoisting the material rides on the front edge of the guides. As soon as the carriage has reached the top the load clears the



ELEVATOR TRAVELS ALONGSIDE OF BUILDING

top of the guides and slides down over the skids onto the floor. All that is necessary to make the operation of this elevator a success is to keep the grooves in the guides and the skid thoroughly greased.

How to Make Patches on Concrete Surfaces

By Rudolph N. Maxwell
Cincinnati, Ohio

PATCHES can be applied to new concrete surfaces with great success by a method the writer has been using for some years. Start the patching as soon as possible after removing the forms, but do not remove the forms so early as to damage the sharp angles or as to leave unsightly places due to the concrete sticking to the forms while green. After cleaning from the concrete to be patched all loose material, by means of a wire broom or other device, wet the surface thoroughly with water. While the surface is still wet take the mortar, usually composed of a 1: 2 mixture of cement and finely screened sand in a slushy state, and throw or press it into the opening with as much force as possible, building up a little at a time if the hole is a large one.

Then take a small block of wood, with sharp edges, about 1 in. thick and 2½ to 3 in. square and rub flatwise in a circle, scraping off all excess material until the general surface of the old work shows and until no more mortar remains than is absolutely necessary to fill the open spaces. Just before completing this operation, rub the block of wood in the direction of the board marks, as a painter does with the last strokes of the brush. If the board marks of the original work are to show, take a sharp instrument and connect up the board lines on the surface of the patch, making it like the other work.

A little practice with the small block of wood will result in superior work, much better than if the mortar is finished with a trowel or if done with a large block of wood or float, which is entirely too big for the best results.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

War Department Establishes Materials Section

Will Redistribute Equipment and Material for Which Original Use Does Not Exist

(Washington Correspondence)

Hundreds of millions of dollars will be saved to the Government and taxpayers of the United States by a new bureau which has been established in the purchase and supply branch of the General Staff, under Gen. Hugh S. Johnson, director of purchases and supplies. The new bureau will have charge of what is to be known as the Surplus Inactive Supply Service, and by direction of the Secretary of War its work will be carried on, through General Johnson, as a branch of the office of Maj. Gen. George W. Goethals, assistant chief of staff and director of purchases, storage and traffic.

The work of the new bureau, as indicated by its name, is made possible by the fact that much War Department material and equipment becomes available or has become available, owing to changing conditions at the front in France and upon other fronts, for needs other than those originally intended to be filled. For instance, some time ago 36 wagons to be used in construction work were ordered for General Pershing, but the troops in charge of that particular piece of construction managed to finish what they were doing by ingenuity, using other equipment right at hand, and General Pershing cabled that it would not be necessary to ship the wagons. Now, through the work of the new Surplus Inactive Supply Service, these wagons will be used in construction work in this country.

Again, it has been found that there are about 2000 tons of special steel on hand, which were ordered for a particular branch of the War Department. It was ascertained in this, as in other cases, that the war has advanced more quickly than production, and this particular steel was not needed for the purpose originally intended, as other material was gotten out which could be put into production more quickly. The result is that under the work of the new bureau this steel will be turned back into other Government industry, where it will do the most good quickly toward winning the war.

Aid to Contractors on War Work

The new bureau will have before it all the time a current list of all this War Department surplus material and supplies, which might be regarded as inactive. A copy of this list or bulletin will be kept in the current desk files of all the purchasing divisions of the War Department, and the new bureau will have representatives in each division. Reference will be made to these lists, to see what the War Department has on hand, before purchases are made or new contracts are let. If a contractor turning out Government work is running short of certain material needed, he will be able to get in touch with the new bureau through the division of the War Department which made the contract with him, and it will be ascertained whether what the contractor needs is on the list of so-called inactive supplies, or it will be ascertained whether the new bureau has knowledge of the likelihood of material needed becoming available soon. The desire is to fill up shortage in industry and in the different purchasing divisions of the War Department. A few tons of steel, some brass or copper rods of a certain character or size, might hold up a great program, or delay General Pershing's supplies for the troops at the front.

To Co-operate with Industries Board

When material or equipment is found which is not wanted by any branch of the War Department, the case is taken up with the War Industries Board, and advice is sought as to where the material and equipment can be used to the best advantage in some war or other essential industry. Then, steps are to be taken so that the particular branch of industry most affected may have the opportunity of purchasing under the system of competitive bids.

Questionnaires for the purpose of taking a census are being sent out. Aside from the saving of hundreds of millions of dollars to the taxpayers and the Government, it is expected that the work of the new bureau will save a tremendous amount of time, labor and material, more essential in the winning of the war than the mere money involved.

War Department To Share Cost of Building Road

The expenditure of $95,000, as the War Department's share in the cost of building a road from Camp Gordon, Georgia, to the Norcross Rifle Range, has been authorized by the department. The total cost of the road is estimated at $190,000.

The present road between the two points runs through clay and it is frequently impossible to reach the range with heavy trucks. As this road will be used chiefly by the military authorities, the latter will bear the greatest part of the expense. The State of Georgia will give $65,000, while DeKalb and Gwinnett counties, through which the road runs, will each contribute $15,000.

No Engineer Commissions Until Draft Law Passes

Baker Order Suspending Civilian Entrance to Officers' Camps Applies to Drive for Engineers

Engineering News-Record is informed by Chief of Engineers Black that the recent order of Secretary Baker suspending all volunteering and the entrance of civilians in the officers' training camp applies also to the current drive to obtain first lieutenants and captains of engineers. The suspension lasts only until the new draft law is enacted, at which time conditions for entrance to camps will be announced.

The order is expected to be only temporary in so far as it affects the engineer officers' camp. All accepted candidates examined up to and including Aug. 13 will be commissioned without undue delay. Candidates examined after that date must await further developments. The Office of the Chief of Engineers will continue to receive applications and the examining board will continue its itinerary and examination of all candidates.

The board has already visited New York, Boston and Chicago and intermediate points. Its itinerary up to Sept. 16, when it returns to Washington, is as follows:

St. Louis, Aug. 15; Kansas City, Aug. 16-17; St. Paul, Aug. 19-20; Denver, Aug. 22; Salt Lake City, Aug. 24; Butte, Mont., Aug. 27; Seattle, Wash., Aug. 29-30; Portland, Ore., Aug. 31; San Francisco, Sept. 2-4; Los Angeles, Sept. 5-7; Deming, N. M., Sept. 10, and Dallas, Tex., Sept. 13.

Adjust River and Harbor Contracts To Increased Cost

The recent rivers and harbors act provides that the additional unexpected cost of labor and materials for certain work undertaken by the War Department shall not fall on the contractors who could not foresee such increases when they bid on the work. The plan reads as follows:

"That if the Secretary of War shall determine that any of the contracts for work of river and harbor improvements entered into but not completed prior to April 6, 1917, the date of the entrance of the United States into the war with Germany, have become inequitable and unjust on account of increased costs of materials and labor and other unforeseen conditions arising out of the war, he is hereby authorized, in his discretion and with the consent of the contractors, to modify and readjust the terms of said contracts in such manner as he may deem equitable and just: Provided, That such modifications and

readjustments shall apply only to work under said contracts remaining to be done hereafter and shall not include any relief for work performed heretofore under said contracts, and any such sum as may be necessary to provide for the increased cost of the contracts due to said modifications and readjustments, not exceeding the sum of $2,000,000, is hereby appropriated out of any money in the treasury not otherwise appropriated; Provided further, That as a condition of any such contract being so modified, the Secretary of War shall have the right, at the end of any fiscal year, until the contract is completed, to make such further modifications as in his judgment shall be advantageous to the United States and just to the contractor."

Camp Sewage Disposal Works Will Be Enlarged

Enlargement of sewage disposal plants at army camps and cantonments will be undertaken immediately by the Construction Division of the Army, according to a statement authorized by the War Department. The average cost of the work at each camp will be about $40,000. The enlargement has been made necessary by the increased number of troops. The decision announced followed a visit to the plants by a committee of sanitary engineers from the Construction Division and the Sanitary Engineering Section of the Surgeon-General's office. The committee reported that enlargements and alterations of the various plants must be made to safeguard properly the health of the troops and of the civilian population.

Men Wanted at Once by the Division of Engineering

One production and efficiency man, an expert bridge designer and four engineers of tests are included in the list of men wanted at once by the division of engineering, United States Employment Service. The division of engineering will not consider applicants who are already engaged in essential industries, as it is concerned only in filling war needs and not in creating them. All men wishing to enter the service of the division of engineering should write at once for application, addressing A. H. Krom, Director of Engineering, 29 S. LaSalle St., Chicago, Ill.

Board for Denver Water-Works Under City Ownership

Besides voting 6248 to 1800 to buy out the Denver Union Water Co., on Aug 6, the electors also indorsed by a large majority the board of five citizens selected by the city government to manage the works. These men are: John C. Skinner, Frank L. Woodward, Benjamin A. Sweet, Charles H. Reynolds and Finlay F. MacFarland. The plant will be taken over as soon as feasible. A general director or manager will be appointed.

Probably No Local Sections of National Societies

New Engineers' Club at Duluth Admits Members of Six National Societies Without Formalities

(*Editorial Correspondence*)

The Duluth Engineers' Club was organized Aug. 5 at a meeting at which Alfred D. Flinn, secretary of the Engineering Council, was the principal speaker. The purposes and aims of this new organization may best be told by the following paragraph taken from the articles of incorporation:

"Its general purpose is to create an instrument by which united action can be obtained by the members of the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual; to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general, and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession; and in general for uplift of the community, the profession and the individual."

At the time of organization and for a period of 90 days thereafter any member of the six national engineering societies (including the Chemical Engineers and Society for Testing of Materials) is eligible to membership without any formality upon the payment of annual dues. Qualifications for the two classes of membership are: Members, 10 years in active practice and three years in responsible charge; or a technical graduate with three years' actual practice and one year responsible charge; juniors must be actively engaged in engineering work or pursuing a course of study in engineering and at the age of 32 they must apply for advancement to member. The club starts with a membership of 87.

The officers selected, all of whom are members of some one of the national engineering societies, are: President, W. C. Swart, M. Inst. Min. E.; first vice president, E. R. Lewis, M. Am. Soc. C. E., chief engineer and assistant general manager of the Duluth, South Shore and Atlantic Ry.; second vice president, W. N. Ryerson, F. Am. Inst. E. E., general manager of the Great Northern Power Co.; secretary, W. H. Woodbury, M. Am. Soc. C. E., valuation engineer, Duluth & Iron Range Ry.; treasurer, W. H. Gallagher, M. Am. Soc. M. E., chief engineer for Peckans, Mather & Co.; board of directors, F. E. House, M. Am. Soc. C. E., Federal general manager of the Duluth, Missabe & Northern Ry. and Duluth & Iron Range R.R.; T. W. Hugo, M. Am. Soc. M. E., consulting mechanical engineer; W. F. Schwedes, Assoc. Am. Inst. E. E., electrical engineer for the Oliver Iron Mining Co.; W. J. Downing, M. Am. Inst. Min. E., chief engineer for the Shenango Furnace Company.

After two years of study of methods of organization it has practically been agreed that there should be no local chapters of the national societies in Duluth, and all society activities shall be carried on through the newly organized Duluth Engineers' Club.

Postpone Construction of Milwaukee Sewage-Works

Construction of the Milwaukee sewage treatment works has been postponed for the duration of the war. The intention had been to start building this year. Work on the intercepting system will be continued. This will divert sewage from the various river and lake outlets and concentrate it at Jones Island, where it is the intention to treat it temporarily with chlorine after passage through grit chambers.

Seattle May Sell $5,500,000 Bonds for Hydro-Electric Plant

Seattle has been authorized by the Capital Issues Committee to sell $5,500,000 of bonds for a 35,000-kw. unit of its Skagit River hydro-electric project, already authorized by popular vote. Only $1,500,000 of the bonds may be sold in 1918, and $1,000,000 every six months thereafter. Capital charges on the bonds must be met from the earnings of the municipal lighting department, of which J. D. Ross is superintendent. The bond issue authorized is designed to cover what will be known as the Gorge Creek unit. The city has water priority rights on two other sites. It is estimated that 200,000 to 250,000 kw. could be developed at the three sites. It is reported that the Capital Issues Committee advises connecting the light and power systems of the city and the Puget Sound Traction, Light & Power Co., so any surplus power of either may be used in the other and duplication of service during the war be obviated.

An outline of the application of the city of Seattle to the Capital Issues Committee was presented in *Engineering News-Record* of Aug. 1, p. 248.

Permanent Highway Transport Committee for New York

A permanent organization of the Highways Transport Committee of the State of New York was formed July 7 at Albany at a meeting attended by David C. Fenner, of the New York City Merchants' Association; George H. Pride, of the Heavy Haulage Co., of New York; George C. Diehl, county engineer of Erie County; Edwin A. Duffey, state highway commissioner, and others. The Hon. Peter Ten Eyck, of Albany, was chosen as state chairman. It is the purpose of the new organization to promote return loads bureaus and motor express routes throughout the state. The New York Merchants' Association has already established a successful bureau of this kind.

Directors of Students' Army Training Corps Named

Well Known Educators Appointed To Be Divisional Heads of College Military Instruction

Divisional directors have been appointed to coöperate in the formation and educational supervision of the Students' Army Training Corps, which, as announced in these pages some weeks ago, provides for the enlistment of men below the present draft age, in a special branch of the army and grants permission to them to attend, on furlough, technical schools for instruction. Units of the corps will be established at virtually all colleges having a minimum enrollment of 100 able-bodied male students.

President McLaurin of the Massachusetts Institute of Technology has already reported in Washington as the educational director of the corps. The divisional directors are as follows: New England States, Charles H. Haskins, dean of the Graduate School of Arts and Sciences, Harvard University; New York and New Jersey, Charles A. Richmond, chancellor of Union University; Pennsylvania, Maryland and Delaware, John Henry MacCracken, president of Lafayette College; Virginia, North Carolina, South Carolina, Georgia and Florida, Edward K. Graham, president of the University of North Carolina; Kentucky, Tennessee, Alabama, Mississippi, Louisiana and Arkansas, Bruce R. Payne, president of George Peabody College; Ohio and West Virginia, Raymond M. Hughes, president of Miami University; Michigan, Wisconsin and Indiana, Mortimer E. Cooley, dean of the College of Engineering and Architecture, University of Michigan; Illinois, Missouri, Kansas and Colorado, A. Ross Hill, president of the University of Missouri; Texas, Oklahoma, New Mexico and Arizona, Robert E. Vinson, president of the University of Texas; California, Nevada and Utah, Ray L. Wilbur, president of Stanford University; Montana, Washington, Oregon, Idaho and Wyoming, Edward C. Elliott, chancellor of the University of Montana.

Becomes Secretary of the American Association of Engineers

Selected as secretary of the American Association of Engineers, C. E. Drayer, assistant valuation engineer of the Nickel Plate, will leave Cleveland in a few days to take up his new work in Chicago.

Mr. Drayer has been actively engaged in engineering society work of local and national character for the past eight years. After graduation from college in Cleveland, Ohio, he served on Western railroads until 1910, when he returned to Cleveland to become field engineer for the Nickel Plate Railroad in grade elimination work. He immediately joined the Cleveland Engineering Society and began to put into practice, as opportunity offered, ideas of advancing the engineer in public esteem and of engineers training themselves to be leaders in service to the community. After two years of work in the local society in Cleveland he began to carry the same message to other societies and in time addressed most of the engineering organizations east of the Mississippi. In 1915 he became associated with Dr. F. H. Newell in forming the Committee on Engineering Coöperation, of which he is secretary. He organized and is secretary of the Ohio Association of Technical Societies.

C. E. DRAYER

He was joint editor of "Engineering as a Career," a series of articles of advice to young men. Several years ago he became editorial correspondent at Cleveland for *Engineering News*. Since the consolidation of *Engineering News* and *Engineering Record* he has continued in that capacity for *Engineering News-Record* up to Aug. 1. Most of his articles on engineering society organization have appeared in the two journals named. Mr. Drayer served the Cleveland Engineering Society as its secretary for two years, and was a member of its executive board when elected secretary of the American Association of Engineers. He formulated the plan of combined membership of the American Association of Engineers and Cleveland Engineering Society outlined by him in *Engineering New-Record* of Aug. 1, 1918, p. 217.

Mexican Engineers in Chicago Buy Irrigation Machinery

Officials of the Agricultural Department of the Mexican Government, most of them engineers, were in Chicago recently purchasing irrigation and farm machinery as a result of a survey of proposed agricultural development in the northern part of Mexico and conditions in the neighboring states to the north.

Amends Draft Questionnaire for Technical Schools

Includes New Clause Which Provides for the Exemption of Students and Professors

Under a recent ruling of the provost marshal general the draft questionnaire has been amended so as to provide a hitherto lacking blank whereby engineering students may claim exemption. The ruling further extends the class to teachers of engineering and instructors in military science in the schools. Section 151 of the selective service regulations has been revised as follows:

"Under such regulations as the Secretary of War may prescribe a registrant who is regularly enrolled in a school approved by the War Department Committee on Education and Special Training, and is pursuing full-time courses leading to a bachelor or higher degree in medicine, engineering, physics, chemistry or other technical subjects essential to the prosecution of the war, or who is an indispensable teacher in such courses, or who is engaged in the training of Army personnel may enlist in the Enlisted Reserve Corps, and thereafter, on presentation by the registrant to his local board of a certificate of enlistment, he shall be placed in Class V, Division D, on the ground that he is in the military service of the United States."

The provost marshal general further states that inasmuch as Division D of Class V includes "persons in the military or naval service of the United States" it is apparent that students who have enlisted according to the provisions of the paragraph cited above may make claim for deferred classification in Class V, Division D, as being in the military or naval service of the United States.

Safety Congress To Discuss Accident Prevention by Contractors

Accident prevention in construction operations will be the subject of one full day's deliberations at the National Safety Council Congress to be held in St. Louis, Mo., Sept. 16-20, inclusive. At this meeting steps will be taken to organize a permanent construction section of the council. The construction program, which will occupy the time of the congress during the morning and afternoon session of Sept. 18, will include the following papers: "Organizing for Safety—How To Secure the Coöperation of Superintendents, Foremen and Men"; "Safe Construction of Scaffolds and False Work"; "Effect of Accident Prevention on Insurance Rates"; "Accident Prevention in the Shipbuilding Program"; "Benefits of Accident Prevention in Contracting"; "Handling Material, by Machine and by Hand," and "How a Small Contractor Reduced Accidents." S. J. Williams, manager of the accident prevention division, National Safety Council, Chicago, is in charge of the program.

Free Disposal for St. Louis Garbage Delivered at Works

Only one formal bid for garbage disposal by reduction was received by the city of St. Louis, Mo., Aug. 6. The present contractor, the Indiana Reduction Co., offered to renew the contract expiring Sept. 1 at the present rate of 87c. a ton paid to it, the city to continue to deliver the garbage to the company at two loading stations within the city. As an alternative, the company offered to dispose of the garbage without charge, provided the city would buy its loading stations and river barges at a valuation of about $20,000 and deliver the garbage to the company's reduction works daily. The city declined this proposition, but offered to tow the garbage without charge from the loading stations to the reduction works, using the city harbor boat, at an estimated cost of 15c. a ton. This proposition was accepted by the company. The new contract will expire Mar. 1, 1920, but will be terminable by the company on 60 days' notice. The city will prohibit private collection by farmers. It is expected that the city will take immediate steps for the installation of a permanent municipal system. The second and informal bid, offering to dispose of garbage and street sweepings without cost to the city, was from two individuals said to represent the American Gas & By-Products Co. of Chicago. It substituted its own for the city's specifications and stipulated that the city must turn over to the bidders the Hirsh experimental plant described in *Engineering News-Record* of Sept. 20, 1917, p. 535, which is not in the possession of the city, and which the city officials assert has not fulfilled contract requirements.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The War Committee of the Technical Societies of Chicago held the first of a series of meetings, for the 6000 members of the 19 societies interested, at the Art Institute in Fullerton Hall on Aug. 1, at which more than 450 engineers attended. The meeting was addressed by S. J. Duncan-Clark, war analyst of the *Chicago Evening Post* on "Recent Developments on the War Front." W. L. Abbott, vice-chairman of the committee, explained the get-together spirit with which the societies in Chicago were working on war problems of the profession.

The Minnesota Joint Engineering Board called a meeting for Wednesday evening Aug. 7, at St. Paul, to meet Alfred D. Flinn, secretary of the Engineering Council. Mr. Flinn explained the work of the United Engineering Societies, Engineering Foundation and the Engineering Council, and asked for suggestions from the engineers of Minnesota and adjacent territory as to how these three organizations could serve them best. A representative of each of the societies present took part in the discussion following Mr. Flinn's address. The Engineers' Society of St. Paul acted as host.

The Engineers' Club of Columbus, Ohio, devoted an entire session July 26 to a committee report on "Flood Protection." E. A. Hitchcock, of the E. W. Clark & Co. Management Corporation, outlined the ten projects presented by Alvord & Burdick and Prof. C. W. Sherman discussed in detail the Summit level project. The annual outing of the club was held Aug. 10 at Glenmary Park.

The Engineers' Club of Northern Minnesota has elected W. J. Downing, chief engineer, Shenango Furnace Co., Chisholm, as its representative on the Minnesota Joint Engineering Board.

The Smoke Prevention Association will hold its next annual convention in Newark, N. J., Aug. 20-30. A tentative program has been arranged by Daniel J. Maloney, smoke inspector of Newark, vice-president of the association. The program will include papers on "Proper Hand Fire Practice in Relation to Firing Furnaces as Applied to Heating Plants," and "Boiler Room Efficiency." An entire day of the convention will be devoted to railroad matters, when papers will be read on the method of firing used by the Pennsylvania Railroad.

Personal Notes

J. W. BEARDSLEY, who was appointed last March as consulting engineer to the Ordnance Department at large, as mentioned in *Engineering News-Record* of Apr. 4, sailed from San Francisco for China July 31 to become assistant chief engineer of the survey of the Grand Canal of China from Tien Tsin 200 miles south. Mr. Beardsley was chief engineer of the Porto Rican Irrigation Service from 1910 to 1916, when he resigned to enter private practice as a consulting engineer. He was formerly employed by the J. G. White Engineering Corporation on investigations of irrigation projects, previous to which he was for seven years engaged in engineering work in the Philippine Islands as chief of the bureau of engineering and later as director of public works. He was graduated from Cornell University in 1891, and after service in Newton, Mass., and Chicago, he accepted a position with the Deep Waterways Commission in 1898. Two years later he entered the Corps of Engineers and in 1902 went to the Philippines. As consulting engineer for the Philippine Commission he investigated irrigation works in Java, Burma, India and Egypt.

EDWARD D. RICH, state sanitary engineer of Michigan, has received a commission in the sanitary corps of the National Army, and will be assigned to duty as chief instructor of sanitary engineers at Camp Greenleaf, Georgia. Captain Rich will succeed Chief Instructor Maj. William C. Hoad, formerly professor of sanitary engineering at the University of Michigan, who was commissioned as major in the sanitary corps of the National Army, at first attached to the office of General Gorgas in Washington, as previously mentioned in *Engineering News-Record.*

A. S. BALDWIN, chief engineer of the Illinois Central R.R., has been elected vice-president of the corporation. Mr. Baldwin, who was born at Winchester, Va., in 1861, entered railroad service in 1880 as rodman for what is now part of the Chesapeake & Ohio Ry. After a year he went with the Iron & Steel Works Association of Virginia, but in 1884 returned to railroad work and was for two years in the employ of the Baltimore & Ohio R.R. on the construction of its Philadelphia extension. He then went to the Chicago, Milwaukee & St. Paul Ry. as principal assistant engineer on the construction of its bridge across the Missouri River at Kansas City. From 1888 to 1901 he was with the Louisville & Nashville R.R. as assistant engineer, assistant to chief engineer and roadmaster, successively. In 1901 he began his service with the Illinois Central R.R. From 1901 to 1902 he was principal assistant engineer, from 1903 to 1904 engineer of construction and from 1905 to the present time chief engineer. Mr. Baldwin was president of the American Railway Engineering Association for the year 1916-17.

BENJAMIN B. FREUD and Harold A. Moore, Chicago, have been appointed captain and second lieutenant, respectively, in the Ordnance Reserve Corps.

RALPH BUDD, formerly chief engineer of the Great Northern Ry., has been elected chairman of the corporate executive committee of the Chicago, Burlington & Quincy R.R. After his graduation from Highland Park College of Engineering, Des Moines, Ia., in 1899, Mr. Budd entered railway service in the engineering department of

the Chicago Great Western, serving as draftsman, rodman, instrument man and assistant engineer, later becoming roadmaster and road superintendent of construction for the St. Louis division. Later he became division engineer. In 1906 Mr. Budd went to Colon, as chief engineer of the Panama R.R. In 1909 he became chief engineer of the Oregon Trunk Ry. and in 1910 chief engineer for the Spokane, Portland & Seattle Ry. Early in 1913 Mr. Budd was made assistant to the president of the Great Northern Ry., a few months later being appointed chief engineer.

A. J. WITCHEL has been appointed chief engineer of the Spokane & Inland Empire R.R. and the United Rys. Co. with headquarters at Portland, Ore. Mr. Witchel has been connected with the North Bank (Columbia River) System since its organization. The properties which he will now supervise were not taken over by the Government when the Spokane, Portland & Seattle, Oregon Electric & Oregon Trunk Line were federalized. A. E. Lufer, Federal chief engineer of the Spokane, Portland & Seattle lines, will relinquish supervision of the Spokane & Inland Empire and United Rys. lines.

CHARLES A. SMEATON, Chicago, has been appointed first lieutenant in the Engineer Officers' Reserve Corps.

CHARLES H. SWIGART, for several years connected with the United States Reclamation Service in the vicinity of North Yakima, Wash., and formerly project manager of the Yakima project, has been transferred as supervising engineer of the Columbia River irrigation district, including the irrigation project on the Columbia near Kennewick.

W. R. DRURY, instructor in sanitary engineering, University of Michigan, and assistant in the firm of Hoad & Decker, consulting engineers, Ann Arbor, Mich., has become associated with the Merchant Shipbuilding Corporation, Bristol, Pa. Since his graduation from the University of Michigan in 1913, Mr. Drury has been assistant city engineer of Ann Arbor.

THOMAS S. GRIFFIN, Brooklyn, N. Y., has been commissioned as captain in the Ordnance Reserve Corps, and assigned to duty with the civil engineering unit of the construction section, Supply Division.

J. H. MOORE has resigned as city manager of Sault Ste. Marie, Mich. Wilder Rich, city engineer, has become acting city manager.

CHARLES FITZSIMMONS, assistant to the chief engineer of highways for the southwestern district of Pennsylvania, has been named chief engineer, succeeding S. W. Jackson, who has been appointed superintendent of construction for the entire state west of the Susquehanna River, as noted elsewhere in this issue.

H. E. JORDAN, superintendent of the filtration plant of the Indianapolis Water Co., has been commissioned as captain in the maintenance and repair branch of the Quartermaster Corps and will be assigned to duty in connection with cantonment water supply.

R. J. F. CALKINS, city engineer, Everett, Wash., has resigned to take up work with the bureau of water resources of the United States Geological Survey, with headquarters at Tacoma. Mr. Calkins has been connected with the city engineer's office for ten years, becoming city engineer a few months ago.

TERRELL CROFT, consulting engineer and author, St. Louis, has been called to Washington, to assume charge of the work of standardizing electrical instruction for enlisted men. Mr. Croft's work will be under the educational committee of the War Department. He had been an instructor at Washington University, St. Louis

C. P. TOMLINSON, Hartford, Conn., has been appointed consulting engineer for the Southern Minerals Corporation, Boston, of which he is also a director. Mr. Tomlinson was graduated from the Sheffield Scientific School, Yale, 1907, and has been associated with Stone & Webster. Since 1914 he has been identified with the Ernest E. Smith interests.

A. W. HORWEGE, formerly city engineer of Petaluma, Cal., has been appointed assistant engineer by the United States Shipping Board and has been assigned to the concrete shipyard on Government Island at Oakland, Cal.

C. A. STRAND has resigned as city engineer of Eureka, Cal., to join the engineering staff of the Trojan Powder Company.

A. A. MATTHEWS, chief engineer of the St. Louis Southwestern Ry., has been appointed assistant chief engineer for all lines under the jurisdiction of J. L. Lancaster, Federal manager; E. S. Pennbaker has been appointed assistant to the chief engineer; R. L. Holmes, assistant engineer of the Texas & Pacific Ry., has been appointed engineer of water supply; W. D. Williams has been made bridge engineer—all with headquarters at Dallas, Tex. F. A. Mote and F. N. Baldwin have been made assistant engineers at Marshall, Texas, and New Orleans, respectively.

WILLIAM EATCHEL, for five years superintendent of properties of Multnomah County, Portland, Ore., has been appointed to succeed John B. Yeon, county roadmaster, who recently resigned to engage in spruce production work for the Government. Mr. Yeon will continue to serve as superintendent of the Columbia River Highway.

L. E. WEATHERWAX, secretary of the Seattle Master Builders' Association, and junior member of Hendrickson & Co., contractors, has enlisted in the Engineer Corps.

LEWIS P. SCOTT, assistant engineer, Illinois State Highway Department, in the Aurora office, has been commissioned first lieutenant in the Engineer Officers' Reserve Corps.

S. J. WILLIAMS, JR., principal assistant engineer of the Wheeling & Lake Erie Ry., has resigned.

S. W. JACKSON, chief engineer of highways for the southwestern district of Pennsylvania, has been appointed superintendent of construction for the entire state west of the Susquehanna River, with headquarters at Pittsburgh.

E. R. LEWIS, assistant to the general manager of the Duluth, South Shore & Atlantic Ry., has been appointed chief engineer.

PAUL E. GREEN, of the firm of Man, Green & Co., civil and sanitary engineers, Chicago, has entered the service of the bureau of industrial housing and transportation, Department of Labor, of which John W. Alvord is chief engineer.

RALPH R. BENEDICT, acting executive officer of the Board of Park Commissioners, Kansas City, Mo., has entered the service of the estimates and requirements section of the Ordnance Department.

F. L. NICHOLSON, chief engineer of the Norfolk Southern R.R., has been appointed consulting engineer of the Virginian Railway.

J. W. FOX, valuation engineer of the Central of Georgia Ry., has been appointed chief engineer for the company

O. L. ELTINGE, assistant engineer, Sanitary District of Chicago, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps. Lieutenant Eltinge was previously chief draftsman in the sewer division of the City Engineering Department of Kansas City, Mo.

OBITUARY

W. H. NEWMAN, formerly president of the New York Central & Hudson River R.R., the Lake Shore & Michigan Southern Ry. and other New York Central lines, died Aug. 10 in New York City.

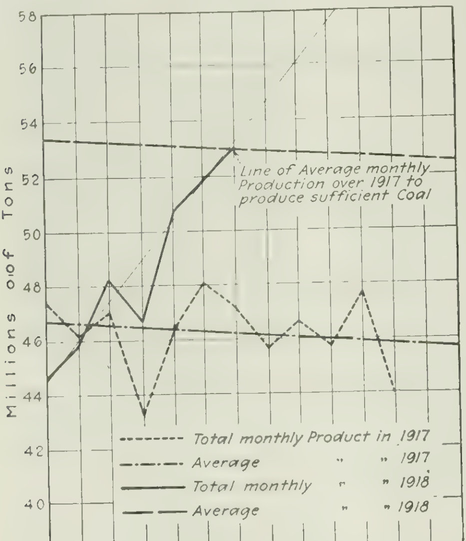
NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

President Warns Country of Extreme Fuel Crisis

Threatened Shortage Twenty Per Cent Greater Than Last Winter and Production Decreasing

President Wilson, by proclamation, has warned the country of a threatened coal shortage which may be 20% greater than last winter. Decreased production on account of miners avoiding deferred classification, resulting in the depletion of their ranks in the collieries, is adding to the danger. The President in his proclamation urges all miners, as a patriotic duty, to accept deferred classification and stay on the job, saying that the crisis demands the best work during a full number of work hours from "the highest official to the youngest boy."



RATE OF SOFT COAL PRODUCTION BELOW REQUIREMENTS

"And it is the patriotic duty of their friends and neighbors to hold them in high regard for doing so," he adds.

In *Engineering News-Record*, of July 18, p. 155, it was pointed out that the coal production, as indicated in the diagram that accompanied that article and which, with July production added, is shown herewith, must be such that the heavy line indicating the total monthly production of 1918 must follow the light line, to meet the coal shortage. It was stated at that time that the production curve was already flattening, but in the second and third week of July the rate was such as to indicate a rapid rise in the line instead of a flattening. The rate for the entire month, however, declined and this is the direct cause of the President's proclamation.

Recent bulletins from the Fuel Administration indicate that the production is running approximately 15,000,000 to 20,000,000 tons behind the schedule, so that it will be necessary to increase the output during August and September to exceed 14,000,000 tons per week or more than 60,000,000 tons per month, instead of the 53,000,000 tons shown for July.

Against this deficiency in production the demand for coal is growing so rapidly that all the estimates made at the beginning of the year are being broken down. Applications for additional allotments are coming from plants newly organized by the War Industries Board, unknown to its fuel administration at the beginning of the year; plants on the preferred list making large increases in their capacity; new shipyards that are being built in numbers far beyond expectation; increased bunkerings, and the Navy. The demand from this last item increased almost 100% in July.

The source of supply for this enormously increased demand lies within a very limited area, falling heaviest on the coal fields of the New River and Pocahontas Counties of West Virginia, and in Pennsylvania, Maryland and Kentucky. Though producing unprecedented quantities of coal, they lie in districts where transportation service is most difficult. The Fuel Administration, therefore, faces the difficulty of meeting the demand from this restricted area where car shortage is the largest factor, labor shortage coming next and mine disability a close third. Operators in portions of the New River and Pocahontas districts of West Virginia are the only ones reporting 100% car supply.

Robert F. Hall Heads Lime Association as Manager

With Headquarters in Washington He Will Direct Association of Lime Producers Lately Organized

Robert F. Hall, well known in the portland cement industry, has been appointed secretary and general manager of the Lime Association. He will have his office in Washington and will manage the affairs of the Association of Lime Manufacturers of the United States, formed after consultation with and at the recommendation of the War Industries Board.

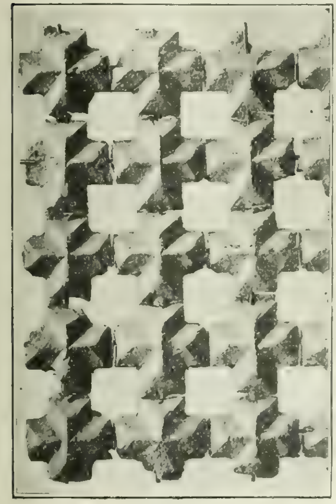
ROBERT F. HALL

Mr. Hall has been a resident of Chicago for 23 years and is a graduate of the University of Michigan, with the degrees of B.A. and LL.B. For a number of years he practiced law in the office of A. W. Green, who was president of the National Biscuit Co. Mr. Hall was associated with Mr. Green in the National Biscuit Co. and for 10 years occupied positions of trust and responsibility with that company. In 1909 he joined the forces of the Universal Portland Cement Co., and at various times held the positions of division sales manager and publicity manager. He resigned from the Universal Portland Cement Co. in April, 1916, to accept the responsibilities of the road promotion work of the Portland Cement Association, in which he remained until Aug. 1 of this year.

These connections with the cement industry brought Mr. Hall in touch with and enabled him to establish friendly relations with practically all of the cement manufacturers of the country. The last work with which he was connected in the cement industry was that of the building of concrete ships and the present advanced stage of that activity is attributed largely to his efforts.

Wire Lath Fireproofed by Baking on Small Terra Cotta Blocks

A novel fireproof lathing, consisting of a rectangular mesh of light wires with a terra-cotta covering baked on, has been placed upon the market and is finding extensive application in New York City. The accompanying cut shows a small section of the lath. The cross-shaped terra-cotta tablets which are baked onto the wires at their junction are not continuous, so that the lath can be put up in rolls for shipment, the wires bending at the junctions of the terra-cotta tablets. The terra-cotta, however, does stiffen the wire very much, and makes it easy to form a flat surface for plastering. The porous terra cotta forms a bond with mortar, obviating the necessity for forcing the mortar through, to form a key at the back; another advantage



FIREPROOF WIRE LATH

is that no furring strips are required. The stiffness of the lath is such that in some office buildings in New York City it was stretched tight from ceiling to floor and plastering was applied directly to both sides, forming a 2-in. solid partition, and the construction was approved by the New York Building Department after fire tests. Another use of this material is to form a plastering surface on which a finishing coat may be applied to concrete walls.

By placing the wire lath against the inside of the forms before the concrete is poured, the lath is left embedded in and firmly attached to the concrete, and furnishes a rough terra-cotta surface of sufficient bond for plastering. This lath has been used extensively in this way in the stations of the new subways in New York City. It is also being used in the construction of the new Pennsylvania Hotel.

Another use to which this material has been put is the fireproofing of large electric cables. A layer of the lath is wrapped around the cable, wired in place, and plastered. This lath is manufactured and sold by the Composite Metal Lath Co., 110 West 40th St., New York City.

Norway Strives To Be First Over Ocean with Concrete Ship

Norway is competing with the United States for the honor of building the first trans-Atlantic concrete vessel. At present the United States leads the world in the building of concrete ships, both in number and in size, but Nick Fougner, president of the Fougner Concrete Shipbuilding Co., of Norway, hopes to be the first to cross the Atlantic Ocean in one of his own concrete ships.

The shipyard of which Mr. Fougner is the head was described in *Engineering News-Record* of Dec. 13, 1917, p. 1088, and the accompanying illustration of the ship "Stier," a 1000-ton concrete vessel, shows a recent product of this shipyard. The vessel is 145 ft. over all, 27½ ft. beam, 15 ft. 9 in. molded depth, and is equipped with an internal combustion engine of 320 hp. It has four water-tight transverse bulkheads of concrete which make the ship practicably unsinkable when carrying a reasonable amount of cargo, the builders believe.

It is expected that the Norwegian builders will adopt the new protective coating which when applied to concrete makes a concrete ship equal in durability to a steel vessel. This discovery is the result of the research work recently done by the engineers of the Emergency Fleet Corporation of the United States.

This company has under contract 12 additional seagoing concrete motor ships, varying in size from 200 to 3000 tons dead weight, and it has already launched a number of craft of various types.

Summer Meeting of Industrial Traffic League

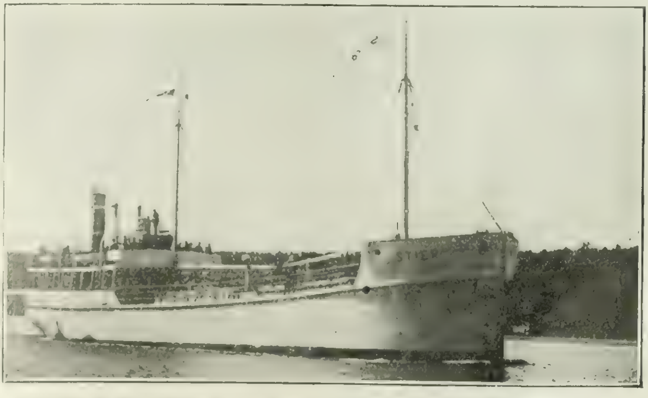
A summer meeting of the National Industrial Traffic League will be held at the Hotel Statler, Cleveland, Ohio, Thursday and Friday, Aug. 29 and 30. This is a postponed date from that given in *Engineering News-Record* of July 25, p. 203. The program of subjects, as announced by the league, will be of considerable importance, and will be published and distributed shortly. Every member is urged to arrange his appointments so as to be able to attend this meeting, and the league invites traffic representatives of organizations or individual concerns not members of the league. The secretary requests a list of such names and of prospective members to be sent to E. F. Lacey, assistant secretary, 413 Tacoma Bldg., Chicago.

Women in the Drafting Room

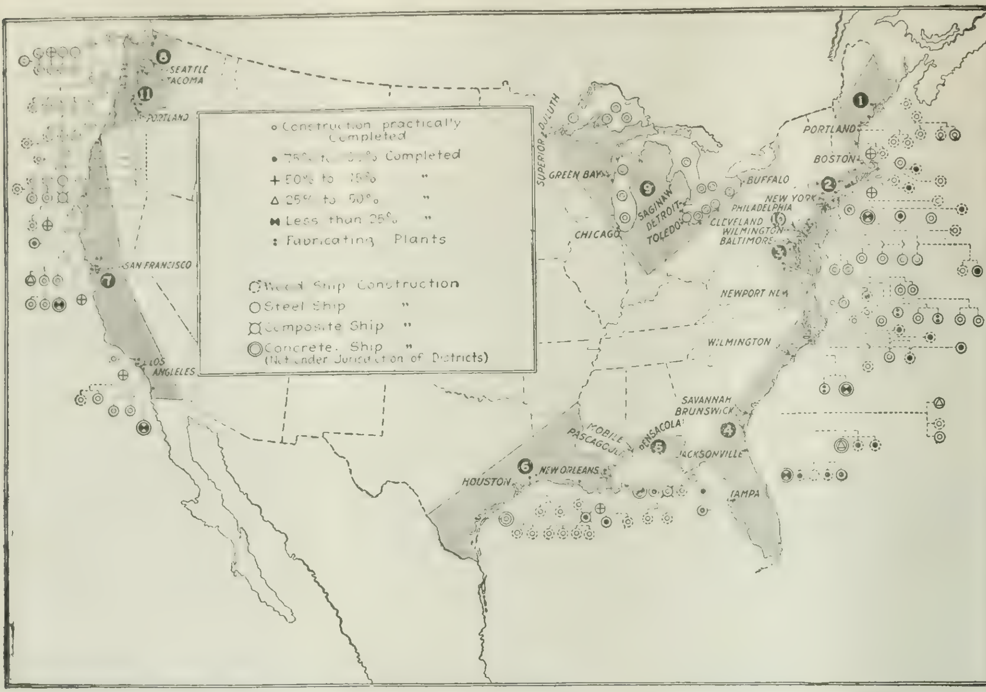
Although the employment of women in the drafting room is not new, it has not, until recently, received much attention. Now, however, the men being called to the colors from this occupation are being replaced by women in increasing numbers. In a recent issue of *Iron Age*, an article on the training of women for the drafting room told the methods employed in the engineering department of the Norton Grinding Co. The system and the results obtained are described by Howard W. Dunbar and W. E. Freeland.

The authors state that the work has not been in progress long enough to determine what will be the measure of success, but so far the adaptability for this work shown by the women is particularly promising.

The Young Women's Christian Association, desiring to coöperate with the Government and having experience in meeting the needs of young women, has established a Bureau of Coöperation with Employers for Industrial Managers, and is prepared to recommend to manufacturers women qualified for positions as employment managers.



TYPE OF NORWEGIAN CONCRETE SHIP EXPECTED TO CROSS ATLANTIC



SHIPYARD CONSTRUCTION FOR COUNTRY SHOWS RAPID STRIDES—MUCH WORK STILL UNDER WAY IN SOUTHEAST

Chemical Industries Will Hold National Exposition

The Fourth National Exposition of Chemical Industries will be held in Grand Central Palace, New York City, Sept. 23-28. It is announced that the advisory committee is working to make every department of the exposition a success.

Exhibits are expected from all parts of this country and Canada. The materials displayed will be of interest and benefit not only to chemists and financiers, but to technical and business men as well. A section for glass and ceramic industries has been added, with which the American Ceramic Society is coöperating. Prominent speakers in chemical and allied industries will present the conditions and needs of the country and the exhibition will illustrate the development of the chemical industry since the beginning of the war in 1914. The shutting out of many vital chemical imports by the war has tended to develop the domestic chemical industries to unprecedented proportions. This exhibition is an outcome of that expansion and will illustrate the changes made in the industry of the United States from the beginning of the war as well as the development of many new processes to meet the emergency demand.

Business Notes

G. M. Rockwell, recently with the Republic Motor Truck Co., has been made district manager and special representative for the Acme Motor Truck Co., Cadillac, Mich.

The Air Nitrates Co. announces the selection of a site east of the City of Toledo for the erection of the Toledo Government nitrate plant. The plant will cost approximately $20,000,000 and the company expects to have it completed in eight months.

William E. Taylor, of Taylor & Co., iron founders, Brooklyn, was recently named as chairman of the temporary trade committee on gray-iron castings of the War Resources Committee.

Russel E. Dean, formerly St. Louis manager of the Kerner Incinerator Co., Milwaukee, and recently sales manager of the Murphy Door Bed Co., St. Louis, Mo., has joined the Rex concrete mixer sales force of the Chain Belt Company, Milwaukee, Wis.

Clifton Reeves, president and general manager of the Reeves-Cubberley Engine Co., has been selected as industrial manager of the Curtiss Aëroplane Co. Buffalo, N. Y. For several years Mr. Reeves was the manager of the United States Board of Conciliation and Mediation, from which he has received a six months' leave of absence. Mr. Reeves will have complete control and management of the Curtiss factory.

Trade Publications

The Concrete Engineering Co., Omaha, Neb., has issued a handbook of fire-resisting construction illustrating various methods of construction followed by that company, and designing data. The book contains cuts of various structures erected by this company.

"The Martin Ditcher Grader and Terracer" is the title of a 28-p. catalog received from the Owensboro Ditcher & Grader Co., Inc., Owensboro, Ky. It illustrates the variety of uses for which this machine will be placed.

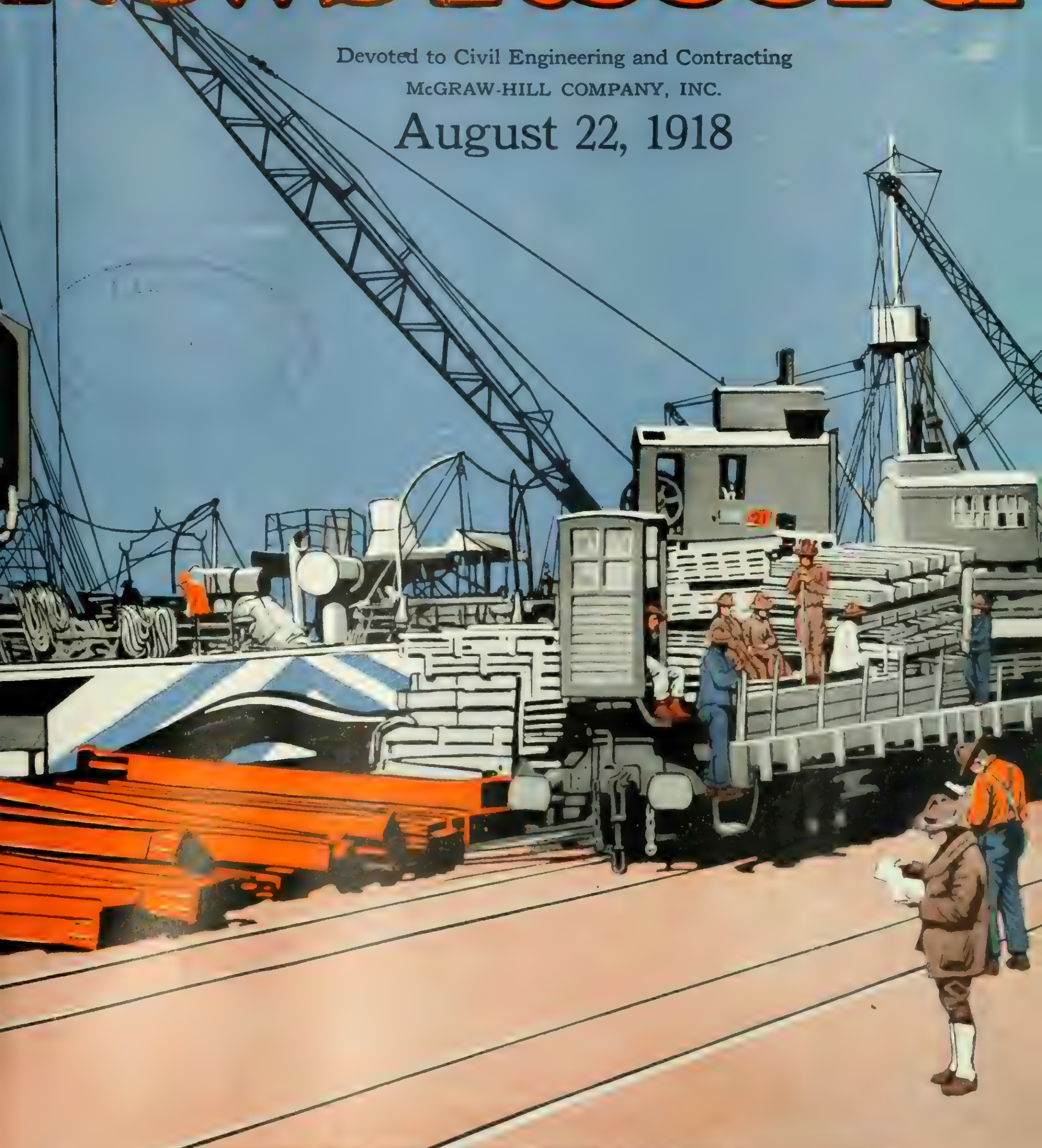
The Steel City Electric Co., Pittsburgh, Penn., has issued Catalog No. 33, dated May, 1918. It is a paper-bound book of more than 100 p., covering the goods handled and other useful data.

Engineering News-Record

Devoted to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC.

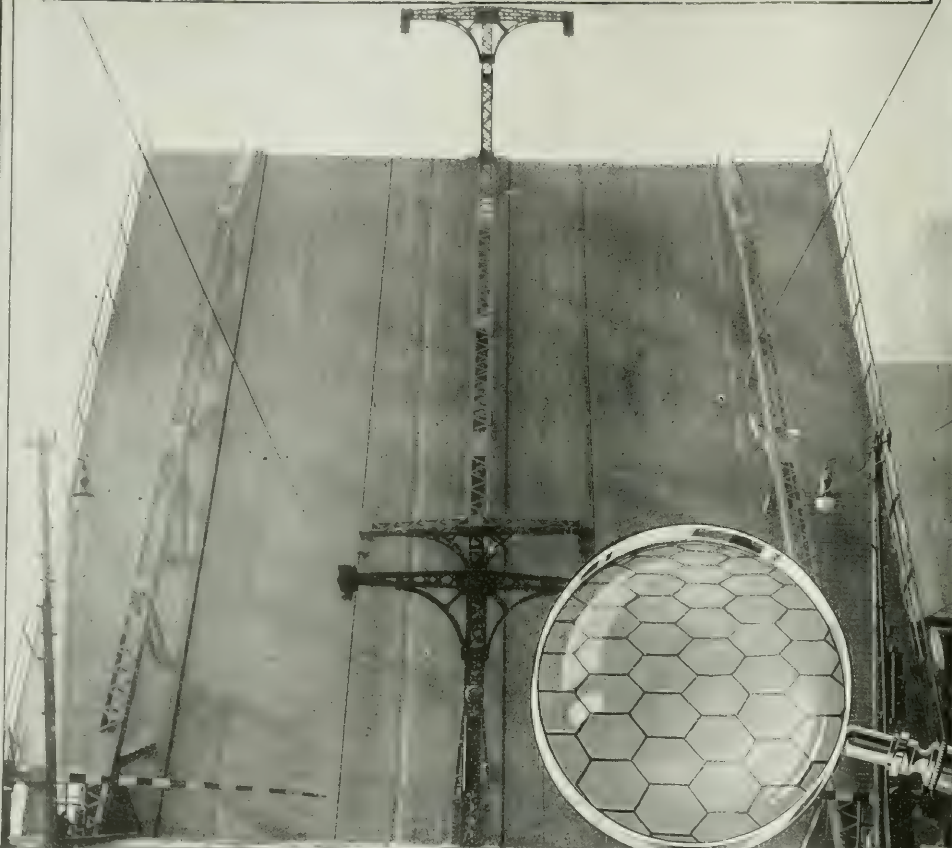
August 22, 1918



In This Issue—Designing Concrete Beams With Fixed Ends—By W. S. Tait.

Kreolite Hex

WOOD BLOCK FLOORS *Best for Bridges*



Kreolite Hex Wood Blocks on Randolph St. Bridge

Chicago specified Kreolite Hex Blocks for the Randolph Street Bridge because of their extreme durability under the heaviest traffic; the Hex shape also provides for the destructive thrust of expansion and bulging. Each block is 90% heart wood, which permits face nailing to the subplanking with 20d wire nails through the heart of the block without splitting. About 25% of these blocks are so nailed. This, with the pitch filler, binds the whole in a monolithic mass to the subplanking of the Bascule lift. Hex blocks knit together under use and absorb traffic vibration, thus prolonging the life of the bridge.

50% of orders received in 1917 were repeat orders.

THE JENNISON-WRIGHT COMPANY

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, AUGUST 22, 1918 — Number 8

Land Reclamation and Reconstruction Problems

INADEQUATE though it be, the $100,000 recently appropriated by Congress to investigate the reclamation of over-wet and of cut-over timber lands insures a beginning of a study fraught with great possibilities. Elsewhere in this issue A. P. Davis, director and chief engineer of the U. S. Reclamation Service, under whom the investigation will be made, reviews the vast potentialities of land reclamation as an aid to solving our post-war reconstruction problems, when three million soldiers and a like number of war-industry workers will be returned to civil life. It is fortunate indeed that the investigation has been entrusted to the Reclamation Service, with its large experience in such work, and with its reputation for ability and integrity.

Broader Reconstruction Studies Are Needed

CONGRESS must be convinced that the country is alive to the reconstruction problem. Next to winning the war, which we are helping to do, comes taking care of the veterans from trench, shipyard, factory and military offices. The $100,000 appropriation for land and reclamation studies mentioned in the foregoing note is but a twentieth part of the sum urged by Secretary Lane for reconstruction studies, as was noted in these columns June 10, p. 1161. The immense total of swamp and of cut-over timber lands and their wide distribution over the country, shown by the article by Mr. Davis, afford a partial illustration of reconstruction possibilities. Mr. Davis also touches incidentally on water-power opportunities, adequate investigations of which alone would cost many times $100,000. These are only two of many possibilities. There are others, not only of a national character, but also in the state, county and municipal fields. All of them need study, and the many and various studies must be correlated. The Federal Government must lead, and it cannot without more adequate congressional authorization and appropriation.

Where Are Reconstruction Engineers to Come From?

ENGINEERING studies cannot be made without engineers. A rapidly increasing percentage of the best engineers of the country are in the army or the navy, in the shipyards or other war industries. More are going every day. Where, then, are the engineers for reconstruction studies to come from? Already the state and municipal services and private industries have been stripped bare of their best men by the military and civilian departments of the Federal Government. Private industries, which will of course play a great part in reconstruction, will require engineers to work out plans, just as will the cities, the states and the country, for reconstruction work in many and various fields. The problem of supplying engineers is being taken up vigorously by some of our engineering schools, as is discussed editorially and discriptively further on in this issue. Washington authorities, both legislative and administrative, should lose no time in providing for men to take up the study of reconstruction—and also for counteracting the possible serious effects of drawing ruthlessly upon the engineering forces of our states, counties and cities.

Propose "Wet" Roads for the Farmers

WET roads are a paradoxical proposal when, generally speaking, the farmers are crying for bond issues to get them out of the mud. Possibly it was the humor of the idea which appealed to the Michigan State Hotel Association when it adopted the slogan "Good Roads, Cider, Wine, Beer," in an effort to become an invisible tail to a popular kite, and put through an amendment to the State Constitution permitting the sale of the lighter alcoholic beverages. Although the swag is to be split three ways, the hotel men mention only the portion which would go to highways, and have underscored the word in their advertisements as if they were unselfishly devoting themselves to improved rural transportation, without a thought of the liquor traffic. Or perhaps they mean to convey the idea—and a very proper one, too—that the farmers will need good roads to go home on after a few rounds at the bar. Certainly this ill-advised and untimely expedient of dragging the issue in by the ears to the confusion of a most important subject will bring down on the astute Solons who devised it the contempt they so richly deserve.

How Cities Can Help Win the War and Save Money

MANY cities which are anxious enough to help win the war are slow in seeing obvious ways in which they can do so—and put money in their treasuries at the same time. One way is to convert their garbage into grease, glycerine and fertilizer by reduction, or else into pork by feeding it to hogs. Bayonne, N. J., has just seen the light, through suggestion from Washington, and has postponed its plans for a garbage incinerator. The food administration is doing good educational work in this line. If it has not already done so it might well seek the coöperation of the Capital Issues

Committee with a view to preventing the approval of bond issues for garbage incinerators until expert investigation has shown that utilization by one or the other means already indicated is not feasible.

A Notable Commission Completes Its Work

JUNE 30 last an unusual commission went out of existence. After 24 years of honorable service, the Boston Transit Commission ceased to be, having completed all the subways Boston felt the need of for the present. Prof. George F. Swain served on this commission throughout its entire twenty-four year life. Horace G. Allen served all but two years, having replaced a member who resigned in 1896. The remaining three members replaced three of the original commission who had died. Throughout its entire existence the commission has been practically free from political influence, and has never been charged with waste, extravagance or inefficiency. In the construction of the original Tremont St. subway, and the later Washington St., East Boston, Boylston St. and Cambridge subways, many very intricate technical problems were solved. The example set by the commission to other similar bodies is of the best. Equally good is the example to legislatures and Government executives as to what can be accomplished when such a body is kept clear of the spoils system.

Denver Water-Works Pass to Municipal Ownership

COMPETING water companies have been so few and so small as to have almost escaped notice. The heavy vote (4448 majority) for the municipal purchase of the property of the Denver Union Water Co. on Aug. 6 brings to mind the most notable example—and failure—of competition between water companies in this country. It also marks the end of a long and bitter conflict between the City of Denver and the company, besides diminishing by one the few larger cities dependent on private companies for their water supply. It was in the early nineties that a rival water company tore up the streets of Denver. A water rate war followed during which rates were cut until for a time one company supplied water at 75% discount and the other gave it away. Soon the inevitable consolidation followed. For the ensuing quarter century there has been a fight on in Denver over water rates, franchise extension or the establishment of municipal ownership. No wonder the majority in favor of purchase was high.

Yankee Business Methods Again

ACCORDING to men who have recently been in South America, there has been little improvement in the business methods of American firms in dealing with customers in that important part of the globe. Were it not that all European trade is cut off, practices such as those reported would bar us from South American markets were our prices the lowest and our goods the best in the world. Imagine yourself a South American contractor who had ordered 22-ft. reinforcing bars for a concrete building already designed and who had received a broken shipment averaging less than 15 ft. in length. Imagine further that on reporting the error, which appeared to you a deliberate failure to fill the order, the North American firm replied with a figurative shrug of the shoulders that it was "merely a mistake." Would you be inclined to pursue your career as a purchaser in the North American steel market to discover what further "mistakes" United States manufacturers might feel privileged to perpetrate? It is a well known fact that one of the largest American manufacturers of construction material not long ago found it advisable to cancel a contract which meant a small loss to it at the sacrifice of the good-will of one of the most powerful South American governments. Another firm not long ago furnished forms that varied from the drawings so greatly as to be useless, and after sending a man to investigate calmly wrote the contractor that there was very little the matter with them. With such methods the American manufacturer cannot hope to last long in the competition for world trade that will follow the war.

Garbage Contract Awarded Without Engineering Advice

RECENT contracts for garbage disposal in a group of three Western cities are on the basis of the contractor getting pay to remove garbage which he uses for feeding hogs, thus making pork for his own benefit, as noted last week. In other cities contractors have been willing to pay for the garbage—after collection at municipal expense. Whatever may be the merit of the particular contracts mentioned, the fact is that the negotiations in at least one of the cities were made directly between the city council and the contracting company, no engineer or other expert being consulted in the interests of the city or the public. As an indication of public opinion on the subject, *Engineering News-Record* is informed that the award of this contract resulted in ousting the entire council at an election immediately following this action. The award was confirmed by the new council, but at a lower figure.

Is Chaos to Return in Highway Control?

GOVERNMENT bulletins had given the impression that all Government agencies dealing with highway problems had been combined when the U. S. Highways Council was organized. The public had a right to infer that from then on a definite highway policy would be followed. That this has not resulted is evident from the report of correspondence (page 352) between the commissioners of Huron County, Ohio, and the District Capital Issues Committee at Cleveland.

The Highways Council adopted the policy of considering only such road work as had been investigated, and submitted to it and recommended for construction by state highway departments, saying that when thus recommended it would give the matter careful consideration and approve or disapprove. This decision appears to have been nullified by the action of the district committee mentioned in refusing permission to issue bonds for work approved by the council, and those who had fondly hoped that whatever the decisions might be, the committee would at least follow a uniform rule laid down by qualified officials, have had a rude awakening.

Instead of this an assistant secretary of a district

committee on capital issues has, in one case, inspected a road, decided adversely upon its military value, exacted a pledge from the county commissioner not to build that road or any other road until such work has been approved by the district committee, and has used as a veiled threat to accomplish his purpose the power of the committee to disapprove the sale of pending bond issues. Furthermore, this coercion has not stopped at interference with new work, but has extended to work for which funds have already been provided, and for which the contracts have been let.

In view of Government assurances, this must be strongly deprecated. Only expert military and highway engineers such as advise the Highways Council are competent to estimate the war value of a highway, and when such functions are delegated to unqualified persons, those responsible lay themselves open to justifiable criticism. Such conflict of authority, if allowed to continue, will throw the entire highway problem back into the chaotic condition which existed before the formation of the Highways Council.

Railway Electrification an Engineering Question

DIRECTOR GENERAL McADOO, in a widely published interview given out on his return from a two-months' tour in the West, declared that if the Government is to continue for any long period to operate the steam railways of the country he would be in favor of wholesale electrification.

In this interview Mr. McAdoo unconsciously revealed one of the inherent dangers of Governmental railway control. The question whether the railways of the country or whether a given system of railways should or should not be converted from steam traction to electricity is not one that should be decided by impressions gathered in a hasty tour by either a railway magnate or a Government magnate. It is a question which should be investigated by competent engineers, qualified to take all the elements of the problem into consideration and accord to each its proper weight. With the railways under private ownership, their managers must find out whether a proposed change or extension will pay or not before they can undertake it. On Government-owned railways no such automatic safeguard exists. Of course the Railroad Administration's budget committee gave careful consideration to various electrification projects earlier this year, and rejected them for this year's budget. But Mr. McAdoo's unqualified declaration in favor of electrification is a reminder that it is at any time possible for unwise projects to be undertaken, for political motives or to benefit private interests, for which the taxpayers eventually have to bear the burden. It is of course true that under private operation of railways wasteful and unwise enterprises are also frequently undertaken, but in that case those who suffer are only those who make the mistake of investing their money foolishly, and the burden does not fall on helpless taxpayers.

There is another point of view with regard to the effect of Government ownership on electrification of railway terminal lines which has been agitated for several years in a number of cities, notably in Chicago. The controlling idea in the agitation there was that the city would reap benefits from electrification and the burden of paying for them would fall on the private owners of the railways. Under Government railway ownership it should be easier to make clear to the public that whatever burdens are laid upon the railways must eventually be paid by the general public.

Mr. McAdoo could profitably add to the information gained in his Western travels a study of the monumental report of the commission headed by Dr. W. F. M. Goss, which presented in 1915 the results of several years' work in studying the feasibility of electrifying the railway terminals of Chicago. That commission found the cost of electrifying the railway terminals in Chicago alone to be in round numbers $275,000,000 on the basis of pre-war prices. Under present market conditions for labor and material the necessary investment would be between two and three times as much. It seems almost needless to add that there is no spare reservoir of either labor, material or capital for the undertaking of any such huge enterprise at the present time.

This is not written to oppose electrification as a policy, but to point out that the electrification of any particular road or system is not a question which can safely be decided except on the advice of expert engineers. Without doubt it is also a question which should be restudied in the light of present-day conditions. On the Pacific Coast, for example, the railways which have been for many years using cheap oil for locomotive fuel find that the days of cheap oil are over; and in northern California there is probably enough water-power possible of development to care for the railways' needs, as well as to furnish power and light for manufacturing and other purposes. Even in the arid Southwest there are possibilities in the development of water power on an enormous scale in the Grand Canyon of the Colorado which are doubtless deserving of study.

Secretary McAdoo's emphasis on the importance of water-power development as a means of conserving coal is most gratifying, and may not be without effect in spurring Congress to take action on the long-pending water-power bill. There is no doubt at all that great public works of this sort, as has again and again been emphasized in these columns, need to be studied and made ready for development against the days when there will again be a surplus of labor and of capital seeking employment. All these public works, however, whether they be railway improvement or extension, water-power development, or land reclamation by irrigation (on which Mr. McAdoo also comments most favorably) need first the expert study of engineers so that the labor and capital may be expended to the best advantage.

An Opportunity for Chicago's Engineering Societies

TWO matters of vital engineering importance, zoning and the return load question, are now before the Chicago Association of Commerce without an engineer being on either committee. This despite the fact that two engineering societies of Chicago are members of the association and the association itself has a subdivision of engineers. The association officials will surely welcome any assistance engineers can and will give, and it is a sad commentary on the society activity

of engineers that they have not been sufficiently in the public eye to make the business men turn to them immediately and instinctively as soon as the problems came up.

Membership in the association carries both responsibility and opportunity—responsibility to bear a share of the burden of civic betterment problems, and the opportunity to work shoulder to shoulder with the staunchest business men of the city. Here the great labor problem is being threshed out from every possible angle. No better counsellor from the standpoint of information is available than the engineer standing midway between capital and labor. But the engineer is most conspicuous by his absence.

The way is open. The Chicago engineering societies with their prestige and far-seeing officers have made easy the path to the business man's council table. He will welcome them most heartily, but they must put upon themselves the burden of going to that table. The financial and business world needs the knowledge and judicial wisdom which the engineers' experience has given them.

The world is moving fast. It awaits no man's leisure. What formerly took five years to decide is now "signed, sealed and delivered" in as many months. If the engineers stay out of the development and it engulfs them the blame is on their shoulders.

Engineering Education for War-Time and Reconstruction Periods

ENGINEERS are needed as never before. They will be in greater demand as time progresses. Their qualifications must be higher, their application more intense, their devotion more single than ever. At a time when their numbers should be increasing to meet war-time and reconstruction-period demands the very fountain head, the engineering schools, are being drained toward dryness of both students and instructors by the exigencies of the war. True, important measures have been taken to keep engineering students at their schools by placing them in the Students Army Training Corps; but this has merely helped to lessen the decline in engineering students. Something is needed to increase the output.

Last year a number of engineering schools hastened graduation and provided a longer possible working period for undergraduates by cutting vacations and otherwise gaining time. That was good, but did not go far enough. It did point the way. Elsewhere in this issue there is outlined what Lehigh and Brown Universities are doing, not merely in their engineering departments but in all their courses as well, to speed up the preparatory period and get their students into the ranks of the fighters and workers for democracy. By cutting vacations and time devoted to examinations both these institutions make it possible for all their students to graduate in three instead of four years.

The change at these two colleges is most significant. It is needed for the reconstruction as well as for the war period. By the time normal conditions are restored the three-year courses will probably have been proved to be so practicable and desirable that many colleges will never go back to four-year courses.

Headshakers and doubting Thomases who question the feasibility of a three-year engineering course will be still more doubtful over the proposal for confining university instruction in engineering to two years, which was set forth in an address by a member of the Institution of Civil Engineers, quoted on p. 353 of this issue. The British courses in engineering, it appears, are only three years in length now. In proposing to cut them a third Mr. Silcock urges that when the schoolboy enters the university he should be treated as a man and made to work a man's day, exactly as is the case with the boy of 17 who goes from school to shop. The argument might well be extended to vacations as well. These are no times for short days and long vacations. If the school day were lengthened, the vacations shortened, the two weeks or more a year now given to examinations cut out, and, with all this, if the engineering and other college instruction were brought closer to the realities of living and working, it would be far easier than now to hold students for needed professional training of all kinds.

Mr. Silcock proposes that his suggested two years at the university be followed by three years of articled training under a member of the Institution of Civil Engineers. This is broadly similar to the coöperative courses in engineering which have been given for a dozen years at the University of Cincinnati. Like courses are to be introduced next month at Rutgers, as stated in the news section. Mr. Silcock would give the student his practical training in a lump, after the university work, while in the coöperative plan work and study alternate in two-week periods.

The coöperative plan has the material advantage of making the student a producer besides making an engineering education a possibility to many who would otherwise be denied a college course. Both advantages are important—doubly so in war-time.

If the regular engineering courses can be reduced from four to three years to meet war conditions, should not the coöperative courses be four years instead of five? The problem would be harder. The Rutgers plan cuts the vacation total to the bone, so no further saving is possible there.

The shortening of all college courses at Brown and Lehigh, the new coöperative courses at Rutgers and Mr. Silcock's arguments for a two-year university course for engineering students are signs of the new spirit of concentration and service in which not only educational but all other problems must be attacked and solved. To meet conditions we must have more engineers and better engineers, and that quickly.

Continuous-Span Bridges and Structural Efficiency

OF POLITICAL interest to the entire country as marking the reconstruction of a link in the main supply line of our now all-important steel industry is the rolling into place of the Bessemer & Lake Erie's new Allegheny River bridge two weeks ago. It also claims a place of note in engineering history. The operation put in service the second great continuous-span bridge of the present era. A new movement in bridge practice is definitely established by this structure, a movement toward economy of a higher type. Tendencies in the same direction have been clearly discernible in other fields of engineering work during recent years.

In the rise of continuous-span construction—signalized by the Sciotoville and Bessemer bridges and, far north toward Hudson's Bay, by the Kettle Rapids crossing of Canada's yet uncompleted grain-export route to Port Nelson—the deciding factor was economy of metal. It is a factor of ever-increasing moment. Evolution of design and progress in methods of fabrication and erection have steadily tended to cut down the cost differences between competing forms of structure to the base-level of difference in material consumed. As this process continues, both cost and service value are coming to depend mainly on structural efficiency—efficiency in applying material to specified duty. The future is sure to see structural efficiency acquire yet greater importance, and the line of progress marked out by the design of the three newest large bridges will be a permanent line of progress.

Present relations between production and consumption of materials emphasize economy of utilization in remarkable manner, and therefore afford peculiarly appropriate occasion for the introduction of the continuous-bridge type. However, though steel economy was the motive, war prices and delivery difficulties played no part in dictating the design. More general causes were active. Chief among them was the fact that a long-established distrust of the continuity principle has bit by bit disappeared before the influence of advancing design and construction methods.

Beyond the mere uncertainty of knowledge which this distrust represents, however, an uncertainty of tangible physical kind long stood in the way of free use of continuous-span bridges. Such bridges involve stress reversals, and these are objectionable with pin connections. The complete elasticity which a continuous bridge must have, in order to make it amenable to analysis, is vitiated seriously by pin-hole play when the forces on the pin reverse. During the years when pin connections were standard in American bridge practice, a continuous bridge was bound to be a structure of uncertain action, its stress distribution depending on the chance fit of the pins and their positions at no-load condition.

It is now many years since pin connections were abandoned for short spans; in the short-span field, however, continuous construction is not easily applied, because of difficulty in providing end anchorage. On the other hand, large bridges present such difficulties in the use of riveted joints that until late years pin connection remained universal.

Such recent works as the Fratt bridge over the Missouri with its long, full-riveted spans, therefore, helped to prepare the ground for long-span continuous bridges. It is significant that the Sciotoville bridge, the first of the three new structures mentioned, required spans of exceptional magnitude, and all its joints are riveted. In part for this reason the Sciotoville bridge is likely to remain the type expression of the new form of construction. The Bessemer bridge, having shorter spans—though presenting fully as difficult problems—might with still better reason be expected to have riveted joints. But its designer, departing from practice established by others, decided on partial use of pin joints, and succeeded brilliantly; the eyebar members which he was thus enabled to use increased the steel economy of his structure considerably.

That skillful engineering can apply continuous construction without being forced to understand restrictions such as abandonment of eyebars or equality of span length is illustrated by the Bessemer bridge. We have been taught that the very real obstacle of physical indetermination due to loose joints may be overcome in two ways. The development of practical riveted joints for bridges of even the greatest magnitude furnished one way; the perfection of bridge-building methods to the point where composite pin and riveted construction is feasible supplied the other.

Much has been made of pier settlement as a danger to permanent serviceability of a continuous bridge. Past writings of many kinds appeared to set up such anticipated settlement as a conclusive argument against the practical use of continuity. But as settlement even in serious cases is small—harmless, in view of the range of motion which the flexibility of a long span allows—probably this argument was never intended to be taken at face value. It seems to have been the outward evidence of a general doubt concerning the proper stress action of elastically continuous structures. Engineers did not feel certain that the shop and the erector would produce a bridge identical in strain-and-stress behavior with that represented on the design sheet and in the computations.

Today this uncertainty no longer exists. The successful construction of the three continuous bridges taught us several important truths. We now know that the adjustment operation is mechanically simple. We also have learned that the required end reactions can be attained with great precision. Finally, we are told that observed and computed deflections checked very closely; and this is perhaps the most important fact of the three, as it proves definitely that our theory of continuous structures is adequate.

Time and engineering progress have dealt with some other difficulties that stood in the way of favorable consideration of continuous bridges by practical engineers. Design calculations for such structures are difficult and tedious, and up to relatively recent years this fact was a very real hindrance. The former practice of proportioning bridge members by stress-reversal formulas—appropriate, if anywhere, only in the designing of detail—acted in the same direction, through reducing the gain obtainable by the continuity action. Current views regarding expansion and contraction, which led to a preference for sectionalized structures, gave an apparent advantage to simple-span and cantilever over continuous construction, but they no longer are determinative; placing a distance of 1200 ft. between anchorage and expansion joint, as in the Bessemer bridge, is today's iconoclastic reversal of yesterday's opinion.

With smaller obstacles thus cleared out of the way, the Sciotoville, Bessemer and Kettle Rapids bridges dispose of the crucial difficulty of uncertain stress action by supplying vital and decisive knowledge on adjustment and stress action. They open a new future to continuous-span construction, and do much toward establishing the type as a definite fashion of design. And because each separate instance was decided essentially on the score of saving in steel, the doctrine of structural efficiency—economy of material—receives significant emphasis.

Roads in Base Section of American Forces Require Widening and Resurfacing

Heavy Traffic by Motor Trucks and Artillery on Practice Marches Necessitates Continuous Maintenance—Many Narrow Roads Were Never Designed for the Traffic They Are Now Carrying

BY ROBERT K. TOMLIN, JR.
War Correspondent of Engineering News-Record
Photographs by Engineering News-Record

AS A result of the occupation of large areas in France by troops of the American Expeditionary Forces, existing roads are being subjected to more intensive traffic than they have ever before carried. It goes without saying that upon the highways in the advance section a heavy burden is imposed, and in a former article I dealt with the work of our Road Service in this forward zone (see *Engineering News-Record* of May, 16, p. 953). Somehow or other, it seems to be taken for granted that the problem of road reconstruction and maintenance is confined to the territory immediately behind No Man's Land. I know that before I arrived over here I had a rather vague idea that most of the engineering activity of the armies was confined to that mysterious region known as "the front." This is by no means the case. In so far as the duties of the highway engineer are concerned, the road problem begins at the French seacoast and extends from there to the trenches.

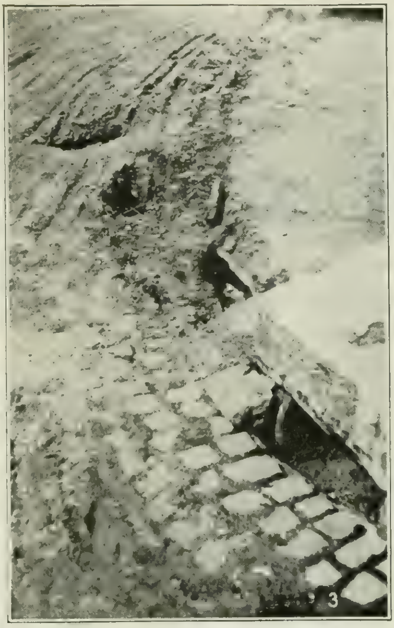
Let us remember that the trenches which American divisions are now occupying and the west coast of France are separated by several hundred miles. Let us remember, also, that practically all of our supplies must be delivered from America at French ports and transported across this stretch of land, several hundred miles long, before they can reach the combatant troops. We have, therefore, a main base of supplies some 3000 miles across the Atlantic, certain places in France where ships carrying these supplies dock, and then this distance of several hundred miles between the marine terminals and the points of ultimate consumption. This condition of affairs is one which has a very decided bearing on the upkeep of the roads.

Of course, most of our material is shipped across France by railroad to the advance section. Yet, strung along in a wide band between the seacoast and central France is village after village crammed full of American troops. There are our cantonments, artillery training camps, forestry camps, aviation grounds, storage depots, railway yards, ordnance dumps, repair shops—all of these groups marking the way between our base sections and forward lines. The creation of these *new* centers of population along our lines of communication, together with the practice of billeting American troops in scores of old French villages, means, of course, a substantial increase in motor-truck traffic on roads which were never designed for such hard usage as they are now receiving. Between towns where two-wheeled oxcarts proceeding at a snail's pace used to supply the bulk of the traffic, one sees now lines of motor trucks hauling supplies, or big powerful French camions pulling 6-in. field artillery pieces in long convoys.

In the immediate vicinity of the newly built American docks in the base section traffic has become specially heavy. Motor trucks are arriving and departing constantly on short-haul trips. Then, too, the presence of American troops in this region means a great deal of fast moving traffic in the form of army cars carrying officers from one point to another. The roads subjected to this ever-increasing heavy traffic are for the most part either dirt or plain macadam, and labor, material and plant for maintenance or reconstruction are extremely scarce.

THE SUPERINTENDENT OF ROADS WAS FORMERLY CHIEF ENGINEER, BUREAU OF HIGHWAYS, BOROUGH OF MANHATTAN, NEW YORK CITY

I have recently returned from a tour of inspection of the roads in a base section which includes the new docks which our engineer troops have built, huge storage depots and railway yards, a big artillery training camp and scores of other important army centers. The superintendent of roads for this section is a major of engineers who was formerly chief engineer of the Bureau of Highways of the Borough of Manhattan, New York City. According to his analysis of the situation the road work in this base section includes the construction of 20 km. of new roads, the complete maintenance of 120 km., and the partial maintenance of 180 km., resulting in a total of 320 km., or, roughly, 200 miles of road. This mileage includes all of the standard types of French road: (1) *Route nationale;* (2) *route départmentale;* (3) *chemin de grande communication;* (4) *chemin d'intérêt local* and (5) *vicinal ordinaire.* These roads, all of the water-bound macadam or plain gravel types, vary in width from 6 or 7 m. in the case of the *routes nationales* to as little as 3 m. for the *vicinaux ordinaires,* which correspond, roughly, to an American dirt road through farming country. At the present time the French Government, through the *Ponts*



FIGS. 1 AND 2. TWO VIEWS ALONG FARM ROAD THREE METERS WIDE NOW BEING USED BY OUR FIELD ARTILLERY TROOPS FOR PRACTICE MARCHES — NOTE MARKS LEFT BY CATERPILLAR TREADS OF BIG GUN CARRIAGES AND NOTE ALSO HOW TRAFFIC HAS BEEN FORCED OUT ON SHOULDERS AND INTO DITCHES

FIG. 3. PASSAGE OF AN ARTILLERY TRAIN THROUGH A SMALL FRENCH VILLAGE HAS BROKEN CULVERT

et Chaussées and Departmental forces, is endeavoring to do the bulk of the maintenance on the national roads and departmental roads; but as American Army activities over here in France expand, much of this work will have to be taken over by the United States.

The problem of the American road force in the base section resolves itself mainly into the upkeep of existing roads, and the building of new roads in the camps, and can be classified under the three main heads of (1) ordinary maintenance, consisting mainly of the filling in of holes; (2) repairs, involving complete jobs of resurfacing, and (3) widening. Many of our centers of military activity in the base section are off the lines of main traffic, with the result that ordinary farm roads are the only existing routes available for motor-truck traffic and practice marches and maneuvers by field artillery with their heavy guns, limbers and camions. In the case of the *vicinal ordinaire*, or farm road, the width of only 3 m. is insufficient for the passage of two trucks, and sometimes, in fact, difficult even for the passage of a single line of the wide artillery carriages. Fig. 1 shows how a practice march of field artillery over these narrow dirt highways chews up the shoulders of the road, even when running on caterpillar treads, whose marks are clearly shown. In Fig. 2, note from the wheel tracks how traffic has been forced off the road into the ditches. Then, too, these artillery loads, amounting to 7 tons per axle, must be hauled over culverts never designed for such weights, with results such as those shown in Fig. 3. This broken culvert was a cement pipe about 1¾ in. in thickness and a foot or so in diameter. For such traffic the demand is for wider roads, or for turnouts at frequent intervals. Then, too, the intersections of these farm roads are not designed for vehicles with the long wheel bases that now use them, so that our road force must build out the edges to provide easier curves at crossroads.

In the case of the wider trunk roads the foundation course of *blocage* ranges from 6 to 10 in. and the top course is about 6 in. On the town and village roads, which are now receiving so much American traffic, however, the top course is very thin, often only about 3 in., and often there is no special foundation course. The problem of maintenance of these routes is complicated by the difficulty of getting crushed stone delivered on the job. It is necessary to resort as far as possible to local material. Fig. 4 shows a gravel and sand pit opened up by the American Army Road Service.

FIG. 4. SAND AND GRAVEL PIT BEING WORKED BY SPANISH LABOR, DIRECTED BY A DETAIL OF ONE OF OUR ROAD-BUILDING REGIMENTS

It is being worked by Spanish labor under the direction of a detail of our roadbuilding regiment. Owing to the scarcity of materials it is not always possible to resurface roads with as thick a course as would be desirable.

For handling the work of complete and partial maintenance on the 320 km. of roads in the base section, the force at the time of my visit consisted of the superintendent of roads, two other engineer officers, 225 men of a roadbuilding regiment, and a labor force of 350 Spaniards. The equipment included one passenger automobile, one light truck, 18 dump wagons, three road rollers, 36 animals and 20 motor trucks, including a number borrowed from the French, a certain proportion of which, however, were always in the repair shops.

The superintendent of roads of the base section recently prepared a statement of the personnel and equipment which, in his opinion, the needs of the work in his district for the next six months demanded. It was essentially as follows: One superintendent of roads, 12 engineer officers, 1500 men. As for plant desired, the following were the chief items: 12 steam rollers, 50 5-ton back-dumping motor trucks, eight light trucks, 85 wagons, 188 animals, 15 sprinkler wagons and a large quantity of small tools such as wheelbarrows, forks and shovels. During the next six months estimates have placed the amount of crushed stone needed at 50,000 tons, or about 5000 carloads. For purposes of inspection there were requested eight passenger automobiles, and nine motorcycle side cars. The present situation in France with respect to the available supply of men and materials is one which has resulted in the giving of priority to requisitions from the zone of the advance section, so far as road matters are concerned.

The labor problem is being partly solved by the employment of Spaniards, who receive 11 francs per day of 8½ hours. These men must house and feed themselves—not a difficult matter, in view of the proximity to the work of a large city and innumerable villages. The army, however, must transport these men, generally in motor trucks, to and from their jobs, or at least to and from points where transport by electric railway is possible. The Spaniards, I am told, are proving to be fairly good workmen. They are not under military control and can be hired and fired as desired. Their wages of 11 francs daily is big money for them, and most of them seem eager to hold down their jobs by doing a real day's work.

This is not the case, however, with some of the Chinese labor which has been imported into France and is under French control. I had an opportunity of seeing a great many hundreds of newly arrived Orientals on French jobs in and near a large camp. They were sprawled along the roadsides, asleep, or squatting in groups, talking. Several times I saw these fellows start out with wheelbarrows containing one-third of a real load. They would take a dozen steps, and then, when the French boss of the gang had his back turned, would flop down on their knees, lay their heads in the bodies of their wheelbarrows, and go to sleep. The only sign of real activity among these Chinamen was along a roadside where a gang, presumably on work of spreading crushed stone, was clustered around a cage containing two canary birds—which I suppose were the mascots of this crew. They had brought the birds out on the job with them, hung the cage on the limb of a tree, and were sitting around like an audience at an open-air theatre, watching their pets jump from one perch to another of the wire cage. I understand that there is some clause in the agreement under which these Chinese "work" which prevents their being disciplined.

After seeing them in action I could appreciate the humor of the scene enacted the next day in the office of the American major of Engineers who has charge of our road work in the base section. The door opened and a French officer entered. After greeting the major, he said, "At last I can help you with labor for your road work. I have 500 Chinamen I will let you have."

The superintendent of roads shook his head in a decisive, unmistakable negative.

"*Mon Dieu!*" exclaimed the Frenchman. "Why do you not want them?"

"*Mon Dieu!*" countered the American. "Why do you want to get rid of them?"

One of the solutions of the labor problem for road work in the base sections may be the use of French refugees from areas in the zone of the armies. A bureau has been established in Paris, and the plan is to organize labor battalions which will be paid, housed and policed by American interests.

"There is this difference between the road problem of the French and American armies," said the superintendent of roads of the base section. "For the forward areas the French have their special engineer troops, while in the zones of the rear the work is attended to by civil organizations, such as *Ponts et Chaussées*, and departmental and *vicinal* services. The equivalent of our own *Ponts et Chaussées* is 3000 miles

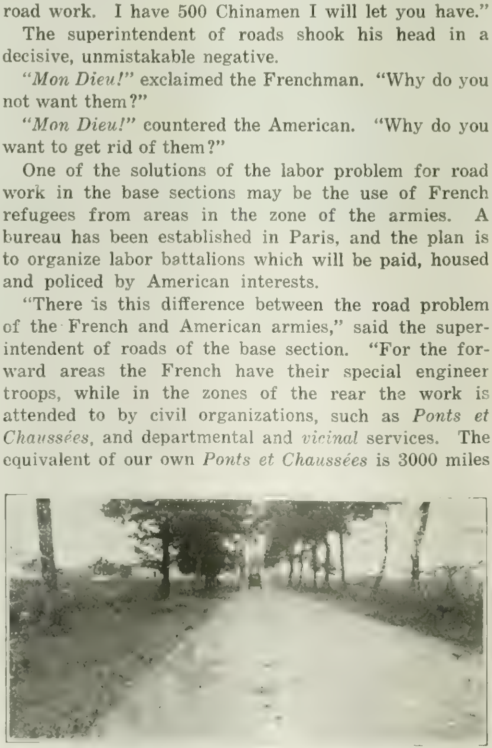


FIG. 5. FRENCH ROAD OF "GRANDE COMMUNICATION" TYPE—USE BY ARTILLERY IS PRODUCING RUTS AND HOLES WHICH WILL SOON NEED ATTENTION

away, in the form of the Federal Office of Public Roads and the various state, county and town highway bureaus. The result is that the American Expeditionary Forces must perform work, in the territory they take over, with their own roadbuilding forces, while this job for the French is done by an existing and thoroughly well-organized department of civilians, leaving the army engineers free for work immediately behind the front.

FIG. 6, 7 AND 8 WIDENING A NARROW ROAD LEADING INTO AN IMPORTANT AMERICAN ARMY CAMP — MOTOR TRUCKS DELIVER CRUSHED STONE TO THE JOB, AND THE STONE IS SPREAD ON EITHER SIDE OF THE ORIGINAL ROAD

To get results equivalent to those of the French we must look forward to a considerable expansion in the American roadbuilding personnel in the regions back from the advance section."

One rather difficult job which the road service is handling is the maintenance of a road leading to our new docks. This route is, in places, flanked by houses which extend flush with the edges of the road, so that at some points there is no opportunity for widening. The traffic of motor trucks to and from the docks is very heavy, and all that can be done is to throw crushed stone into the holes which develop in the road surface. In one place, to secure better drainage, it was necessary to tunnel under a barn, for these buildings form regular walls along both sides of the road, there being no room even for sidewalks. This road is particularly difficult to maintain, because in addition to the almost endless stream of traffic it carries it is frequently inundated during high tide, being fairly near the water. Under conditions of lighter traffic the superintendent of roads in the base section told me he would like to try some form of road construction other than macadam—possibly a concrete road—but inasmuch as this is practically the only route leading to our new docks, the traffic over it continues in a steady stream all day, and sometimes far into the night, and there is no opportunity for putting the road out of service for reconstruction, even during a comparatively short period. About the only thing that it is possible to do with this road under present conditions is to fill up the ruts with broken stone as they develop.

On another rather heavily traveled road the maintenance force in the base section accomplished the feat of making a 3-ft. fill under traffic. This fill consisted of sand and gravel, and was spread in thin layers between the movement of vehicles.

Particularly in the vicinity of large American army camp centers for the repair of machinery and equipment, it has been necessary to do a considerable amount of road widening. Figs. 6, 7 and 8 give an idea of the problem and how it is being handled. This road was originally only about 3 m. wide and of macadam construction with rather thin surfacing—too thin, in fact, to stand up under the motor-truck traffic which it will soon have to bear. The widening process consists of adding about one meter of paved surface to each shoulder, and putting on a top surfacing of about 4 in. Crushed stone for this job has been delivered by motor trucks as shown in the pictures. This process of widening generally is not complicated by the necessity of providing new drainage ditches, inasmuch as French practice generally places these ditches some distance from the shoulders of the road, leaving space for additional paved widths when this becomes necessary.

In another route which had to be resurfaced, the following scheme of construction has proved efficacious: The road is first scarified, and upon it a layer of hard blue stone 4 in. thick is spread. For binder material there is added a thin layer of soft limestone. The surface in this condition is then watered and rolled with a 17-ton roller until it becomes sloppy. Then a layer of sand is sprinkled over the top and the material rolled again. When it dries out this form of construction makes a hard, smooth road.

One of the difficulties of the road work in this base section is the matter of securing an adequate supply of crushed stone. Plans are under way for the opening up of several quarries by our forces. The rights for these must be secured from the French property owners, and it is not always an easy task to reach an agreement on prices, particularly as the negotiations must be conducted in French, either directly or through interpreters.

Of course, the local quarry owners are losing no opportunities of getting as high prices as possible for their rock, and our superintendent of roads is equally vigilant in his efforts to secure a fair price from the standpoint of the American Army. I happened to be present during one of these quarry-buying negotiations, and I noted particularly that the major of engineers who is looking after our interests in this section has learnt enough French to judge of values when stated in francs, and to say *"trop cher"* when an exorbitant figure is quoted to him.

In addition to the road work proper, there is the matter of bridges. Our work did not include the building of any new bridges, for in this region there are numbers of structures of all types, some of them built more than 100 years ago. In walking over one of the oldest bridges (suspension type, 250-ft. span), in the wake of a two-wheel ox-cart, the floor could be seen to rise and fall in a regular wave, and there was a noticeable creaking and swaying of the bridge. The road superintendent is responsible for keeping our troops off such structures as he considers to be unsafe. Among his many other duties he must examine these old bridges and reach a decision as to whether or not they are suitable for use.

On the subject of types of roads over here the superintendent of roads in the base section has authorized me to quote him as follows:

"The French national and departmental roads are masterpieces of thoroughly first-class construction. The alignment, gradients, curves, drainage and roadbed are perfection, and the water-bound macadam surfaces have been developed to the last degree in both use of materials and execution of the work. Water-bound macadam, however, has proved in France, as in the United States, to be unfit for heavy motor-truck traffic, and many millions of dollars would have been saved and much greater efficiency in the motor transport service would have resulted had these loads received a hard-paved surface before the war. This is the lesson to be derived from an intensive study of the roads of France."

Appropriates Supposed Powers of Highways Council

District Capital Issues Committee Refuses Permission to Finance Highways Approved by Washington Body

WHILE Government bulletins, apparently official, have described the United States Highways Council as having power to authorize, or prevent all highway activities, it would seem that this is not the case. The District Capital Issues Committee with headquarters at Cleveland, Ohio, is reported to be exercising authority which was supposed to belong only to the Highways Council. Following is a review of the proceedings of the committee, including extracts from its correspondence with the Huron County, Ohio, Board of County Commissioners, which tend to justify the above report. In any event, the announced policy of the Highways Council to consider and rule only on work investigated and recommended by the various state highway departments, is not being followed.

Application having been made for permission to issue bonds to the amount of $123,000, and the Huron County Commissioners having furnished a map, showing the projects in question and the connecting improved roads, as requested by the Capital Issues Committee, an assistant secretary of the committee was sent out to inspect the roads. After completion of his inspection he requested the commissioners to discontinue certain improvements, particularly that upon the No-God Road for which bonds had already been provided and the contract let. The county officials agreed to postpone the work with the understanding that the requested $123,000 bond issue for Main Market Road No. 1 be allowed.

Upon receipt of a letter agreeing to this, and after stating that the officials had evidently misunderstood his request, the assistant secretary wrote: "My suggestion was not only that the improvement on the No-God Road be not made, but also that no other roads be improved or paved, whether or not the money for such purposes be in fund, unless and until the Capital Issues Committee be given a chance to pass upon the improvements as being military necessities. In other words, the Capital Issues Committee is desirous that Huron County confine its improvements to Inter-county Highway No. 1, if such application eventually be approved, or at least to carry on no further improvements without the sanction of the committee. I trust that a letter formally agreeing to the above suggestions will be forthcoming promptly, as I have no doubt that until it is the formal opinion from Washington with regard to Inter-county Highway No. 1 will be delayed."

To this the county commissioners replied that they had no intention of doing other road work than that on Main Market Road No. 1. This, however, was not satisfactory to the assistant secretary, who made out and requested the commissioners to sign the following form, omitting, however, $25,000 of the amount for which they had applied.

"We, the commissioners of Huron County, do hereby agree between ourselves and the Capital Issues Committee that if the improvement of Main Market Road No. 1, and the issue of bonds in the amount of $98,000 for the improvement of same be allowed by the Capital Issues Committee, for and in consideration of said fact, we, the said commissioners, will not improve any other road in the Huron County or repave the same, whether the money be in fund or not, without the prior approval of the Capital Issues Committee or its district committee at Cleveland. This promise is not to prejudice our right to proceed with work which has already been started and for which a bond issue is not necessary. It is to be understood that no work has been started within the meaning of this agreement unless the actual physical construction has been commenced.

The county commissioners signed and forwarded this agreement substantially as written, inserting, however, the $25,000 omitted by the committee.

So much for the incident in Huron County. The extracts from the correspondence speak for themselves. Other reports, however, go to show that this is not the only place in Ohio where the District Capital Issues Committee has interfered with important road work. Ohio industrial plants which use the highways point out that this seems peculiar in view of the fact that an analysis of the entire road requirements of the State of Ohio has been submitted to the United States Highways Council, and that the council has approved the building of certain roads, as being of military necessity and importance. Inasmuch as the United States Highways Council is composed of representatives from the War Department, the Department of Agriculture, the Railroad Administration, the War Industries Board and the Fuel Administration, it might be assumed that its recommendations had been made after careful consideration of all of the conditions.

Why the District Capital Issues Committee has seen fit to disregard the recommendations of the council is not stated, but it is alleged that upon two projects, namely, the Cleveland and Youngstown road, and a portion of the motor parcels post route between Columbus and Toledo, both of which have been approved for construction by the Council, the District Committee has refused to authorize the issuance of bonds. The latter road has been particularly requested by the Post Office Department, and the other is a main thoroughfare southeast of Cleveland.

Two-Year Engineering Course Urged by British Engineer

Followed by Three Years Under Member Institution of Civil Engineers, Would Lead to Associate Membership

UNIVERSITY work for only two years, followed by three years' training under articles to a practicing engineer was advocated by E. J. Silcock in a paper introducing a general discussion of "The Training of Engineers" before the summer meeting of the Institution of Water Engineers held recently in England. The university work should be preceded, Mr. Silcock said, by a good general education at a public school. The speaker had no objection to the teaching of Greek and Latin in the earlier period of public school work, but declared that the last two years should be concentrated on natural sciences, mathematics—including at least calculus and the relation of triangles—and two modern languages.

Entering the university at the age of about 17 years, the student "must be taught to regard himself as no longer a schoolboy, but a man who has really commenced work. He should be held strictly to regular hours from 9 a.m. to 5:30 p.m., with one hour for luncheon, on five days of the week, and from 9:30 to 1:00 p.m. on Saturdays. In addition, there would be a certain amount of "overtime" evening work in the form of note-taking and study.

Vacations would have to be cut materially from present practice. A month in the summer and a week each at Christmas and Easter were suggested. Examinations should be cut to a minimum, the speaker said, but a feature should be made of test papers. Two examinations in the two-year period were suggested. One of these would be by the university, at the end of the first year, and the other by examiners appointed by the Institution of Civil Engineers. The second examination might include the theoretical part of the examination for admission as an associate member of the Institution.

The university studies would have the following general scope: (1, 2, and 3) elementary chemistry and physics, and also geology, each with special reference to engineering; (4), surveying instruments, their use and adjustment; (5), strength of materials and methods of testing; (6) hydraulics—"to be very, very fully treated"; (7) calculation of stresses in structures and graphical methods; (8), dynamics; (9 and 10), general principles of various prime movers, and instruction in their selection and testing; (11), transmission of power. Drawing should not be given at all in the university, but reserved for the office. Surveying and leveling are also best taught in practice. There should be no attempt to teach mere manual dexterity in the handling of machine tools.

"So far as is known," said Mr. Silcock, "there is no university or technical school curriculum which covers the ground suggested above, and if there were it would be quite impossible to do justice to it in two years without modifying the usual timetable."

Articles and Apprenticeship

Practical training for the engineering student would comprise three years of being articled to a corporate or full member of the Institution of Civil Engineers. During the first two years of this period the student would be engaged chiefly in drafting work, interspersed with visits to works in progress and practical fieldwork on surveys and leveling. The third year would be given more to outdoor work of various practical kinds in positions of some responsibility.

During the whole three years of apprenticeship the student in training should devote himself for at least two nights a week in winter to continuation classes, preferably at the university at which he took his two years' course; or, failing this, at "some good technical institute or school." At the end of his third year of articled training, when the student would be, say, twenty-two years old, the "embryo engineer should be able to earn a salary sufficient to keep him." The final step in his training would be to take the second part of the examination for associate membership in the Institution of Civil Engineers at, say, 23 or 24 years of age, which test should be of a more practical character than the one now given.

Discussion of Mr. Silcock's paper by about a dozen men brought out no large and united volume of opposition to his educational scheme. One or two thought the proposed two years' course would be too grinding. Two or three urged that considerable shopwork should be included in the training of an engineer, particularly a water engineer. One dissented somewhat strongly from the proposal to exclude drawing from the university course, urging that it afforded relaxation from intensive mathematical studies. Words were spoken by one or two against cutting the usual three-year university course to two years. These speakers referred to the

current American practice of having a course extend to four years. Mention was made of the fact that at Birmingham University the professor in civil engineering had provided a four-year course for those who wished more than three years. One speaker voiced appreciation of the general requirement of American universities which makes English a compulsory subject.

Following the discussion, Mr. Silcock, speaking of the objections that had been offered to his proposal for a two years' university course, said he had proposed reducing the college period because boys do not work half their time in college, and get into habits which give them an altogether wrong idea of what their future life will be. "If a lad went straight from an ordinary public school into a mechanical engineering shop, or into an office," Mr. Silcock said, "he would have to put in those longer hours. Why should he not put them in if he went into a technical college?"

Mr. Silcock's address and an abstract of the discussion which ensued may be found in the London *Surveyor* for July 5, 12 and 19.

War-Time Changes in Education at Three Institutions

Brown and Lehigh Cut All Courses to Three Years —Rutgers Starts Five-Year Co-operative Engineering Courses

ENGINEERING and all other courses at both Brown and Lehigh universities will be comprised within three instead of four years, beginning in September. In each case there will be three instead of two college terms, and no curtailment in the actual instruction given. These are wartime measures. At the same time, Rutgers College, New Brunswick, N. J., will open coöperative courses in civil, electrical and mechanical engineering, extending through five years. The announcement of these courses says nothing about wartime conditions, but for convenience they will be outlined further on in connection with reviews of the three-year courses at Brown and Lehigh.

Three 14-Week Terms at Lehigh

Under the four-year system at Lehigh there were two terms of 17 weeks each, or 34 weeks in a year, which gave a total of 136 weeks in four years. Deducting eight weeks devoted to examinations during the four years left 128 weeks for instruction. Under the new plan there will be three terms of 14 weeks each devoted entirely to instruction, or 126 weeks of instruction for the entire course. Examinations will give place to "tests" throughout the term. There will be vacations of a week at Christmas, another week in the spring, and eight weeks in summer, but part of the latter "will be devoted by engineering students to summer schools in practical work."

While considering it primarily a war-time problem, Brown University announces distinct recognition of the need of fitting college courses to meet reconstruction problems as well. Thus it says in its announcement that it is adapting itself "aggressively to the national service in the war and in the readjustment to follow."

There will be three 16-week terms at Brown in all courses, including those in the college for women. The engineering courses were rearranged in accordance with the program just outlined, before changes in the other courses were announced.

Prospective occupation is to guide the student at Brown in choosing, toward the end of his freshman year, any one of the six courses leading to the degree of A.B. or Ph.B. Having made this choice, he will work on the principal of "concentration," which is said to have given satisfaction in the schedule of studies previously followed for the Ph.B. degree. Apparently, attendance during the summer term will be optional at Brown. In other words, the student may take four years for a course if he wishes.

Five-Year Coöperative Course at Rutgers

Rutgers states, in announcing its five-year coöperative course in civil, mechanical, and electrical engineering, that it will follow the plan "developed and used at the University of Cincinnati during the past twelve years." The course will lead to the B.Sc. just as it does with the present four-year course at Rutgers. There will be a vacation of a single week at Christmas and one of two weeks late in the summer. Both of these vacations will be taken from college rather than from shop time, thus giving 26 weeks of industrial work and 23 weeks of study.

About 80 students will be taken in the new five-year courses during the first year. There will be a common program of study for all first-year students. Manufacturing concerns in the vicinity of New Brunswick, the announcement states, prompted the college to establish the new coöperative courses.

For the benefit of those not familiar with the University of Cincinnati coöperative plan, the following two sentences may be quoted from the Rutgers announcement:

"Students are arranged in definite pairs, and the members of the pair alternate every two weeks so as to give a continuous one-man service in a definite place of employment. They receive the same rate of pay as other workers of like grade, and are under the same conditions and regulations of employment."

Build Walls and Roof Before Second Floor

Thus Providing Permanent Housing in Which Floor Concrete Could Be Safely Placed In Cold Weather

RUSH conditions at the Menasha Paper Co., at Ladysmith, Wis., required last winter a new machine shop building at very short notice. Work was started in the late autumn, and cold weather caught the construction early. In order to avoid the necessity for temporary housing to provide temperature warm enough for the laying of the floor concrete, it was decided to carry the walls of the two-story building up to the roof and place the roof before putting in the intermediate reinforced-concrete second floor.

The building, shown in the view, is 38 x 206 ft. in plan, and two stories high. On Oct. 24 the contractor started driving steel sheet piling to close the site along the adjoining Flambeau River. Footing concrete was started five days later, closely following the excavation

SHELL PLACED BEFORE SECOND FLOOR TO PROVIDE FOR WINTER CONCRETING

and piledriving. The latter was completed Nov. 5, and the rig was dismantled and yarded out of the way, except the engine which was retained for handling building materials. Footing concrete was completed Nov. 12, and the brickwork on the walls started the same day, being carried thereon clear to the roof. A horizontal slot was left in the brick walls at the second floor level, the wall above that being carried up in pilasters between the large windows.

Bricklaying was finished Dec. 4, and steel roof trusses which had just arrived were in place on the following night. Redwood roofing and steel purlins were finished Dec. 14, and the prepared roofing Dec. 19, Meanwhile, forms for the second-story machine-room floor, which was a 13-in. slab with two heavy concrete girders running the full length of the building, were being erected. Reinforcements and the templets for bolt holes, anchor bolts, etc., were placed by Dec. 27, the floor was completed by Dec. 31, and the installation of the machines was started Jan. 3.

The plans were prepared by J. P. Jacobson, consulting engineer, Minneapolis. The work was done by Siems, Helmers & Schaffner, St. Paul.

Framing Plans Simplify Fieldwork on Cincinnati High School

Single-Sheet Framing Plan Gives All Data Required by Form Builders and Steelworkers, Condensing Information Embodied in Several Sheets of Architect's Drawings

BY JOHN T. SULLIVAN

Covington, Ky.

TIME consumed in field computations by construction superintendents and foremen was greatly reduced on the concrete buildings for the East Side High School, Cincinnati, O., by special framing plans made from the architect's drawings. These framing plans gave, on one sheet for each floor, all the dimensions necessary for laying out and framing the formwork. Using the architect's drawings for the same purpose would have made necessary the consultation of several drawings and the making of numerous computations and measurements. Supplemented by steel lists, also specially prepared for field use, these framing plans reduced the time consumed in framing forms and in preparing reinforcement to a fraction of the period required when working directly from the architect's drawings.

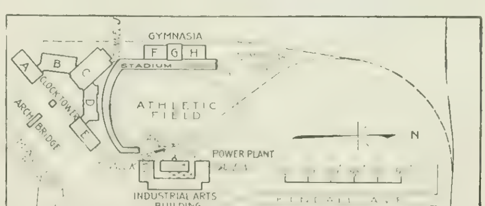
Costing some $1,500,000, the East Side High School work comprises 10 buildings and other structures shown by the outline plan. Concrete construction is employed throughout. Buildings A to E and the clock tower were made one construction contract and all other structures were made another contract. It is with the second contract that this article deals.

Framing Plans Cut Time and Decrease Errors

It was decided by the contractors to make framing plans for the concrete work and to keep the architect's draings for office use only. The reasons for this decision were (1) the size of the scale used and the size of the buildings necessitated larger architects's drawings, which were too bulky to use for field erection; (2) the number of dimensions shown on the architect's drawings had to be very limited in order not to crowd out other branches of the work shown thereon; (3) to obtain the sizes of beams, columns or footings necessitated not only looking these up on the plans but also in the schedules shown in the book of specifications; (4) too much time would be lost in adding up rows of dimensions in order to obtain the one dimension which was desired; (5) while the foreman would be adding up a row of dimensions his gang would be standing around waiting for orders.

Therefore the framing plans, which replaced the architect's drawings in the field, were reduced from the scale 4 ft. to the inch, which was used by the architect, to the scale of 8 ft. to the inch. These plans contained every possible dimension which could be needed for the erection of the work, and gave also the sizes of all beams, columns and slabs on any particular floor; gave the sizes and location of all openings, angles, anchor bolts, etc., and gave all sections which were necessary to show the elevation of the various beams and slabs.

To complete each framing plan required about one



OUTLINE PLAN OF CINCINNATI EAST SIDE HIGH SCHOOL BUILDINGS

week, after which time it was submitted to the architect for check and approval. Making a so-called framing plan is not a new idea. It is, however, unusual to make a framing plan which is complete in itself and not merely a retracing of the architect's drawings, omitting all other branches of work shown thereon which may not pertain to the contract in question. Plenty of dimensions are needed in a framing plan; this statement cannot be too strongly emphasized.

In order to show the advantges obtained in the field in the erection of a footing, consider footing 40, shown on the footing framing plan. The first step will be to locate the center lines. The north-south center line is given as 15 ft. from the north-south building line of the offset. Or, if it should happen that footing 81 had been previously laid out, the north-south center line of footing 81 could be shifted 6 in. east immediately to form the north-south center line of footing 40. The east-west center line of footing 40 could be laid out from the building line for the south face of the south wing by adding the dimensions 19 ft. 1¼ in. plus 17 ft. 8¼ in., a total of 36 ft. 9½ in. This same center line could be laid out from the building line for the north face of the south wing by adding the dimensions 12 ft. 11⅝ in. plus 13 ft. 3⅞ in., a total of 36 ft. 3½ in. The next steps in order are to obtain the size of the bottom, the size of the top, the height and the elevation of the bottom of the footing. All this information is obtained

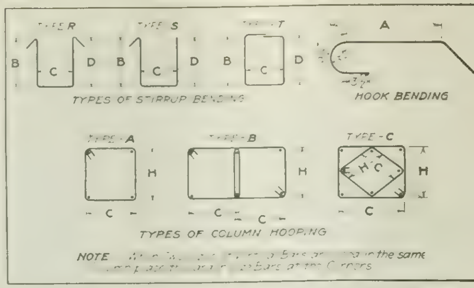


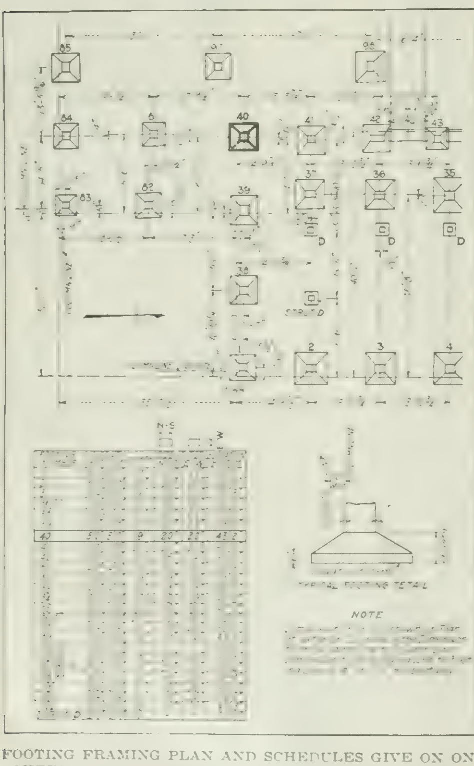
DIAGRAM EXPLAINS ALL BENDS NAMED ON STEEL LIST SHEET

from the schedule at the bottom left-hand corner of the footing framing plan. There are four such schedules, extending across the bottom of the plan, of which the drawing shown is only a small portion. These separate schedules take in the footings located directly above them. The steel for each footing can be obtained directly from a steel list which will be described later.

Now, compare this work with that required if the architect's drawings were to be used in the field. To begin, it would require more time to calculate center lines from the architect's foundation plan. Having obtained the center lines, it would then be necessary to refer to the footing schedule in the back of the book of specifications, p. 10, where the size of the bottom and height of the footing are given. The next step would be to refer to the column schedule, p. 9 of the specifications, in order to obtain the size of the top of the footing. This would be calculated by finding the size of the column which rested on the particular footing, and then adding 2 in. in each direction to the column dimensions. The next step would be to refer to the architect's drawing showing the longitudinal section of the building in order to obtain the elevation of the bottom of the footing. By using the framing plans all these extra steps are eliminated in the field, and in case a check is desired it is an easy matter to run through the procedure very rapidly and with only one drawing to handle.

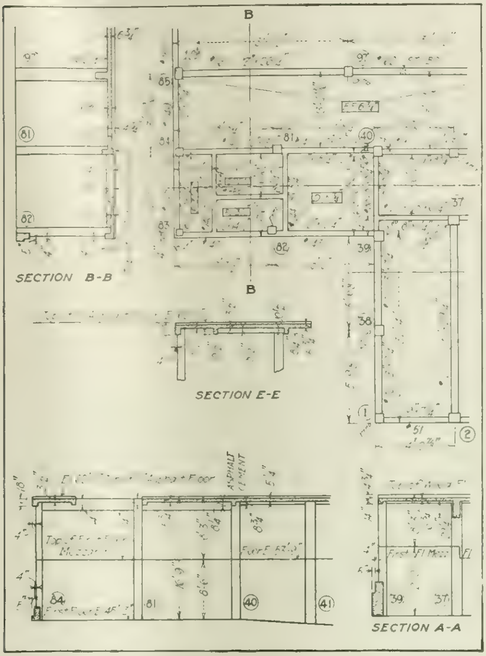
The framing plan for the foundation walls shows the elevation of all the foundation walls, sections through them, openings for windows, beam pockets, places where angles occur, and also all lines of offset for limestone ashlar work.

The framing plans for the various floors show the sizes of all columns, beams and slab thicknesses. This enables the carpenter foreman easily to list his sizes of beam sides, joists, floor panels, shores, etc. One advantage to be noted is in the erection of columns. Column 40, shown on the second floor framing plan, may be taken as an example. The first step in the erection of this column would be to set up the column form in position and plumb it and brace it on all four sides. After this is done the next step would be to get an elevation on the column with an engineers' level, and establish the cut-off line for the floor above. The next step would be to mark off the pockets where the beams frame into the column. Each beam which frames into column 40 has been dimensioned on the framing plan in such a way as to show how far from the corner of the column



FOOTING FRAMING PLAN AND SCHEDULES GIVE ON ONE SHEET ALL DATA FOR LOCATION AND FORM FRAMING

the beam pocket should be started. That is, beam pocket 91 starts 4 in. east from the north-west corner of the column. If the dimension 4 in. were not given, it would be necessary for the carpenter to figure back along beam 91 to column 41, where he would find that the west face of beam 91 was flush with the west face



FRAMING PLAN FOR EACH FLOOR GIVES ALL FRAMING DATA FOR THAT FLOOR

of column 41. Then, by calculations of some length, the difference between the west face of column 41 and the west face of column 40 could be computed, and finally the required dimension 4 in. would be obtained. The time wasted in the field on supposedly small items like this is enormous.

The reinforcing steel which was required was listed on 10 x 16 in. sheets. From these were made blueprints which were bound together with a cover sheet containing a key to the various bends and types. The sheets were numbered, and at the head of each sheet was indicated where the steel listed thereon was to be placed. Each item was then listed.

Taking for example C-83 as listed opposite Tag 1, it can be seen that C-83 stands for Column 83. At the top of the sheet it is shown that this column helps to support the second floor. The size of the column is 16 x 16 in. The steel which makes up the column consists of Tag 1; namely, four ⅞-in. round bars 23 ft. 9 in. long. The total number of ⅞-in. round bars is also four, since there is no other member the exact duplicate of Column 83. The bars have been ordered cut to length, as is shown by a "cut from" column. The type is shown as "St" meaning straight, and the bending diagram shows that the C portion is the only bending column made use of in this case and therefore indicates that no hooks or bends occur in these bars. Tag 2 gives the hooping material, which consists of 22 ¼-in. square twisted rods 4 ft. 9 in. long, to be cut from 40 ft. material. The hoops are of the A type as shown on the cover sheet, while the bending diagram columns indicate a 4-in. hook on each end, with dimensions C as 12 in. and H as 12 inches.

Taking a more complex example, B-1-20, as listed opposite Tag 7, it is assumed that B-1-20 represents two second-floor beams, 1 and 20, which are exact duplicates. The steel consists of that shown opposite Tag 7; namely, four 1-in. square twisted straight bars per beam with a 10-in. hook on each end, as shown in the bending diagram columns; tag B consisting of one 1⅛-in. square twisted straight rod 36 ft. 9 in. long per beam with a 10-in. hook on each end; tag 9 consisting of three 1-in. square twisted bent rods 33 ft. 9 in. long per beam with the dimensions of the hooks and bent segments, as shown in the bending diagram columns as follows: (Hook) 10-in. hook on the end; (A) distance from the hook to the first bend, 2 ft.; (B) Inclined segment, 3 ft. 10 in.; (C) lower straight part, 25 ft. 4 in.; (D) inclined segment, 3 ft. 10 in.; (E) top straight part to hook, 2 ft., and (Hook) 10-in. hook on the end. The (H) column shows the depth of the trussed rods as 32 in. Tags 10 and 11 show the bending diagrams for the other two bent bars which occur in each beam. Tags 12 and 13 give the number and sizes of the stirrups. The key to the type is shown on the cover sheet. The remark column shows how the stirrups are spaced.

The system of plans and steel lists described was worked out by the Roos Bros. Construction Co., Cincinnati, O., contractors for Group II of the high school buildings. Garber & Woodward, Cincinnati, O., were the architects.

Wisconsin Board Rejects Reproduction Cost Less Depreciation

UNLESS a public utility has not only earned the sum represented by depreciation in excess of a fair return on the original investment, but has also returned the same to the investors, retaining no depreciation reserve represented by assets, reproduction cost less depreciation cannot be used as the final measure of fair value for rate-making purposes, states the Wisconsin Railroad Commission in an opinion rendered in the case of the Milwaukee Electric Railway & Light Co., as reported in *Public Utilities Reports*. The owners of the utility, says the commission, are entitled to have their prudent and honest investment kept intact until returned to them. Where reproduction cost less depreciation is used as controlling in determining fair value, unless the amount earned to provide for depreciation is returned to the investors, it will not usually earn a return sufficient to constitute a fair return on the investment.

Interest on reserve assets held in the business, furthermore, will not, it is held, bring the return up to a fair figure unless the rate of interest equals the rate constituting a fair return. On this point the commission says:

"If the reserve assets are held in the business and the reproduction cost less depreciation is used as a basis for valuation, a return upon such reproduction

cost less depreciation at the normal rate, plus interest earned upon reserve assets, would be less than a fair return upon the investment unless a rate of interest were actually earned upon such reserve assets equal to the rate which constitutes a fair return for the property as a whole. Where reserve assets actually earn less than the fair rate of return upon the investment as a whole, the only way that occurs to us in which investors can obtain a fair return upon their full investment is by earning a higher rate on the cost new—less depreciation than would be required if the investment, as already discussed, were used as a basis. Unless the rate of return on the cost new less depreciation is to be enough higher than the rate which should be applied to the full investment to bring the total return, which is made up of the return on cost new less depreciation and interest earned on reserve assets, the reserve being provided on a straight-line basis, up to an amount which would constitute a fair rate of return on the investment, we see no way in which the investor, under such a method of valuation, would secure a fair return upon this investment unless it is to be assumed that the amount earned for depreciation can be withdrawn from the business, and the investment thereby diminished."

To show that this cannot properly be assumed, the commission quotes from the decision in the Knoxville Water Co. case that "the company is not bound to see its property gradually waste without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years the original investment remains as it was at the beginning."

More Data on Filter Sand Growth at Grand Rapids

Increase of Sand Grain Incrustation Rapid During Past Year—Lime Cost Increases but Quality Decreases

ANOTHER year's data on sand growth in the filters of the Grand Rapids (Mich.) water softening plant, now available from the latest annual report of Walter A. Sperry, chief chemist, indicate a rapid increase during 1917. Three articles describing the experience with sand growth at Columbus, O., Grand Rapids and McKeesport, Penn., appeared in the *Engineering News-Record* of May 3, 10 and 17, 1917, pp. 250, 304 and 351. As Mr. Sperry's report is not to be printed the main table is repeated, with the 1917 figures added. The 1916 figures are also somewhat changed. The report states that the sand samples seem to have been selected from a spot not representative for sieving tests. Thickness of such sand coating for the four years ending August, 1917, was 0.040, 0.064, 0.115 and 0.187 mm. The sand increased in size over the original 2.1 times in 1914, 2.56 in 1915, 3.57 in 1916 and 4.82 times in 1917. The specific gravity of the original sand was 2.651. It had decreased to 2.508 in 1915, to 2.424 in 1916 and to 2.383 in 1917. In 1916, 25.2% passed a 0.659-mm. sieve and there were no smaller grains. By 1917 only 1% passed the same sieve and 95.1% passed the next highest sieve of 1.057-mm. mesh. All passed a 2.124-mm. sieve in 1915 and 99.4% in 1917.

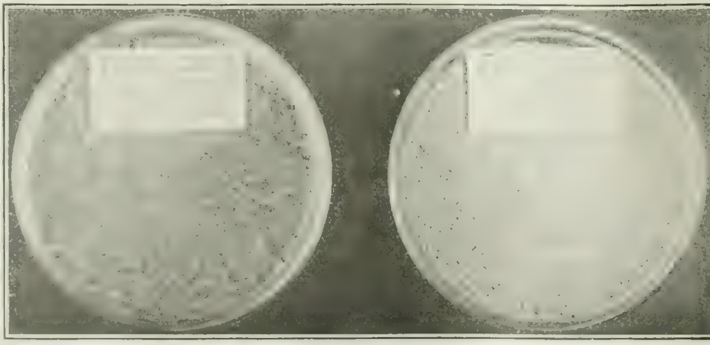
Costs of chemicals are reported as increased, consistent with the difficulties of obtaining them as regards quality, production and delivery. Lime has increased 39.5% over 1916 and 53.8% over 1915, in addition to a drop in quality from 88% water soluble CaO in 1915 to 83% in 1916 and to 77% last year. Alum has increased in cost 11.9% as compared with last year and 22.7% as compared with the year before. The total operating costs of the plant have increased 24.1% over 1916 and 62.8% over 1915. Per million gallons the operating costs for 1914, 1915, 1916 and 1917 are \$11.33, \$12.86, \$14.87 and \$18.84. This includes wages, chemicals, power house water, and the cost of supplies and repairs.

CHARACTERISTICS OF FILTER SAND AT GRAND RAPIDS

	Effective Size, Mm.	Uniformity Coefficient	Per Cent Acid Soluble
Sand as specified	0.35–0.44	Less than 1.65	5.0
Original sand	0.27	1.61	6.5
After washing and scraping	0.55	1.36	6.5
After use Oct., 1913	0.42	1.33	23.0
After use Aug., 1914	0.51	1.22	45.2
After use Aug., 1915	0.58	1.12	57.6
After use Aug., 1916	0.75	1.04*	68.0
After use Aug., 1917	1.05	1.00	77.5

* Interpolated from curve for years 1913–17, inclusive.

The average chemical constituents in parts per million in the river and filtered water, respectively, were as follows: Turbidity, 16 and 0; total hardness, 228 and 87; alkalinity 194 and 46, incrustants, 34 and 41; magnesium 18.5 and 10.4. Bacterial counts were respectively 1980 and 9, with a maximum of 45,000 and 300 and a minimum of 100 in the river and 0 in the filtered water. The average wash water used was 2.2% and the average length of run between washes was 19 hours, with maximum and minimum of 49 and 6, respectively. The number of typhoid fever cases, 50 per 100,000, was the lowest since the plant was put in operation in 1912.



FIVE YEARS' GROWTH OF FILTER SAND AT GRAND RAPIDS

Long-Span Concrete Beams Should Have Fixed Ends

Method Given By Which Computation of Rigid Frame Design May Be Readily Made

By W. S. Tait
Vice President and Chief Engineer Tait Engineering Co., Chicago

Most building ordinances make no provision for fixed ends of concrete beams. Thus, the standard design requirement for a single span concrete beam supported on concrete columns at each end provides that the beam shall be designed for a moment of WL/8 at the center. Where brick bearing walls are used instead of concrete columns this requirement is approximately correct, but is far from true where the beam is supported by concrete columns more or less fixed to the beams. Little or no provision is made to allow for the bending to which the column must be subjected as a result of the fixity of the connection with the beam. This method of design provides a beam about 50% too strong and in long-span construction columns which may be exceedingly weak.

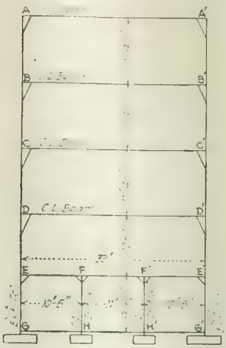


FIG. 1. OUTLINE OF FRAME TO BE INVESTIGATED

When the present design rules were formulated, concrete beams of more than 30 ft. in span were very rare, and no adequate analysis of the distribution of the bending moments between the column and beam was available for the practicing engineer. As concrete construction has progressed, however, the spans used have been gradually increased until column spacings up to 60 ft. are now sometimes encountered. With spans of any magnitude it is essential that due provision be made for the bending moments due to the fixity of the columns and beam connection. A good example of a fixed beam design in reinforced concrete is the new factory for the Illinois Watch Case Co., at Elgin, Ill. This building is four stories and basement in height, approximately 215 ft. in length and 34 ft. in width. In the basement, the columns are placed about 12 ft. centers in each direction, but in the upper stories it was desirable to provide a clear floor with no columns except in the exterior walls. The exterior columns are spaced 11 ft. 7 in. on centers throughout the length of the structure, and beams span across the building between these columns. The floor consists of a one-way reinforced-concrete slab. The first floor is of flat-slab construction. All of the floors are designed for a live-load of 200 lb. per square foot.

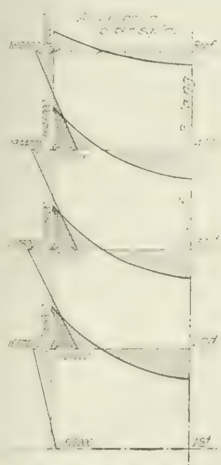


FIG. 2. DIAGRAM OF MAXIMUM MOMENTS

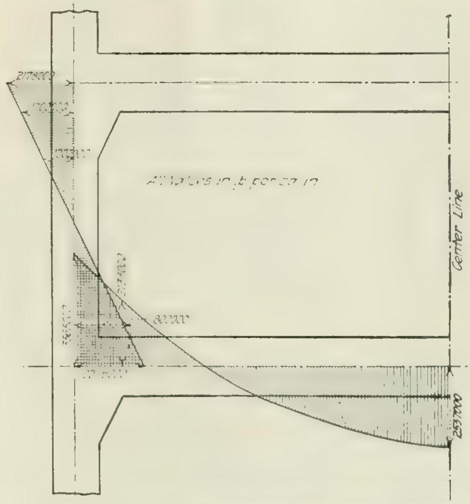


FIG. 3. ENLARGED DIAGRAM OF MOMENTS AT CONNECTION

The distribution of bending moments through the columns and beams was obtained by the analysis known as the method of slopes and deflections. In this analysis the bending moment is found in the beam at the intersection of the center lines of the columns and mid depth of the beam and in the column just above and just below this intersection.

The general equation for the moments at this intersection is as follows:

$$2E\frac{I_B}{l}\left(2\theta_A + \theta_B - 3\frac{d}{l}\right) = C$$

where

E = modulus of elasticity of concrete;

I_B = moment of inertia of the beam;

l = length of beam;

θ_A, θ_B etc. are angles of deflection at points A, B, etc. of member under load;

d = amount of deflection of far end of members;

C = resisting moment at joint.

In making this analysis the joint is considered to be the point of intersection of the column center and the horizontal line of the mid-depth of the beam.

Since we do not wish to find the amount of the deflection the term E may be omitted, also since each end of the beam is equally rigid there will be no deflection d at the far end of the member. Therefore, the bending moment in the beam at the joint becomes

$$I_B/l\left(2\theta_A + \theta_B\right) = C \qquad (1)$$

Now let $K = I/l$, $K_C = K$ of column, $K_B = K$ of beam, $n = K_B/K_C$.

M_{AB} designates the moment at point A in member AB; M_{BA} designates the moment at point B in member

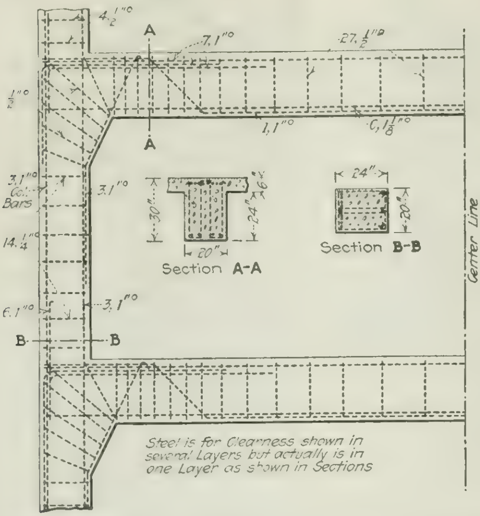


FIG. 4. REINFORCING DETAILS AT RIGID CONNECTION OF BEAM TO COLUMN

BA. Now $I_B/l = K_B = nK_C$ and equation 1 becomes

$$nK_C\left(2\,\theta_A + \theta_B\right) = C$$

In the beam θ_B is equal and opposite to θ_A so that the moment in the beam at the joint becomes

$$nK_C\,\theta_A - C.$$

Also, we may write unity for K_C and simplify this equation to $n\,\theta_A \mp c$. Similarly, the moment in the column can be written $2\,\theta_A + \theta_B$. The diagram Fig. 1 shows the structure under consideration.

From the simultaneous equations 1 to 5 in Table I the moments at each joint in the beam and columns can be obtained. Have obtained $M_{CC'}$ for instance in the beam the moment at the center of the span equals $WL/8 - M_{CC'}$.

Before solving these equations values must be obtained for n. We must first, therefore, prepare approximate designs from the beams and columns and obtain values of I/l for each. Using these approximate values, the moments are obtained considering each

TABLE II SUMMATION OF MOMENTS ALL IN M INCH LBS

Cases	1	2	3	4	5	6	7	
Points	All Floors Loaded	3rd and 4th Loaded 2nd No Load	2nd and 4th Loaded 3rd No Load	2nd and 3rd Loaded 4th No Load	4th Loaded 2nd and 3rd No Load	3rd Loaded 2nd and 4th No Load	2nd Loaded 3rd and 4th No Load	Max.
Beams Neg Roof	1592	1588	1612	1503	1608	1518	1530	1612
4.	3625	3645	3540	1449	3560	1392	1360	3645
3	3688	3595	1413	3590	1404	3525	1401	3688
2.	3540	1350	3463	3565	1270	1369	3483	3565
Pos Roof	1028	1032	1008	1117	1012	1002	1090	1117
4.	2375	2355	2460	726	2440	783	815	2460
3.	2312	2405	762	2410	771	2475	774	2410
2.	2460	325	2537	2435	905	806	2517	2537
Columns								
MAB	1594	1590	1612	1498	1608	1520	1495	1612
MBC	1850	1944	1540	706	1617	1022	395	1944
MCD	1884	1578	807	2178	473	1782	1070	2178
MDE.	1422	319	1657	1348	565	266	1595	1657
MEG.	—357	—42	—426	—336	114	—28	—410	—426
MBA.	1778	1725	2009	746	1956	910	980	2009
MCB	1738	2208	674	1418	930	1744	325	2208
MCD.	2142	1044	1806	2226	703	1102	1885	2226
MED.	443	128	509	522	197	112	490	522

floor loaded. From the moments thus obtained the beam and column sections may be designed. It is now necessary to obtain the correct value of I/l for the design, and since the arrangement of steel in the beam

FIG. 5. IN ELGIN WATCH FACTORY 34-FT. CLEAR SPAN BEAM RIGIDLY FRAMED TO COLUMNS

and column is not the same throughout their length equivalent constant moments of inertia which would give the same results as the varying values of these moments of inertia must be calculated. From these constant moments of inertia the correct values of n can be obtained and a new solution for moments made. If the design used above in obtaining these moments of inertia provides fairly closely for the moments now

TABLE 1.

	Beam Moments	Column Moments Below Beams	Column Moments Above Beams	Σ of Moments At Joints
1	$M_{AA'} = n\theta_A - \frac{WL}{12}$	$M_{AB} = 2\theta_A + \theta_B$		$M_{AA'} + M_{AB} = 0$
2	$M_{BB'} = n\theta_B - \frac{WL}{12}$	$M_{BC} = 2\theta_B + \theta_C$	$M_{BA} = 2\theta_B + \theta_A$	$M_{BB'} + M_{BC} + M_{BA} = 0$
3	$M_{CC'} = n\theta_C - \frac{WL}{12}$	$M_{CD} = 2\theta_C + \theta_D$	$M_{CB} = 2\theta_C + \theta_B$	$M_{CC'} + M_{CD} + M_{CB} = 0$
4	$M_{DD'} = n\theta_D - \frac{WL}{12}$	$M_{DE} = 2\theta_D + \theta_E$	$M_{DC} = 2\theta_D + \theta_C$	$M_{DD'} + M_{DE} + M_{DC} = 0$
5	$M_{EF} = 8600$ in.-lb. $\left(\frac{WL}{100}\text{ Flat Slab Moment}\right)$	$M_{EG} = 2\theta + 0.$ No Moments @ G	$M_{ED} = 2\theta_E + \theta_D$	$M_{EF} + M_{EG} + M_{ED} = 0$ i.e $M_{EG} + M_{ED} = +86000$

Summarizing the above

1 $\frac{WL}{12} = n\theta_A + 2\theta_A + \theta_B = n\theta_A + 2\theta_A + \theta_B$

2 $\frac{WL}{12} = n\theta_B + 2\theta_B + \theta_C + 2\theta_B + \theta_A = \theta_A + n\theta_B + 4\theta_B + \theta_C$

3 $\frac{WL}{12} = n\theta_C + 2\theta_C + \theta_D + 2\theta_C + \theta_B = \theta_B + 4\theta_C + n\theta_C + \theta_D$

4 $\frac{WL}{12} = n\theta_D + 2\theta_D + \theta_E + 2\theta_D + \theta_C = \theta_C + 4\theta_D + n\theta_D + \theta_E$

5 $86{,}000 = 2\theta_E + 2\theta_E + \theta_D = \theta_D + 4\theta_E$

found, it will be unnecessary to recalculate the moments of inertia from the revised sections. The next step is to solve the equations 1 to 5 for varying members of floors loaded and from a tabulation of the results obtain the maximum moments. Table II is a tabulation for this case.

Figure 2 is a diagram of the moments in the structure and Fig. 3 is a large scale diagram for one story from which the moments at the edges of the brackets may be obtained. Fig. 4 shows the design used for one of the frames. After obtaining the maximum moments and also the column loads the various members can be designed. Fig. 3 shows the diagram of maximum moments.

In designing the columns for direct load and bending, care must be taken in considering the column section just above the floor, as this is the critical point. The reason for this is that it will be observed that the moment is as high at this location as anywhere in the columns, and we have the bare column section acting at this point without any bracket.

This building was erected in the autumn of 1917 for the Illinois Watch Case Co. of Elgin, Ill. George Morris was the architect and Charles Geirtz & Sons, contractors, executed the construction. The design for the reinforced-concrete structure was prepared by the Tait Engineering Co. under the personal direction of the writer.

Land Reclamation Would Provide Work and Homes For Hosts of Veterans

Irrigation and Drainage of 20,000,000 Acres Would Care for Million Families in Agricultural and Allied Pursuits — Water-Power Development Incidental to Irrigation Would Save Fuel and Aid Transportation

By Arthur P. Davis
Director United States Reclamation Service, Washington, D. C.

AT THE close of the great war in which we are engaged the United States will probably have more than three million men under arms and perhaps an equal number engaged in the manufacture of munitions and in other war industries, nearly all of whom must have other employment soon after the cessation of hostilities. Most of these men will have been drawn from lines of industry which are equally necessary to the welfare of our people and the conduct of the war; namely, agriculture, mining, manufacture, transportation, trade, etc., and the places thereby vacated will have been filled for the most part by the use of machinery, by women, and by boys and girls who have entered gainful occupations earlier than they normally would have done, in order to meet war conditions. Few of these people will be willing to relinquish their employment and the independence it insures, nor is it fair that they should be required to do so. It will be necessary to absorb six million able-bodied men into the ranks of industry, and this cannot be done without extensive preparations well in advance.

A similar problem, of much less magnitude, was presented at the close of the Civil War in 1865, but the vast public domain in the West was able to absorb the discharged soldiers, for at that time "Uncle Sam was rich enough to give us all a farm." The pending problem cannot be so met, for the number of men to be cared for will be several times greater and the arable public domain has passed into private hands and is mostly occupied.

Foreign Countries Working On Reconstruction

The importance of this problem has been keenly appreciated in foreign countries for some time, and extensive legislation has been proposed, and in many cases passed, looking to the provision of employment and homes for those whose best years have been given to the defense of our liberties, and the United States should not be a slacker in performing its part of this problem.

Owing to its great resources, the United States can fairly be called upon to shoulder a portion of this burden for Italy and other European countries with dense populations whose resources are inadequate to discharge these functions properly, and prevent great suffering, waste and perhaps disorder, which always accompany extensive unemployment.

Australia has already appropriated $100,000,000 to be used at the end of the war in the purchase and improvement of land for homes for its returning soldiers. In proportion to population this corresponds to $2,000,000,000 for the United States. Canada, Great Britain, France, Germany and Italy are undertaking similar measures.

In no case does this action take the form of charity or permanent gifts to the recipient. It is recognized that the discharged soldier will be able, and should be required, to earn his own living and carve out his own destiny, except in case of permanent disablement, for which hospitals and homes will be provided as a matter of course.

Careful consideration is being given to the training of those partially disabled and the provision of opportunities for their employment in industries in which they can be useful, but the able-bodied, uncrippled soldier will be equally helpless if opportunity for employment is not afforded him. Some of these men can doubtless for a time be profitably employed in the construction of public roads and in other public works which may be needed, but it would not be wise to carry such work beyond the limits of actual necessity, and they will furnish but a small fraction of the relief actually required.

It must not be forgotten that at the close of the war the United States will have the most colossal public debt ever known in the history of the world. Heavy

taxation must be continued for a long time to cancel this debt and reduce the interest as rapidly as possible. No funds should be devoted to any public works not actually needed, nor expended upon useless undertakings of any kind. There is, however, one class of public works which will not only return to the public in cash their entire cost, but will also be a permanent addition to the resources of the country and provide homes for a large number of those engaged upon their prosecution. This work is the irrigation of arid lands and the drainage of the vast areas of swamp lands within the limits of the United States.

Vast Arid and Swamp Areas Await Reclamation

The area of arid lands, in the 17 Western states, which can be irrigated by storage of flood waters and their diversion upon such lands is variously estimated at from 15,000,000 to 20,000,000 acres. This is sufficient to furnish homes to nearly a million farmers and an equal number of laborers, mechanics and other residents necessary to complete the communities that would be formed. A beginning on this work has already been made, the experimental stage has passed, and it has been demonstrated that this work can be made to increase production greatly and finally to return its cost to the Government from those who receive its benefits. Irrigation projects have an incidental value in the development of power to lessen the consumption of our diminishing fuel supply. They also benefit the country at large by the regulation of our streams and the abatement of flood damages in many cases. This work can be wisely and economically extended to solve its share of the reconstruction problem now pressing upon our country.

A still larger share may be performed by the reclamation of extensive areas of swamp lands. These are not only more extensive than the arid lands that can be reclaimed, but can, as a rule, be reclaimed somewhat more cheaply per acre. They are generally alluvial lands containing much fertility in the form of vegetable mold and of mineral plant food washed in from the hillsides through the centuries. Usually they are near the centers of population and are suitable for dividing into small tracts for intensive cultivation.

By making some preliminary investigations while the war is in progress we can prepare a program of feasible reclamation and development which will immediately employ millions of discharged soldiers and workmen directly upon the works required and indirectly in the manufacture of machinery and other supplies necessary for its prosecution.

The Hon. Franklin K. Lane, secretary of the interior, has proposed and is actively advocating such a program, and if supported in Congress will prepare a plan adequate for the solution of this problem when the need is presented.

Congress Provides $100,000 to Begin Studies

The sundry civil act, recently approved, contained provision for an appropriation of $100,000 "for an investigation to be made by the Director of the Reclamation Service of the reclamation by drainage of lands outside existing reclamation projects and of the reclamation and preparation for cultivation of cut-over timber lands in any of the states of the United States." That this appropriation was a deliberate adoption of a broad policy of reclamation is shown by the remarks of the chairman of the appropriation committee, who said:

"In nearly every state in this Union there are thousands of acres that can be reclaimed—some by putting water on them and others by taking water off them; some in a climate very much more favorable than others, and yet under the restrictions of existing law only land within the public-land states would be considered. I believe that the very essence of statesmanship consists not so much in undertaking to prevent movements as in directing and controlling them.

"We have built up a splendid Reclamation Service, the head of which is a man of very level-headed judgment. The committee on appropriations felt that it would be performing a distinct service, a needed and real service, if it gave to that bureau the money necessary to make a preliminary survey of the United States and to get from it information that will enable Congress intelligently to spend money in reclaiming the land rather than to be dependent upon the enthusiasm of advocates of particular projects in particular localities. The matter is of great importance. There have been many bills heretofore introduced in Congress for the drainage of swamp lands, bills for the further reclamation of arid lands, bills for the reclamation of cut-over and burnt-over land. We ought to have a real policy before we start into the expenditure of the millions that will flow from the adoption of any of these schemes under the various authorizations of the different bills which I have enumerated."

Some Irrigation Results Already Attained

The wide popular approval of Secretary Lane's proposition has aroused considerable interest in the details of the possibilities suggested, and a few words of elaboration may therefore be added. Under the provisions of the Reclamation Act, which has now been in operation about 16 years, the Interior Department has reclaimed about 1,650,000 acres, of which more than 1,000,000 acres were under actual irrigation in 1917, and the balance is mainly in the undeveloped portions of the farms occupied by settlers who are gradually putting this into cultivation. The projects already under way when completed will bring the reclaimed area to more than 3,000,000 acres, which is somewhere between 10 and 20% of the remaining area that can be reclaimed.

Many of these projects when irrigated require drainage. The Interior Department has 24 dredges and excavators at work at various points, digging drainage canals and laying drain pipe. The Reclamation Service has constructed about 450 miles of open drains and 160 miles of tile drains, and this work is still in progress. It has established the efficiency of the methods used, and has furnished a volume of detailed cost data which is very valuable in estimating new work.

The law requires the return of the money invested in these reclamation projects by the occupants of the land reclaimed. No interest is charged, and repayments are spread over a period of 20 years, with lighter payments at first, while the settler is struggling to bring the desert into production. There is no question of the capacity

of all of these lands to repay the reclamation charge. The experimental stage is passed, much has been learned in engineering, legal and practical lines, insuring the safety of more rapid progress in this reclamation work in the future without endangering public interests and with great benefit to the producing and home-making capacity of our people.

Water Storage and Power on the Colorado

One of the interesting features of the proposed irrigation development is the storage and diversion of the waters of the great Colorado River. Practically all of the easy and simple diversions have been accomplished, but great possibilities remain in storage in large reservoirs and the diversion of water through high-line canals, tunnels and other works of magnitude.

The Colorado River is an international stream, the waters of which are referred to in international treaties. It is also an interstate stream, and hence as a domestic problem is also of national character. Besides this, it is rated as a navigable stream, and the control of navigation has always been considered a national function. For all these reasons, therefore, the development of the Colorado River is not only national in character but is absolutely impossible of proper development by any other agency. The basin of this river contains nearly 3,000,000 acres of irrigable land in the United States, besides more than half a million in Mexico. Of the area in the United States about half is already irrigated, and the natural water-supply is entirely appropriated for this purpose. Large volumes of water run to waste, however, throughout the winter and particularly in the season of melting snows, May, June and July. By proper storage works these waters can be impounded and held for use during the low-water season, while the abatement of the floods thereby will incidentally benefit the lands along the river's course.

Power Development Would Conserve Fuel

Another incidental benefit is the regulation of this water for power purposes and in the cañons of this great river system are vast possibilities of power development much needed in the intermountain industries of mining and transportation. A portion of this power development can be made incidental to the construction of irrigation works, but the major portions are in the main independent thereof, although receiving great benefit from the regulation of the water in the irrigation reservoirs. Power possibilities on the Colorado River are very great, and though many years will pass before this can all be developed or will all be needed, the regulation of the water will immediately stimulate this development, which in turn will assist in bearing its share of the cost of the irrigation. All the power development thereby produced will check the consumption of fuel which has been advancing at such a terrifying rate during the past few decades.

Thirty years ago, or more, it was noticed that the consumption of coal had been, for several decades, doubling each 10 years. That is, the consumption was increasing in a geometrical ratio. Each succeeding decade has shown a continuation of this rate and recent years indicate a still greater acceleration. If this tendency continues, the accessible coal will be exhausted within a few decades. In addition to this, we have been using an enormous quantity of fuel oil, the consumption of which has grown rapidly. Many important oil fields have been nearly exhausted or greatly depleted, and the production has been maintained only by the rapid development of new fields. This cannot continue much longer, and the virtual exhaustion of our oil supply is a certainty in the near future. For all these reasons it is very important to encourage hydro-electric development in order to postpone the day of fuel shortage.

The Colorado basin is only an illustration of similar possibilities on many other streams of the arid region, most of which are interstate in character and afford great opportunities for irrigation and power development.

Vast Area of Swamp and Overflow Lands

The swamp and overflow lands are distributed widely throughout the Eastern and Central portions of the country, there being but little land of this character in the arid region. The inclusion of their reclamation in the general scheme will make the enterprise a national instead of a sectional one. The states containing the largest areas of swamp lands—in the order of area—are Florida, Louisiana, Mississippi, Arkansas, Michigan, Minnesota and Wisconsin, while nearly all the other states contain somewhat smaller areas. Table I gives the latest information regarding the areas of swamp and overflow lands in the United States.

TABLE I.—CLASSIFIED ACREAGE OF UNRECLAIMED SWAMP AND OVERFLOWED LAND

State	Permanent Swamp	Wet Grazing Land	Periodically Over-flowed	Periodically Swamp	Total
Alabama	900,000	59,200	520,000	...	1,479,200
Arkansas	5,200,000	50,000	531,000	131,300	5,912,300
California	1,000,000	1,000,000	1,420,000		3,420,000
Connecticut	.....	10,000	20,000	....	30,000
Delaware	50,000	50,000	27,000	200	127,200
Florida	18,000,000		1,000,000	800,000	19,800,000
Georgia	1,000,000		1,000,000	700,000	2,700,000
Illinois	25,000	500,000	400,000		925,000
Indiana	15,000	100,000	500,000	10,000	625,000
Iowa	300,000	200,000	350,000	80,500	930,500
Kansas		59,380	300,000		359,380
Kentucky		100,000	300,000	44,600	444,600
Louisiana	9,000,000	1,196,605			10,196,605
Maryland	100,000		92,000		192,000
Maine	156,520				156,520
Massachusetts	20,000		39,500		59,500
Michigan	2,000,000	947,439			2,947,439
Minnesota	3,048,000	2,000,000		784,308	5,832,308
Mississippi	3,000,000		2,760,200		5,760,200
Missouri	1,000,000		1,439,600		2,439,600
Nebraska		100,000	412,100		512,100
New Hampshire	5,000		7,700		12,700
New Jersey	326,400				326,400
New York	100,000	100,000	329,100		529,100
North Carolina	1,000,000	500,000	500,000	748,160	2,748,160
North Dakota	50,000	50,000	50,000	50,000	200,000
Ohio			100,000	55,047	155,047
Oklahoma			31,500		31,500
Oregon	254,000				254,000
Pennsylvania			50,000		50,000
Rhode Island			6,000	2,064	8,064
South Carolina	1,500,000		622,120	1,000,000	3,122,120
South Dakota	100,000		511,480		611,480
Tennessee	639,600				639,600
Texas	1,240,000	1,000,000			2,240,000
Vermont	15,000		8,000		23,000
Virginia	600,000		200,000		800,000
Washington	20,500				20,500
West Virginia			23,900		23,900
Wisconsin	2,000,000			360,000	2,360,000
Total	52,665,020	6,826,019	14,747,805	4,766,179	79,005,023

The permanent swamp lands, or nearly two-thirds of the total, produce absolutely nothing, and besides being an eyesore are breeders of mosquitoes and malaria. The other classes produce slight revenue which is precarious and only a small fraction of what they are capable of producing, if reclaimed. They also are unsanitary. Many of these are interstate projects, lying

in part in two or more states, and are necessarily national in character.

Table II gives the area of stump and inferior timber land in acres for the different states. These figures furnish a fairly reliable approximation to the actual acreages. They were compiled from figures obtained from township, county and state officials, lumber and logging companies, and individuals well informed on these conditions in their localities. While the results of this survey are necessarily approximations, it is believed that the figures are as reliable as any it is possible to obtain upon these acreages.

State	Acres	State	Acres	State	Acres
Ala	14,785,000	Mich	11,686,000	Penn	5,297,000
Ark	13,893,000	Minn	14,022,000	S. C	8,994,000
Calif	3,031,000	Miss	13,203,000	Tenn	7,833,000
Fla	10,109,000	Mo	8,900,000	Tex	12,936,000
Ga	20,141,000	Mont	674,000	Vt	2,070,000
Idaho	676,000	N. H	2,608,000	Va	9,929,000
Ky	3,222,000	N. J	1,151,000	Wash	3,330,000
La	11,877,000	N. Y	5,997,000	W. Va	4,634,000
Me	6,135,000	N. C	12,745,000	Wis	13,246,000
Md	1,848,000	Ore	3,537,000		
Total					228,509,000

Drainage problems are beyond the reach of individual effort and require the coöperation of public authority as well as public funds. This is true of large irrigation enterprises, but still more completely is it true of drainage. When an irrigation system is built any land owner not desiring to contribute his share to the public enterprise may decline to use and pay for the water unless some public means of compulsion, such as taxation, is exercised. But the managers of the irrigation system may refuse to furnish the water unless the land owner contributes his share, and the desirability of irrigation generally brings about coöperation in time as a matter of self-interest. Not so, however, with drainage. If the drainage system is operated at all it relieves all of the lands within the district drained whether their owners contribute or not, and there is no way of withholding the benefits from noncontributing lands. It becomes, therefore, imperative that drainage be done under some authority whereby all land owners shall be made to contribute their fair share for the benefits bestowed.

It cannot be expected that all the possibilities of reclamation outlined in this article will be undertaken immediately after the war, but reclamation of the most promising areas, one-third or one-fourth of the area upon which it is feasible, should be attempted. Assuming the reclamation of 5,000,000 acres of arid lands and 15,000,000 acres of swamp lands, these projects would provide direct employment for hundreds of thousands of returned soldiers on the construction of works which when completed would furnish homes for some of the same men and their families who would later return to the Government all the funds expended for their benefit. These 20,000,000 acres would make homes for nearly half a million families engaged in agricultural pursuits and an equal number in auxiliary occupations in the towns and villages which would grow up and the railroad systems which would be made necessary. Incidental benefits would be the encouragement of water-power development, thus conserving our fuel supply, the elimination of disease-breeding swamps and morasses of vast extent, and the amelioration of flood damages incident to water storage and stream regulation.

In addition to these material benefits, the plan proposed will help to solve to a large extent the social and economic problems of preventing the unrest and consequent danger to the tranquility of government, which would otherwise flow from the condition of having millions of unemployed with little prospect of entering gainful occupations or establishing homes.

Rock Cribs Blanket River Bank in California

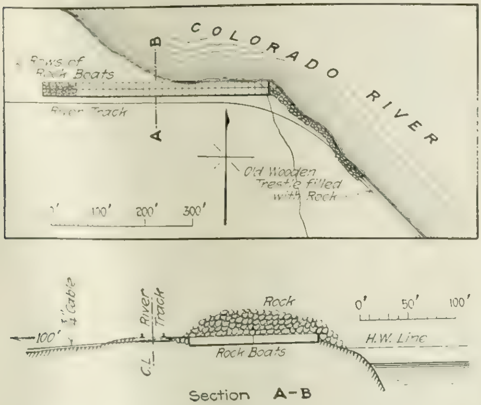
Rapid Erosion on Colorado River Checked by Cribs Which Drop Over the Caving Face and Form Permanent Protection

BANK protection consisting of shallow rock-filled cribs, or "rock boats," which drop over the face of the bank as it erodes, has been used at a sharp bend in the Colorado River near Needles, Cal., where the erosion threatened the line of the Atchison, Topeka & Santa Fé Ry. It was found that riprap would sink and afford no protection while the river was cutting so fast that no work of any value could be done along the face of the bank.

In this emergency it was decided to build cribs on the ground at a little distance back from the river. These were in two rows, lashed together at each corner by 16 ft. of $\frac{3}{4}$-in. wire cable, and anchored by similar cable to deadmen set 100 ft. back from the line of cribs. It was expected that when erosion began under the outer edge of the cribs in the first row they would drop into an inclined position and form a blanket protection for the

HOG FENCING HOLDS ROCK WHEN CRIBS TILT ON CAVING BANK

face of the bank, the cribs of the second row remaining practically horizontal. The engineers state that this plan worked successfully, the erosion being stopped at



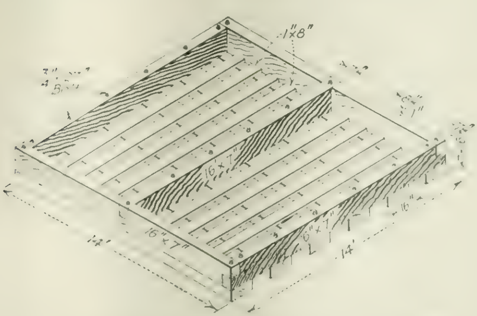
ROCK CRIBS STOP EROSION OF RIVER BANKS ON COLORADO RIVER

the row of cribs. The accompanying views show the cribbing in its original position and as it was placed finally.

Construction of the cribs is shown by the accompanying drawing, but the dimensions and sizes of the timbers used varied as second-hand material was utilized. The design is based on the use of old trestle stringers for the main timbers, with any available material for the bottom.

Rock filling was placed by hand and was covered with woven-wire hog fencing secured by staples. Additional rock was then piled on, to a depth of three or four feet.

Somewhat similar rock-boat cribs had been employed before, but with a size of 7 x 14 ft., built of old stringers and floored with 4 x 6-in. material. They were used largely under riprap to prevent its settlement. When tried for the protection of piers and banks it was found in some cases that when the boats were undermined the rock would roll out, so that the cribbing became of little value. For this reason a wire-mesh covering was adopted to hold the rock in place. Any available material was used for this purpose, but generally it was of about 4-in. triangular mesh with No. 6 and No. 14 wires.



2 SHALLOW CRIB OR BOAT FOR ROCK FILLING

Information as to the cribs and the bank protection at

4 ROCK-FILLED CRIBS FALL AS BANK CAVES, AND FORM PROTECTIVE MATTRESS

Needles has been furnished by G. W. Harris, chief engineer, and M. B. Clark, division engineer, of the Atchison, Topeka & Santa Fé Ry. (Coast Lines).

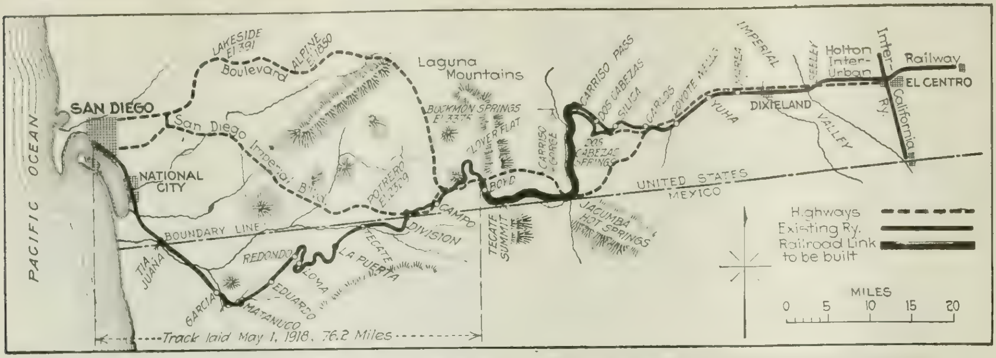
Will Complete New Railway Route to Pacific Coast

Line Rises from Sea Level to 3657 Feet, Then Falls to 50 Feet Below Sea Level—17 Tunnels in 12-Mile Gorge

APPROVAL granted by the United States Government for continuing the construction of the San Diego & Arizona Ry. will result in establishing a new transcontinental route having its terminal at the city and port of San Diego, Cal. It will give a direct line of about 220 miles from the Southern Pacific at Yuma, Ariz., to San Diego, as compared with the present indirect route of about 373 miles through Los Angeles, which is in part over the Southern Pacific and in part over the Santa Fé system. This is expected to benefit the city and the great irrigation district in the Imperial Valley.

The San Diego & Arizona Railway has in operation a line from San Diego east to Campo, 65 miles, of which 44 miles lie within Mexico. It has also 32 miles from Carriso Pass east to Seeley, whence connection is made by means of the Holton Interurban Ry. with El Centro, on a branch of the Southern Pacific. This end of the line lies in the Imperial Valley.

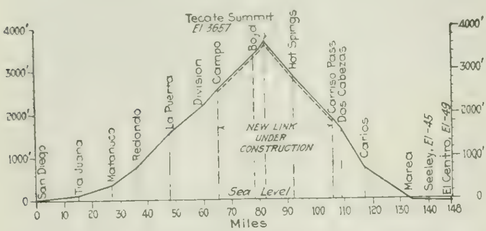
Completion of the 40-mile link between Campo and Carriso Pass will open a direct connection line between San Diego and the Southern Pacific system at Yuma. This 40-mile link, however, constitutes the mountain section and involves heavy construction work. It in-



SAN DIEGO & ARIZONA RAILWAY WILL COMPLETE LAST LINK IN NEW TRANSCONTINENTAL ROUTE

cludes also the summit of the line across the range, as shown by the profile.

Starting at approximately sea level at San Diego, the



PROFILE OF MOUNTAIN BARRIER CROSSED BY NEW RAILWAY TO THE PACIFIC

line will have a steadily increasing grade for 82 miles to a summit elevation of 3657 ft. on the Tecate divide. From this point it falls continuously, until at about 135 miles it reaches sea level and then continues to fall until at El Centro it is 49 ft. below sea level. The maximum grade is 2.2%. It will be seen by the map that considerable development is required to maintain the grade limit, including a loop at Clover Flat and a double loop near Loma, Mexico. The map shows also the San Diego and Imperial boulevard, with alternative routes between San Diego and Campo.

Construction of the new link is divided between the Twohy Bros. Construction Co., Portland, Ore., and the Utah Construction Co., Salt Lake City, 21 miles and 19 miles, respectively. The latter company's contract includes a 12-mile stretch in the Carriso gorge with 17 tunnels aggregating 13,412 ft. in length. On June 1 track had been laid for 108 miles, leaving 31 miles on which the grading was in progress. About 50% of this grading and 20% of the tunneling had been completed at that time. It is expected to have the line completed early next year.

D. A. Pontius is general manager of the San Diego & Arizona Ry.; E. J. Kallright is chief engineer.

Unit Costs for Setting Water Meters

By Allen F. Brewer

Merion, Penn.; Lately Assistant Valuation Engineer, New Jersey Utility Commission

COST data pertaining to house meter setting are frequently of considerable interest to valuation and water-works engineers. To derive unit costs for such work in tabular form for reference in estimating on proposed installations or appraisals is of great value as a time saver. As a guide to arranging such a tabulation, the following data are presented. The costs quoted may be used with reasonable assurance as to correctness, inasmuch as they are averages obtained from current actual work.

To derive similar figures independently, it is only necessary for the engineer to tabulate the data from his own meter installation cost cards. The number of fittings required, together with costs by sizes, may be tabulated and averages arrived at for the number, total cost and average cost per meter set. It is well to add that fittings include tees, ells, caps, plugs and crosses, although the latter three are seldom used in house meter work. Average costs for couplings and seals may be likewise obtained. Meter costs are not considered, inasmuch as various types may differ considerably as to base price and discount.

Labor is assumed on a one-man basis, an average of 1¾ hours being derived for both carting and installation. Average percentages to be added for storeroom and tools have been derived, as have other unit figures, from actual observation of meter installation cost cards.

TABULATED UNIT COSTS FOR SETTING ⅝- TO 1-IN. WATER METERS

Material	[illegible]	[illegible]	[illegible]	[illegible]	1 in
Average number of fittings	4.5	4.5	4.5	4.5	4.5
Average cost per fitting	$0.036	$0.036	$0.036	$0.042	$0.058
Cost of fittings per set	.162	.162	.162	.189	.260
Cost of stop cock	1.250	1.250	1.250	2.200	3.500
Cost of couplings	.300	.400	.500	.600	.800
Cost of coupling seals	.300	.300	.300	.300	.300
Cost of register seals	.050	.050	.050	.050	.050
Total cost of material	$2.062	$2.162	$2.262	$3.339	$4.910
Cost of storeroom, 3 per cent of cost of material	.062	.065	0.068	.100	.147
Labor					
Average man-hours per set	1¾	1¾	1¾	1¾	1¾
Average carting-hours per set	1¾	1¾	1¾	1¾	1¾
Cost of carting[1] @ 80c per hour	$1.400	$1.400	$1.400	$1.400	$1.400
Cost of labor @ 60c per hour	1.050	1.050	1.050	1.050	1.050
Cost of tools @ 2% of labor	.021	.021	.021	.021	.021
Total cost of labor	$2.471	$2.471	$2.471	$2.471	$2.471
Total cost of setting	$4.595	$4.698	$4.801	$5.910	$7.528

[1] Does not include driver. Vehicle [illegible] automobile. Driver to be the mechanic. Where vehicle is [illegible] cost of 30c per hr. per horse may be substituted.

Grouting Wells in Rock Formation Effective and Simple

Water Protected from Contamination, Head Saved, Casing Protected—General Principles Stated—Examples and Cost

By W. G. Kirchoffer
Hydraulic and Sanitary Engineer, Madison, Wis.

GROUTING wells with cement has given such satisfactory results in the experience of the author on water-works construction and improvements that he ventures to submit some notes on several wells lined under his direction. First, the principal reasons for lining and some general remarks on practice will be given.

The wells discussed here are those that are drilled in and receive their water from a rock formation, and may be either deep or shallow. The reasons for grouting wells in the manner hereafter described are: (1) To save the head of flowing wells by preventing leakage into nonwater-bearing strata or through openings in the casing made by rust; (2) to protect the casing of either non-flowing or flowing wells from decay by substituting a cement mortar casing; (3) to prevent the water from becoming polluted by seepage from a source of contamination near the surface which perhaps is the most important of all and warrants the extra expense incurred. The additional cost may be partly offset by using a poorer quality of casing than would be safe without grouting, since the cement wall, properly put in, will last as long as the rock itself.

This process can be used for either new or old wells. If the old well is small in diameter and the surface of the rock or other noncaving formation is near the surface, the well can be reamed to a size sufficient to allow for the grout, or the size of the well may be reduced by inserting a smaller casing, properly packed at the bottom, to provide a form for the cement mortar.

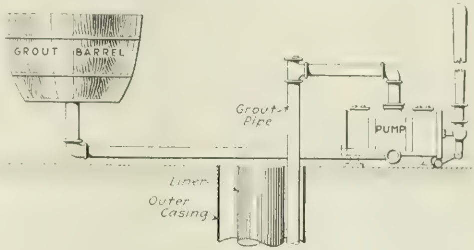
Grouting a New Well

In the case where the grouting is to be done on a new well that portion of the well that must be grouted is drilled to a large diameter, say 12 to 20 in., and to a depth sufficient to prevent leakage, seepage, etc. The depth to be grouted is usually predetermined by a knowledge of the strata and should preferably extend to or near the top of the water-bearing formation from which it is desired to obtain the water. An outside casing must be used in materials which will not stand long enough to permit of completion of the work.

The hole at the bottom of the grout should be made smaller, to a size just large enough to receive the "liner," which should be seated firmly in the rock to a depth of at least 2 ft. The liner can be made of any grade of metal sufficiently strong to withstand handling and prevent collapse. The top of both the outside and inside casings should reach the surface of the ground or to the point where the water is to be taken off. In the case of flowing wells, the liner may be used as the discharge or suction pipe if pumping is done, and directly connected to the pump or horizontal pipe. The space between the two casings should be at least 2 in. but more is desirable.

The grouting apparatus consists of a line of 1¼-in. pipe sufficient to reach within 10 ft. of the bottom of the space to be grouted, a hand or tank pump and a half barrel or watertight box of about the same size. The 1¼-in. pipe is hung between the liner and the outside of the well, so connected that it can be readily raised as the filling progresses. The grout is made of cement of such a consistency that it will pour readily. No sand is added while the pump is in use.

By having the dosing box or barrel above the pump the suction lift is eliminated and for that reason the grout flows much more readily. The water in the well should not be disturbed during grouting, as any difference in pressure might cause the grout to flow out of the annular space between the casings into the well. Tests for this leakage should be made by means of a small bucket which can be made of ¾-in. pipe, 6 in. long, let down in the well opposite the end of the liner. If cement is getting into the well, the water will have a milky appearance when brought to the surface.



THE GROUTING APPARATUS IS SIMPLE

When the grouting has reached a point near enough the surface to cover all rock crevices, one-third sand may be added to the cement and the mixture poured into the pipe in place of pumping it.

At Whitewater, Wis., the water-works plant has two deep wells, one 976 ft. and another 540 ft. deep, also two shallow wells. The 976-ft. well was drilled many years ago. When completed it had a head of 19 ft above the ground level, and flowed 218 gal. per minute into a reservoir 110 ft. in diameter. The flow gradually decreased until it, with the two shallow wells, flowed only 1 in. in depth into the reservoir in 12 hours. The 540-ft. well was located close to Whitewater Creek, which receives the drainage from the city. The rock formation came near the surface at this point and was very badly shattered.

Plans for Reaming and Grouting Two Wells

After the sewerage system was constructed and before the disposal plant was completed, this well became contaminated to a marked degree. The surface of the St. Peter's sandstone from which a portion of the flow was obtained was encountered at a depth of about 154 ft. Plans and specifications were drawn for the reaming and grouting of these two wells to a depth of 156 ft. The outside casing in the surface materials was 16-in. O.D. casing and the hole in rock was 15 in. in diameter. The liner used was 8 in. inside diameter. The holes below a depth of 156 ft. were reamed to 8 inches.

When the work on the 976-ft. well was completed, it was again connected to the reservoir and the combined

flow of it and the two small wells was found to be 6 in. in depth in 12 hours in place of 1 in. before grouting; an increase of 500 per cent.

Well No. 2 was not connected to the reservoir, so no measurements were made, but contamination ceased. This well was really a new one, as the rock in the old well was so badly shattered and the hole so crooked that it was not reamed like well No. 1. This will be reduced from 8 to 4 in. in diameter and grouted like the others.

To prevent the grout from passing into the drill hole below the 4-in. pipe in No. 2 well, a rubber bag attached to a line of ¼-in. pipe was inserted to a depth of a few feet below the end of the 4-in. pipe. Air will be pumped into the ¼-in. pipe until the bag is inflated so that it presses firmly against the wall of the drill hole, which is very irregular. A small quantity of sand will be poured into the 4-in. pipe so as to be sure to seal the opening and cover the rubber bag before the grout is placed. After the grout has set, the air will be released and the pipe and bag withdrawn.

The work on the two wells to a depth of 156 ft. was let for $2350. The reaming below that depth was $3.50 per foot. The greater part of the cost of the work was, of course, in the reaming to a diameter of 15 in. and the casings. The process of grouting after the equipment is on hand is simple and comparatively inexpensive. The work on Well No. 1 was performed in two days by three men and required 27 bbl. of cement.

At Mineral Point two wells about 150 ft. deep were supplying the city, but became contaminated by surface water from the hills nearby. A new well of the same diameter as those at Whitewater was put down to a depth of 150 ft., with grouting to a depth of 64 ft. This well cost $710. The detailed prices were: In surface formations requiring 8-in. and 15-in. casings with grouting, $10 per foot; in rock requiring only 8-in. casing and grouting, $7 per foot; 8-in. hole in rock, no casing or grouting, $3 per foot.

A comparison of the bids on work of this kind with work involving only one casing follows: At Sparta, Wis., for drilling and casing a 16-in. O.D. hole to depth of 117 ft., with 10-in. liner and grouting to a depth of 190 ft., $1850 was the lowest bid. For the same hole 10 in. in diameter, cased to 117 ft., without grouting, the lowest bid was $899. The total depth was 277 ft. and in either case the bid for work below a depth of 190 ft. was $3.50 per foot.

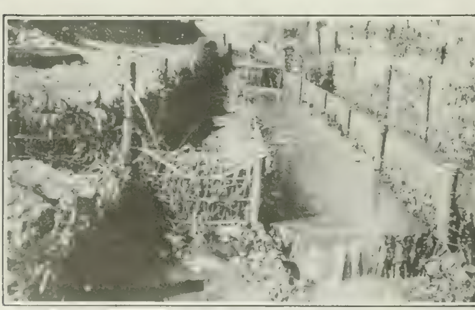
At Hartford, Wis., the lowest bid was: 130 ft. cased with 16-in. O.D. casing, 330 ft. 10-in. casing and grouting to a depth of 330 ft., for the lump sum of $3180; 300 ft. 10-in. hole in rock at $5, $1500; total, $4680.

Making a Stream Build Its Own Check Dams

Floods Deposit Debris and Sediment in Porous-Walled Compartments Built Across and Up and Down Stream

By Albert Marple
Tropico, Cal.

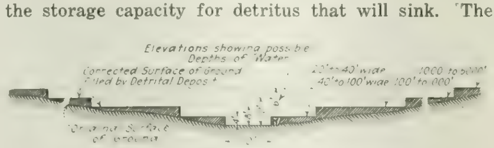
A SCHEME for building up check dams to prevent the erosion of stream banks with the detritus carried by flood waters has been applied in southern California. The plan, it is claimed, can be executed at far less cost than that of the ordinary check dams designed to accomplish the same purpose. The plan involves building, during the low-water season, a series of porous obstructions in the channel of the stream. These can be made of woven wire fastened firmly to posts, or of any other form of construction which will permit the water to flow through while retaining the débris. The point of primary importance to be observed in the construction is that the top of each successive obstruction or dam must be at about the same level as the bottom of the one next above.



POROUS CHECK DAMS PARTIALLY FILLED WITH DEBRIS

The theory is that the floating débris, sand, boulders and all matter carried along by the water strike the porous dam and partially clog it, thus retarding the flow and "backing up" the water in a pond behind the obstruction.

The detritus is deposited in this pond and the floating material is checked by the porous dam, increasing the storage capacity for detritus that will sink. The



TYPICAL CROSS-SECTION PROTECTION WORK COMPLETED

heavier material does not get as far as the dam itself until the pond or basin above has been filled to the level of the top of the dam. The dams are anchored upstream and as the pond fills the weight adds to the stability of the structure. An important feature claimed for this form of construction is that once the basins begin to fill it is impossible for the stream bed to shift.

When the first or upper basin has been filled, débris naturally begins to catch on the edge of the next dam below, and the process is repeated as far as the system has been built. The system may be built for the entire length of a stream or only at points where pro-

tection is necessary. The height of each successive structure, as the work is carried upstream, is increased enough to secure the desired effect. If the stream bed is very steep it may be that the lower edges of the upper "dams" will be suspended 6 to 10 ft. in the air. In such cases, of course, these upper dams would not come into service until those below had served the purpose.

By subdividing the space behind the dams into secondary porous compartments, with two sides across and two sides parallel to the stream bed, the cross-section to which the stream will build can be controlled to a nicety, the center being kept lower than the sides. After the basins are filled, the stream bed is "stepped up" from center to side just as the series of dams are extended upstream. The effect of this gradation of the banks is to keep the higher velocity at the center and comparatively quiet water at the sides.

The illustration shows such a protection work that was partially built up in Laurel Cañon Creek, near Los Angeles.

On this work a total of about a mile of protection has been built. Last winter an unusually heavy run-off occurred from a district tributary to Laurel Cañon that had been burned over. Water came in greater volume than ever before known and carried great quantities of sand and débris. When the flood subsided the entire check dam system was intact and about one hundred of the parallel secondary compartments were filled level with the tops of their protecting dams. The grade of the stream bed varied from 15 to 3½%. On the 10% grade the stream more than filled a bridge culvert 12 ft. wide and 4 ft. deep. The protected channel averaged about 25 ft. in width, and the center course varied from 8 to 10 ft. in height. The cost of installing the system including side lines, wings and all incidental work, averaged about $2 per lineal foot.

In an installation in a nearby cañon the width of the channel averaged 35 ft. and the grade was arbitrarily predetermined at 25%. The total installation extended for a length of about 150 ft. and had a center channel 10 ft. wide. The purpose of this installation was to prevent the erosion occurring as a result of this drop of 25 ft. This installation was also subjected to a severe run-off from a burned-over area. In both cañons so much sand was brought down that at times the entire structure was completely concealed, and was exposed later, it is stated, only by the continued action of the water.

The system described in the foregoing has been developed and installed by Alvaro W. Pratt, Hollywood, Cal.

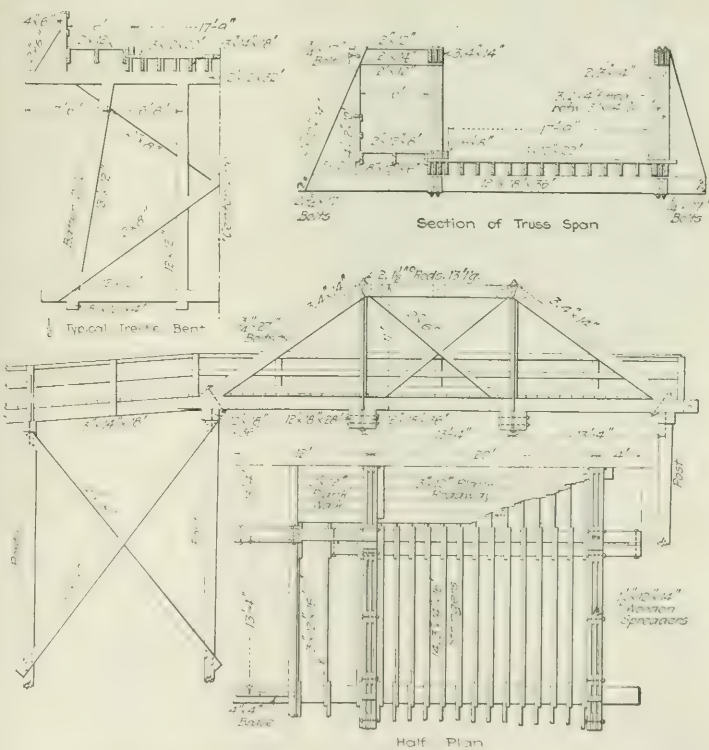
Plank Trusses Carry Streets Over Depressed Tracks

IN CONNECTION with the lowering of the tracks of the Oregon-Washington Ry. to eliminate grade crossings at Portland, Ore., described in *Engineering News-Record* of June 6, p. 1097, three temporary timber bridges were built to accommodate street traffic.

Truss spans of 40 ft. in two of the bridges carry the streets across the tracks, the remainder of each structure being a trestle with framed bents and spans of 16 ft. Each of these bridges has a roadway 17 ft. 9 in. wide and a 6-ft. sidewalk, and is designed for a live load of 200 lb. per square foot. The trestle approaches have grades of 6 to 8 per cent.

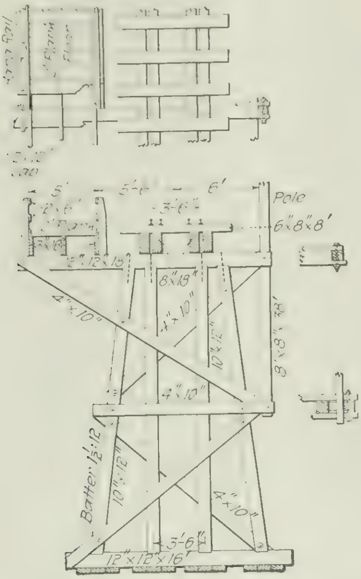
The trusses are built up of planks, as shown in one of the accompanying drawings. They are spaced 20 ft. on centers, and carry the 6-ft. sidewalk outside of one truss by means of extended floor-beams at the panel points. This necessitates a rather unusual arrangement of the bracing on the outside of this truss.

The third structure is a framed-bent trestle throughout, with spans of 15 to 20 ft. It has no roadway, but



PLANK TRUSS SPAN IN TRESTLE CARRIERS STREET OVER TRACKS

carries only a single-track street-car line of 42-in. gage, and a 5-ft. sidewalk. The construction is shown in the drawings. This trestle is 700 ft. long and is built partly on a curve, so as to pass around the site of the permanent bridge. It has approach grades of



TEMPORARY TRESTLE PROVIDES SUPPORT FOR STREET-CAR LINE AND SIDEWALK

7%, these being reduced to 3.5% for a short distance on each side of the level 22-ft. span over the tracks.

Designs for these structures were included in the engineering plans prepared by the city for the grade separation. This work is under the supervision of O. Laurgaard, city engineer. The Pearson Construction Co., Seattle, has the contract.

Lake Beach Sand Has High Load-Sustaining Value

Some Tests Made at the Southern End of Lake Michigan Show a Maximum of Five Tons per Square Foot Is Permissible

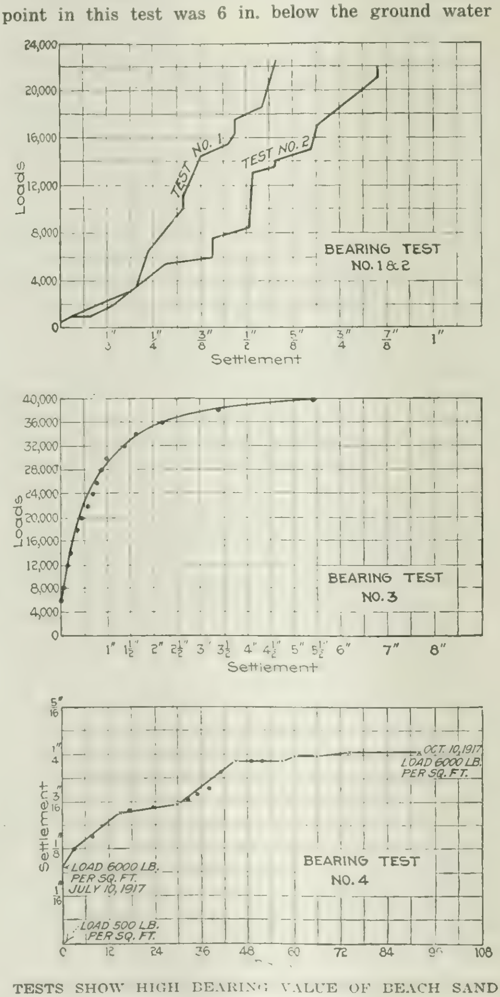
By W. S. Thomas
Assistant Engineer, Gary Tube Co., Lorain, Ohio

But little data has been published that shows the permissible loading on the fine sand of which the beaches of the Great Lakes are generally composed. When very heavy structures are to be erected on such a soil, tests generally are made to determine the safe figure. Certain buildings were proposed for erection by the Gary Tube Co. near the southern end of Lake Michigan, and since the contemplated foundation loading of these buildings was about three tons per square foot it was decided to make tests which would determine whether the soil conditions warranted such an imposition.

The soil at this point is composed entirely of a fine sand. Tests were made under these conditions at points not more than 2000 ft. from the shore. A loading platform, as is shown in the illustration, was constructed and the test location was well cleared of all grass and weeds. The bearing timbers were placed directly on top of this cleared surface, except that in the second test, holes a foot deep with sloping sides were due to receive the timbers.

As first planned, tests 1 and 2 were to be loaded to 10,000 lb. per square foot in increments of 500 lb. per square foot applied at intervals of 48 hours. This schedule was adhered to as far as possible, but when this load was reached and no decided settlement noticed, it was decided to continue the loading. As a result, a final loading of 22,000 lb. per square foot was reached without attaining any marked settlement. At this point the capacity of the platform used had been reached.

The bearing point elevation of the first test was 18 ft. above normal lake level. In the second test the bearing elevation was 3.5 ft. above normal lake level, and since water was reached at +4 ft., the bearing point in this test was 6 in. below the ground water



TESTS SHOW HIGH BEARING VALUE OF BEACH SAND

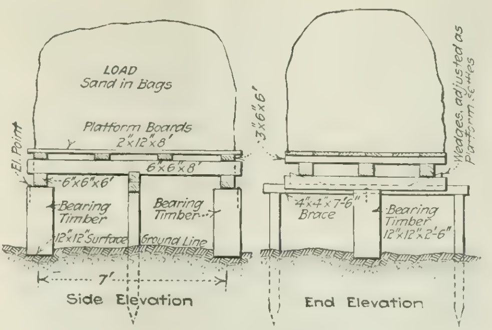
level. This test showed a greater settlement than the first experiment—due no doubt to this fact.

The first test having been stopped due to a lack of strength in the loading platform, this was strengthened to a point where it was thought sufficient to carry a load which would produce decided failure. The loading in this test was composed of large eye-bolts weighing from 33 lb. to 61 lb. apiece, and was placed on the platform in increments of 2000 lb. per square foot every 24 hours. No settlement was recorded until a load of 6500 lb. per square foot had been reached. This is probably due to the fact that the platform being heavier, the sand was compacted to a slight extent during the period of construction.

If the curve showing settlement of test No. 3 is moved over until its settlement at a loading of 65 lb. coincides with a similar loading of test No. 1, it will be found that this curve falls between the curves of tests 1 and 2. This would add about ¼ in. to the total settlement of this last test. A final loading of 40,000 lb. per square foot was recorded before failure occurred. One bearing timber settled to such an extent that the platform could not be used for further loading.

Based on the results of test No. 3 and using a factor of safety of 4, it would seem that five tons per square foot could be used as a maximum loading with perfect safety.

Test No. 4 was loaded to 6000 lb. per square foot



TEST PLATFORM CARRIED 22,000 POUNDS

at the start and the settlement noted from time to time. The load in this case corresponds closely to the contemplated foundation loadings. To a recent date the settlement amounted to $\frac{5}{32}$ of an inch, probably due in part to the displacement of the sand caused by the vibration from driving piles—since no protection was given to the bearing point to guard against disturbance of this sort or from the weather.

The tests were conducted by the writer under the supervision of W. G. Bowman, chief field engineer of the Gary Tube Company.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Engineering Council's War Committee Wants Inventors

Members of the ten national technical societies represented on the war committee of the Engineering Council have received the Government Bulletin No. 2 on "The Enemy Submarine." They are asked in a circular letter to use their inventive talent and technical training in the study of the various problems which arise in the preparation for and prosecution of the war. The war committe was organized to make possible the utilization of the patriotism and original thought of the members who could not go to Washington with their ideas. "The greatest care will be taken," states D. W. Brunton, chairman, "to discover and utilize everything of value that may inhere in suggestions and inventions submitted. Not only will they receive studious examination but, when necessary, trials and experiments will be conducted. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular departments of the army and navy service where they may be most profitably utilized."

In the bulletin, which was compiled by the Naval Consulting Board and the war committee to supersede Bulletin 1 on "The Submarine and Kindred Problems," are indicated more fully the requirements for war inventions, in order to show the limitations outside of which creative efforts may not be expected to produce results of value, and to assist the student in avoiding the duplication of previous accomplishment.

Engineers Study Compensation

Following the presentation of the article by W. A. Stinchcomb on "Engineering Salaries Adjusted to Cost of Living," in *Engineering News-Record* of Aug. 1, p. 238, the Young Men's Committee of the Western Society of Engineers, which meets regularly every week to discuss current engineering topics, society affairs and policies, learned that the salaries of five of those present were from 0 to 33% higher than on Jan. 1, 1917, the average increase being 20%. According to Mr. Stinchcomb's commodity tables they should have been increased 20%. Of the ten men present only five were able to segregate their living expenses into the classes noted in Mr. Stinchcomb's article. The average increase of the ten was 19%, ranging from 0 to 60%. Savings, which were considered the criterion of whether a proper compensation was being obtained, varied from 9 to 30% and averaged 18%.

Salaries of all had been increased except for a university professor and for two men in the employ of the City of Chicago, where no readjustments have been made in twenty years. The latter have been asking for increases varying from 22 to 33%, and it was with a view to getting at the reasonableness of the requests of the city employees that the committee went into the matter so thoroughly. Previous opinions to the effect that these men were properly compensated were speedily revised after an evening of intensive investigation and individual economic comparisons.

Incentive for further study was found in the dis-

closure of the rapid exodus of engineers from the city employ, because of the lack of recognition of advancing salary scales outside. One department has only 20% of its former force left. Those who remain are confronted with a staggering amount of work. Some departments are filling engineering positions with 60-day political nontechnical appointees.

While the young men's committee cannot commit the society to any expression of opinion, its own opinion is that the efficiency of the engineering work of the city is being lowered materially, that the citizens will be poorly served, and that the engineering profession will suffer prestige. Therefore, any effort to raise the pay of the city's engineers is judged by it a proper sphere of society activity.

Chicago Engineers Getting Together

Three more technical societies in Chicago have joined the war committee, making 19 in all. Military activities are being coördinated fast and the first of a series of meetings for members was held July 30. S. J. Duncan-Clark, war analyst of the Chicago *Evening Post*, spoke in the rooms of the Western Society of Engineers on "The Latest Moves on the War Fronts." It is planned to have noted war analysts describe various phases of the situation on the fighting front as they develop.

The committee has a paid secretary and is helping to place men in all technical branches of the Government. It is coöperating with the recently established engineers' division of the United States Employment Service and is sending out a brief questionnaire asking for a statement of qualifications and availability for war work.

Among many engineers there is talk of further cooperation and affiliation of general society activities. The progress made by the Cleveland Engineering Society in this line with the American Association of Engineers in reducing combined dues is being looked into.

Urges Engineers to Get into Politics

Under a July date the Illinois Society of Engineers has issued a one-page bulletin calling on engineers to bear their part as citizens and get into politics because of the obvious necessity of having the nation's affairs at this time in the hands of men selected only for their loyalty, ability, public spirit and strength of character, rather than for mere partisan or political reasons.

Continuing in this vein, the admonition to action in this time of carrying on a great war against a powerful and unscrupulous enemy, the bulletin states that men with any taint of "yellow" who seek office should be turned down decisively. The nation needs honest and true MEN as its representatives in the Government of the United States. The same reasoning is applied to the serious problems of preparing for the carrying on of commerce and industry after the war.

"Every member is requested to consider his own personal responsibility in the support of his country and of its principles of freedom and democracy," the bulletin states. "Act upon this principle at once in helping to select the right men, and at the primaries in voting for them. Our country must be our first consideration."

The Illinois Society of Engineers is in effective coöperation with 18 other technical societies of Chicago in war work and is a contributing member of the Citizens' Unit, a civil organization backing the 108th Engineers, formerly of the Illinois National Guard, by looking after the welfare and interests of the men and their families.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Equal Payments to Liquidate a Debt With Interest

Sir—Referring to my article entitled, "Equal Payments to Liquidate a Debt with Interest," appearing in *Engineering News-Record* of May 2, p. 871, and to criticisms by L. B. Merriam and Julian Hinds in your issue of July 18, p. 143:

The problem for which solution was offered was a purely practical problem which arose in the ordinary conduct of business between the executive heads of two corporations, one of which is the largest of its kind in the world. The only unusual feature of the problem was the stipulation that all payments should be equal, and the solution presented in my article was accepted after considerable correspondence and argument. The original proposal of the creditor corporation was that given in the last paragraph of my article.

So far as my experience and observation go, it is customary in the ordinary transaction of business to cover short-term debits by notes, each note cancelling a certain principal, and bearing interest thereon from the date of the note to its maturity. This is correct in theory and in practice, the idea being that the use of another's money involves an indebtedness for such use for the period during which the money is used, and that the obligation ceases coincidentally with the use. I believe this to be quite general practice, and I know it to be not unusual.

Mr. Merriam's criticism appears to be that in my solution the interest was not kept paid up to the dates of the several installments. The answer is that in the actual transaction the common use of notes was made.

Mr. Hinds' criticism is seemingly that a sinking fund was not provided for retiring the entire obligation at the end of the 29th period by a lump-sum payment. Mr. Hinds' method would be perfectly justifiable, but would have to be made the subject of a special agreement, and is not, I believe, in conformity with the usual business practice. It is a method which is frequently used by engineers and others in figuring relative economies of different schemes and in providing for amortization of long-term debts by periodical contributions to the sinking fund.

It does seem somewhat elementary to conduct a discussion relative to computing interest on a comparatively simple obligation, but, judging from the several methods which have been advanced both to me per-

sonally by letter and through your pages, there is not a well established and understood practice in handling this simple subject.

I cannot agree with Mr. Hinds' conclusion that "it is possible, of course, to agree to some arrangement, that suggested by Mr. Shepard, for example, which will give a result intermediate between simple and compound interest, but the logic or necessity of such an arrangement is not apparent." I am confident that a little investigation will show that many, if not most, matters of this kind are arranged by notes, each note standing alone so far as interest and capital are concerned, but the total capital payments embraced by the several notes equalling the total of the original obligation. This is the simplest and most logical kind of simple interest.

R. B. SHEPARD, JR.,
Office Engineer, Valuation Department, Atlantic Coast Line Railroad.
Wilmington, N. C.

Imhoff Tank Sludge Makes Raspberries and Lettuce Grow at Toronto

Sir—The experiment being carried out at Dallas, Tex., with Imhoff sludge, noted in *Engineering News-Record* of July 25, p. 164, is very interesting to me, as it parallels work which is being done in Toronto.

We have had considerable difficulty in obtaining a thoroughly digested sludge in our experimental Imhoff tank, but toward the end of last summer were getting a fairly good sludge. In spite of this, in the spring some of the office staff who were cultivating plots of ground used this sludge on their potatoes and corn, and although no quantitative results were collected, the size of the potatoes and healthy deep green color of the corn was very marked in comparison with that which had not been fertilized. The sludge was merely spread on the ground and then dug in, after the ploughing was finished. The soil is a clay loam and had not been cultivated for some six or seven years.

In consequence of this, I arranged with a market gardener about 14 miles from the disposal plant to take some of the sludge from the drying bed this spring and use it as he would his ordinary manure. He hauled altogether some 10 tons, containing approximately 60% water, and used most of it on two acres of his raspberry bushes. The remainder he used on small patches of ground in his kitchen garden. Unfortunately, the benefit to his bushes will not be definitely known until next year, except that a comparison of the new canes which will bear next year with those bearing this year is as the thickness of one's little finger to one's thumb. The new growth in 14 weeks is half as high again as in the unfertilized bushes. The color of the leaves on the fertilized bushes is a dark, rich green while on those not fertilized it is a light, yellowish green. The soil is a very light, sandy loam; in fact, on top of one mound is a blow sand, and it is in this place that the improvement is most noticeable.

The gardener in applying the sludge spread it on the surface of the ground and scuffled it in, and is very much pleased with the results he has obtained so far as it keeps the land moist and friable. He states further that with common manure he has a continual fight with a great variety of weeds, while with the Imhoff sludge there are only tomato plants to contend with and these are easily killed. His only complaint is concerning the cost of delivering the sludge to his farm.

It is unfortunate that the city itself cannot experiment, but at the present time all the land available around the works has been taken over by the Rotary Club and given out in small holdings to the residents

IMHOFF TANK SLUDGE MAKES LETTUCE GROW

of the neighborhood for garden truck, and they are only amateurs.

I am inclosing a photograph of two heads of lettuce grown within 10 ft. of each other, one of which was sludge fertilized.

I hope to continue the experiments, not only with the Imhoff sludge, but also with the old sludge in the lagoons, which are really shallow separate digestion tanks.

This work is all carried on under R. C. Harris, commissioner of works, W. R. Worthington, assistant engineer in charge of sewers, with myself as general superintendent of the plant.

I. H. NEVITT,
Superintendent, Main Sewage Disposal Works.
Toronto, Ont.

Effect of Frost Action on Pavements

Sir—The explanation given in J. L. Harrison's article, in *Engineering News-Record* of Feb. 28, of the manner in which concrete pavements are injured by frost, seems to be borne out by observations made on an unusual case of heaving which occurred on a New York state highway in Chautauqua County.

The pavement, on the northern end of the Jamestown-Bemus Point road, was laid in 1916, but for some reason the construction of a small culvert and of the short section of pavement over it was delayed until October of the following year. On excavating for this culvert, soft black muck was found about 4 ft. below the surface, and several springs were encountered, some of them directly under the pavement.

To provide foundation for the culvert and drainage for the springs, a blanket of fine gravel and sand and an 18-in. layer of screened gravel were placed in the

bottom of the trench. Screened gravel was also used for backfilling the trench.

Because of the lateness of the season, it was necessary to build the pavement as soon as possible after the culvert was finished, and to eliminate danger from settlement of the backfill the portion of the culvert top under the pavement was brought to subgrade elevation with 1:3:6 concrete. Metal reinforcement was placed in the bottom of the pavement slab where it spanned the trench.

Metal reinforcement weighing 0.28 lb. per square foot was also placed 2 in. below the surface over the entire area of the new pavement. The adjoining old pavement was not reinforced.

The winter of 1917-18 was unusually severe in this neighborhood, but there was a period of fine weather in March with temperatures as high as 50° F. on Mar. 12 dropping to 10° F. on Mar. 16. On Mar. 17 what was apparently a serious settlement at the culvert was noted, but careful levels, taken at that time, indicated that there had been neither settlement nor heaving directly over the culvert, but that the pavement on both sides had been raised from 0.3 ft. to 0.4 ft. higher than the elevations shown by a survey made the previous autumn. This heaving seemed to be uniform, extending at least 1000 ft. in both directions from the culvert, but no breaks appeared in the profile except at the culvert.

Subsequent levels show that the pavement has gradually settled to nearly its original position. The elevations, taken in November, 1917, were recorded only to the nearest tenth, but they are sufficiently close to show that the frost had little if any effect on the position of the culvert. It would seem that the precautions taken to insure drainage at that point prevented heaving by affording a means of relief from the pressure which resulted from freezing.

No serious cracks, and very few of any kind, have developed during the course of the heaving and settlement, probably because the material composing the subgrade is uniform in character, and because the cross-section of the roadway is such that all surface drainage is promptly removed. CHARLES T. FISHER,

Senior Assistant Engineer,

New York State Highway Department.

Jamestown, N. Y.

More About the Baltimore Imhoff Tanks

Sir—The article by Thomas D. Pitts entitled "The Truth about Imhoff Sewage Tanks at Baltimore," published in *Engineering News-Record*, July 11, is an interesting one. It is not the intention of the writer to attempt to discuss the operation of the circular Imhoff tanks at Baltimore, but it may not be amiss to say that those who are familiar with the operation of sewage settling tanks will not be at all surprised to learn that circular tanks with a radial downward and upward flow have not proved satisfactory in operation. It has always appeared to the writer that the principle of such operation is fundamentally wrong.

Mr. Pitts says: "I do not believe that the Imhoff tank will prove satisfactory for any plant which has to handle quantities of sewage approximating ours, especially where it is stale, as at Back River, but it may be both satisfactory and economical for smaller plants, with fresher sewage, if ample sludge room is provided." Will Mr. Pitts be kind enough to supply the data on which he bases this opinion? It is difficult to see wherein the volume of sewage to be handled is any factor in the question of treatment by Imhoff tanks—provided, of course, that the tanks are of sufficient capacity to handle the flow. And it would be interesting if Mr. Pitts would explain why Imhoff tanks will not handle stale sewage.

Mr. Pitts further says: "I should prefer a longitudinal-flow design in any event, and our experience is that the horizontal flow is less likely to lead to excessive sludge formation than the downward flow used in our tanks." It would be interesting if Mr. Pitts would explain just what he means by this statement and by the term "excessive sludge formation." The statement would seem to lead to the conclusion that less sludge would accumulate with a horizontal-flow tank than with a radial downward-and-upward flow tank of the type used at Baltimore.

And does Mr. Pitts mean to convey the idea that it is desirable, in order to prevent what he terms "excessive sludge formation," to have some of the suspended matter carried over in the effluent rather than to have it deposited in the tank? The writer has supposed, generally speaking, that one function of a sewage settling tank was to remove as much of the suspended matters as possible. OPERATOR.

[To the foregoing letter Mr. Pitts replies as follows. —Editor.]

Sir:—My belief that the Imhoff tank will not prove satisfactory for large disposal plants such as that at Back River is due chiefly to the increased cost for maintenance and operation which has been shown by our experience. I am also of the opinion that the stale condition of the sewage, which always exists in such large plants (at Back River the sewage is distinctly septic), makes the operation of the tanks less satisfactory because the solid matter is to some extent broken up by the septic action, so that sedimentation is less complete, and also because the septic condition of the sewage apparently tends to increase the odors from the tanks. I am, unfortunately, unable to support my beliefs on these points by laboratory data, because for the past two years our technical staff at Back River consisted of a chemist-bacteriologist and one laboratory helper only, and under those conditions it was impossible to do anything more than the necessary routine work. I am, and have always been, of the opinion that our results could be improved if the city authorities would provide a sufficient technical staff for somewhat extended investigation work, but, lacking this, comparison of the observed results at Back River with stale sewage, with the results obtained in other plants with fresher sewage, has led me to form the opinion I have given.

As to "Operator's" last question, I am not surprised that he cannot understand my statement about excessive "sludge" formation. The reference should have been to "scum," not sludge. The layer of scum which formed on the surfaces of our tanks was so deep that it frequently extended below the bottoms of the baffles, so that it was necessary to put the tanks out of service until the scum could be sunk or skimmed off.

Philadelphia. THOMAS D. PITTS.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Prompt Reward Incites Effort

PROMPT reward for extra effort is the best incentive to continued high effort by workmen. A time-card system, which furnished each workman every night a credit slip for money earned during the day, was described in *Engineering News-Record* of Aug. 1, p. 244. On road construction visited a year or two ago, a somewhat similar procedure devised for a different purpose was observed. A bonus system of payment was being operated, and every morning as the men reported for work each was handed a slip giving him credit for the regular wage and for the bonus earned by him during the preceding day. The direction of the work was unique, perhaps, in no respect, except in the issue by the pay clerk of these daily credit slips for money earned. A potent psychological factor was, however, called into play by this action. Any reward that is deferred to a relatively far-distant pay day has little effect as a spur to increased effort on the average man. Either reward or punishment, if it is to be effective, must be promptly applied. With the system of credit slips mentioned immediate reward was possible, and the regular routine of the weekly payroll was not disturbed. The slip received by each man every morning was tangible evidence to him that extra money was his because of extra effort made by him the day before. It was an incentive to him to begin the new day's work determined to equal or excel his record of the day before.

C. S. H.

Other Articles In This Issue of Interest to Contractors

Cement Gun Used To Put Concrete Walls on Wood-Frame Mine Mill

NEW concrete walls to replace siding on three wood-frame mills of the Portland Gold Mining Co., at Victor, Col., were effectively put on last spring with the cement gun. The work was started by stripping the buildings to the wooden skeleton. To this skeleton was nailed triangular wire mesh in rolls 50 in. wide and 150 ft. long. After the wire had been stretched to the frame, unit forms were put up on the outside. The forms varied in size, the standard being 16 ft. long and 3 ft. wide, but all consisted of a top, bottom and middle wall of 2 x 4 in. pieces with vertically placed $\frac{3}{8}$ in. cedar lagging. The lower form was nailed to the framework; the succeeding ones were nailed at the bottom to the form immediately below and wired at the top to the studding. Concrete was then applied from the inside for a thickness of about $1\frac{1}{2}$ in. When the wall had been shot from the inside the forms were taken down and the concrete applied from the outside until a 2-in. thickness was secured. The surface was then given a stucco finish. For the gun 45 lb. air pressure was used, and the water carried its natural pressure of about 60 lb. The flow of air was about 175 cu.ft. per min. The $1:3\frac{1}{2}$ mix was turned once before being thrown over a $\frac{3}{8}$-in. screen. It was then shoveled into a hopper and drawn from there into the gun. Once applied, the concrete was wetted twice or three times on succeeding days. Before shooting against concrete already placed the wall was thoroughly washed with a hose.

Both swinging and stationary scaffolds were used.

FORMS WERE PLACED IN UNIT SECTIONS 3 FT. DEEP

SHOOTING CONCRETE WALL ON OLD WOOD FRAME

The highest stationary scaffold was 55 ft. and the swinging scaffold was used on the tallest building, 82 ft. in height.

The percentage of rebound varied with the local conditions and the nozzleman. Experiments showed that between 7% and 35% of the concrete fell as rebound. This was taken up and used again. The concrete adhered to the wall only when applied directly and at right angles. When shooting from the inside it was found impossible to get the material against the form behind a timber such as a brace. What concrete was forced between the timber and the form was merely rebound and could be disintegrated with a trowel.

The forms were taken down between 12 and 24 hr. after shooting. If they remained longer they were hard to remove.

A total wall area of 40,000 sq.ft. was concreted. The last building, containing about 12,000 sq.ft., was completed in three weeks. The average amount of wire placed in a day by three men on the scaffold and two on the ground was 900 sq.ft., the record for four men on the scaffold being 2,500 sq.ft. A daily average of 750 sq.ft. of concrete 2 in. thick was maintained throughout the work, using one gun.

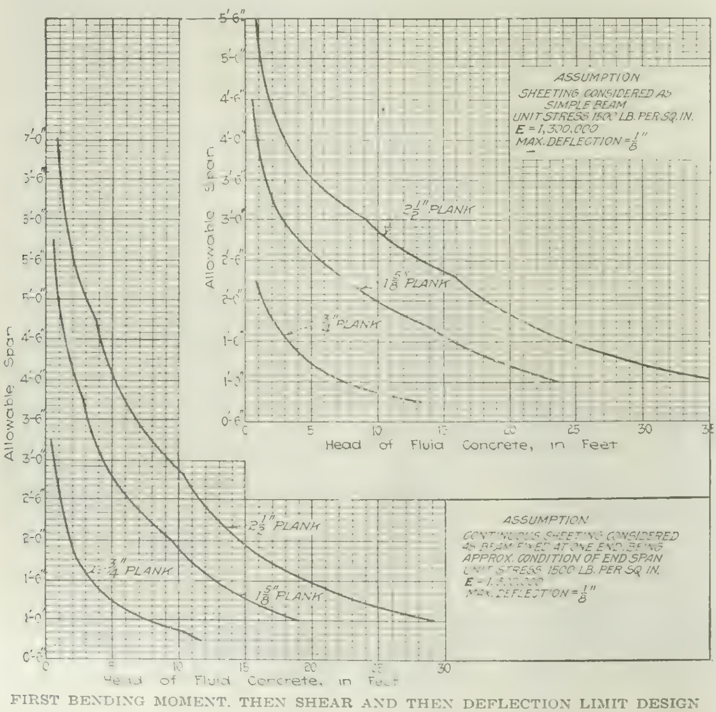
Show Size and Span of Sheeting at a Glance

By S. M. Cotten
Phoenix, Ariz.

Two charts which make it easy to select at a glance the size of sheeting and the allowable span in designing concrete forms were developed by the writer in connection with the bridge work of the State Highway Department of Arizona. They are reproduced herewith.

One of the charts was calculated by assuming each piece of sheeting to act as a continuous beam, the unit stress being taken at 1500 lb. per sq.in. and the modulous of elasticity at 1,300,000, a maximum deflection of ⅛ in. being allowed. The plank is considered as a beam fixed at one end, this being assumed to be the approximate condition of the end span. It will be noted that this chart allows somewhat longer spans for low heads, while the other chart, calculated on the same assumptions but for simply supported sheeting, indicates that sheeting under this condition of loading can support higher heads over short spans.

The individual curve for plank of each size is not uniform, the breaks occurring where a change takes place in the factor which controls the allowable span, the maximum deflection being the limiting condition in some cases, the bending moment in others, and the shear in still others.



FIRST BENDING MOMENT. THEN SHEAR AND THEN DEFLECTION LIMIT DESIGN

Build Concrete Pier in Ice Sheet Twenty-five Feet Thick

A solid mass of ice 25 ft. thick covering rock had to be penetrated to gain a foundation for the south river pier of the Hudson Bay Ry. bridge over the Kettle Rapids of the Nelson River, only 100 miles from Hudson Bay. The site of the pier is on a rock island, under all ordinary conditions, but in winter ice jams raise the river level sometimes as much as 20 ft., and when the construction gang was ready to start work the water stood 10 ft. above the rock level. As the working season is short, no time could be lost, and the pier had to be built in the ice. To start work the ice was excavated, and in a little more than three weeks rock was reached. By this time the level of the water in the river had fallen a few feet, but it was still well above the rock level. Though the ice walls of the shaft appeared perfectly solid, water percolated through so that it stood at the same elevation as in the open river channel, some distance away. A timber caisson was built, shaped on the bottom to fit the irregularities of the rock surface, and was sunk within the well. All openings in the caisson walls were sealed by driving sheetpiling, scribed to the rock surface and driven so as to broom the ends. The entire rock surface inside the caisson was then picked with needle bars, to insure its being entirely clear of ice. As previous examination of the rock during low water had shown it to be sound, the foundation was now ready for concreting. Concrete made of heated materials

was deposited within the caisson by deep-water buckets, and the footing was completed within four days after the rock was first reached. No difficulties developed during the construction of the pier shaft.

The work was done by MacDonald Bros., for the Hudson Bay Ry., J. W. Porter, chief engineer.

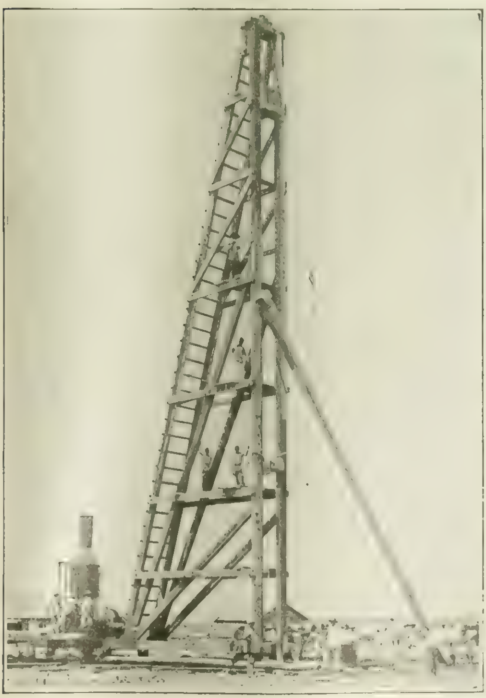
Cast Pickup Bars for Handling in Concrete Piles on Java Contract

By A. S. Buisman

Engineer, Holland Concrete Company of Weltevreden, Dutch East Indies

STEEL rods stuck through the form and extending beyond the sides of the finished concrete pile at the points for attaching the double lifting tackle were found very convenient by the Holland Concrete Co., of Java, Dutch East Indies, in recent work. Two inches or more projected on each side of the pile, serving to engage double lifting hooks. Since the pickup points were properly placed beforehand, this made it simple to raise the piles and put them in the leads, and at the same time reduced the lifting stresses to a definite basis and made accurate design possible.

It was required that the piles be placed in a definite position, and the expedient of putting the bars a little off center made it easy to raise them in the proper hoisting position. Fastening and detaching the hooks took a minimum of time, as it was simply necessary to slip them under the ends of the pickup bars. All



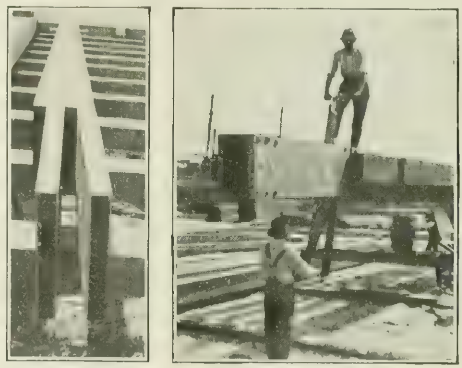
DOUBLE LIFTING HOOKS ENGAGE BARS CAST IN PILES

damage to the piles from using chain or rope slings was entirely avoided.

The piles with which this was done are not exposed to the action of sea-water; but, had they been, the same method would have been employed, using hardwood pins instead of steel bars.

Triple Scarf Used in Dry Dock Timbering

IN THE side frames of a number of wooden floating dry docks now under construction, W. T. Donnelly, consulting engineer of New York City, has introduced a triple scarf joint, economically cut in a special miter box, instead of the standard single scarf commonly used. The joint and the method of sawing it are shown herewith. As usually made in a 14-in. stick, the single scarf is about 6 ft. long, with four or five bolts and a 2-in. normal cut on each side. In place of this the triple scarf reduces the slope of the oblique cut so as to permit of two normal 2-in. cuts on each end of



MITER BOX USED TO SAW SCARF JOINT SHOWN IN VIEW AT LEFT

the joint, and reduces the length to about 4 ft. Increased efficiency of the joint is claimed.

In making the triple lap the miter box is used as a saw guide, as shown in the view, and the joint is readily chiseled out between the cuts.

Toll Roads Disappearing in Pennsylvania

With the conclusion of negotiations between State Highway Commissioner J. Denny O'Neil and officials of the Lancaster & Susquehanna Turnpike Co., the Lincoln Highway in Pennsylvania was freed from its last toll section. Since Commissioner O'Neil took office he has succeeded in freeing approximately 200 miles of state highway routes from the toll system. This has been accomplished through the use of funds provided by the 1917 session of the state legislature, which set aside $500,000 for the purpose of buying up these franchises. There still remain 308 miles of toll roads in the state, of which 185 miles are located on state highway routes. It is planned to eliminate these as fast as arrangements can be made with the counties and the turnpike companies. Under the present arrangements the counties are paying one-half the cost of elimination.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Boston Transit Commission Goes Out of Existence

24-Year Life Ends When All Extensions of Program for Rapid Transit Are Completed

After an existence of 24 years, the Boston Transit Commission ceased to exist on June 30 last.

In 1894 the commission of five was created to construct the Tremont St. subway. Its term of office was to be five years. Before the term had expired the legislature authorized the construction of the Washington St. tunnel and the East Boston tunnel, and afterward it authorized the construction of still other subways. The term of office of the commission has, therefore, been extended from time to time, and it expired by limitation June 30, at which time all the subways authorized had been completed. Some work left, including settlements for damages and other legal matters, and the construction of a transfer station between subway and surface cars at Massachusetts Ave., on the Boylston St. subway, are to be handled by the Mayor of Boston, the city treasurer and the commissioner of public works. The Boston Transportation Commission, however, consisting of the city treasurer, the commissioner of public works and one appointed member, has been created. Ex-Mayor Josiah Quincy, a former member of the Transit Commission, is the appointed member.

During its term of office the Transit Commission has expended about $38,500,000. The successive acts which have prolonged its existence have usually provided that the term of office of the members should be extended, so that the commission has been unbroken in membership, except by death or resignation. Prof. George F. Swain was a member of the commission throughout its existence, and Horace G. Allen served from 1896 on. Three of the members originally appointed since 1894 have died, and one resigned.

With the passing out of the commission an engineering staff composed of men with long experience in subway and other transportation matters, was broken up. Almost all of the men have secured other positions.

Federal Engineering Employment Service Busy

The new Division of Engineering of the United States Employment Service, opened a short time ago in Chicago under the direction of A. H. Krom, seems to be very busy. The record for the month of July shows that the division received 468 applications for help from employers, 1314 applications for help from workers, was able to forward 1063 applications and actually placed 483 men in positions. This branch of the Government Employment Service is intended to serve as a clearing house for the employment of Government engineers, although it may extend to private work in the future. It is urged by the division that engineers register, either through the local branch of the United States Employment Service or through the Division of Engineering at Chicago.

Joint Highway Meeting Postponed

The joint convention of the American Association of State Highway Officials and the Highway Industries Association, which was to have been held during the week beginning Oct. 5, as announced in *Engineering News-Record* of July 18, p. 149, has been postponed until the week of Dec. 2. It is stated that conditions which became known after the original date had been set made this action advisable.

The highway officials will hold closed meetings on Monday, Tuesday and Friday, while the joint meetings will be held on Wednesday and Thursday. No change has been made in the proposed place of meeting as far as known, and it is expected to take place in Chicago.

Let Contract for Nitrate Plant at Toledo

Contract for the construction of the Government nitrate plant at Toledo, Ohio, has been let to Bates & Rogers, of Chicago, by the Air Nitrates Corporation, the Government agent in the construction and operation. The cost is estimated at close to $10,000,000.

Concrete Ship Association Formed

At a meeting in New York City July 24 assembled for the purpose of furthering the interests of concrete ship construction there was formed the International Concrete Ship Association. For the time being the affairs of the association are to be conducted by a general committee composed of the following twelve members: Guy Vroman, H. F. Cuntz, Victor C. Coxhead, Frank Van Vleck, K. McLeod, R. C. Morris, E. H. Beckert, A. C. Holzapple, Maurice Deutsch, John C. Pell, Harold P. Brown and Albert Oliver. Offices will be at 7 E. 42d St., New York City, with H. F. Cuntz as secretary. Annual dues have been fixed at not to exceed $500 for corporations and at $25 for individual members.

More Money Needed for Free Bridge Approaches

$250,000 Estimated as Needed to Put St. Louis Bridge in Partial Use—$8,000,000 for Full Use

Expenditure of about $250,000 to permit even a partial use of the municipal (free) bridge across the Mississippi River at St. Louis will be necessary, states B. F. Bush, regional director of railroads for the Southwest district in a letter to the president of the St. Louis Chamber of Commerce. In addition to $16,000 for changes to permit connections with the tracks of the Merchants' Bridge Terminal Ry. without the use of objectionable reverse curves—an expenditure which Mr. Bush stated he would recommend that the Government issue authority to make—he enumerates $157,000 for double-track work and connections on the east side, $35,000 for a double-track connection with the terminal railway tracks near Eighth St., St. Louis, and $35,000 for an interlocking plant. These expenditures, however, would, the letter states, make possible only partial use of the bridge for freight trains, involving two objectionable back-up movements on the east side of the river for the greater part of the traffic. Something more would have to be spent for signals and interlocking if the bridge were to be used by passenger trains.

To permit extended use of the bridge for freight and passenger trains, Mr. Bush quoted the following figures from estimates made some time ago by a disinterested engineer: North and south connections with tracks of Illinois Transfer Co. at East St. Louis, $500,000; additional connections and interlocking plants between east side lines to permit routing trains to the easterly approach, $500,000; elevated structure and approach from vicinity of relay depot, East St. Louis, to municipal bridge, $3,000,000; south St. Louis approach at west end of Municipal bridge, $1,000,000. This makes a total of $5,000,000, but at the present cost of labor and material Mr. Bush thought the cost would be increased to $8,000,000.

Huge Gun-Relining Plant To Be Built in France

Approval of the plans for the building of an enormous gun-relining plant for the United States Army in France has been announced by the Ordnance Department, United States Army. This plant will reline the big field guns, which are put out of service after about 200 shots. The project calls for an expenditure of from $25,000,000 to $30,000,000, the machine tools alone

running well up toward $20,000,000. In addition to the tools and the buildings housing them, there will be a number of 240-ton cranes, a steam electric generating plant of approximately 5000 kw. capacity, and housing facilities for the workmen. Among the machines required is a planer 500 ft. long, the largest ever built. This has as a distinguishing feature a bed plate of reinforced concrete instead of the usual wrought iron.

Government May Take Over All Power Plants

To meet the power shortage throughout the country a bill has just been introduced in the House by Representative Sims, of Tennessee, which provides "that the President may construct or acquire power plants and transmission lines, and incidental property necessary for the production of material and commodities essential to the national defense." He is empowered either to take over privately-owned power plants or to advance funds from the appropriation to assist in their private operation. The measure specifies further that the power to construct or acquire any power plant, transmission lines or incidental property shall terminate at the end of the war, and that the power to operate and maintain the plants shall continue only for such time as the President shall deem necessary.

Compensation when the plants are taken over is to be fixed by the President. In the event of a dispute, 75% of the amount fixed by the President shall be paid, and the owner may sue for the remainder in dispute.

The bill carries an initial appropriation of $200,000,000 for acquiring power plants. A large portion of this, it is reported, would be used to build or acquire power plants at the mouths of coal mines.

Canadian Engineering Standards Committee Organized

The Canadian Engineering Standards Committee has been organized in Montreal with official representation from the government departments, the Canadian Manufacturers' Association and several important technical organizations. Its objects are to secure interchangeability of parts, to cheapen manufacture by the elimination of the waste occasioned by a multiplicity of designs for the same purpose, and to effect improvements in workmanship and design. It is expected to have the effect of harmonizing British and American practice.

The following officers were elected: Chairman, Sir John Kennedy; vice chairmen, P. H. Vaughan and Capt. R. J. Durley; honorary secretary-treasurer, Dr. John B. Porter; secretary, Frank S. Keith. The headquarters of the committee will be at the Engineering Institute Building, 176 Mansfield St., Montreal.

Publicity for War Department Purchases

Will Regularly Give Out Lists of Articles Purchased Under Various Bureaus

The General Staff of the War Department has prepared plans for obtaining publicity for lists of all articles purchased by any supply bureau, so that all manufacturers and the public generally may obtain full information regarding the needs of the department. Any manufacturer in the United States who wishes to manufacture Government supplies is invited to send in his name to the bureau purchasing that kind of supplies and state his position to furnish the goods.

It is announced that circular proposals will be sent to all persons on such mailing lists whenever the bureau need supplies. These will be invitations to submit bids. Full publicity will be given as to the opening of the bids and the awarding of contracts, except in cases where it may be decided that valuable information would be transmitted to the enemy. Determination as to the military value of such information will be decided by military censors and not by the officers or persons handling the supplies in the bureaus.

Any manufacturer interested in having his name on such lists should send in his application, accompanied by references from banks or reputable business concerns or from the chairman of the local regional manufacturers' organization associated with the War Industries Board. If his plant is deemed satisfactory as well as his references, his name will be placed on the mailing lists of the bureau which handles the supply in which he is interested, and he will thereafter receive the notices sent out by the War Department regarding the purchase of articles.

It is announced that, in conjunction with this service, desks are being established to afford information to manufacturers and their representatives as to the officers handling the articles purchased by the bureau, and to supply blanks for proposals. A central information office will be maintained at the office of the Director of Purchases and Supplies, General Staff, and bulletin boards will be erected on which will be posted all circular proposals.

Argentina in Market for Sulphuric Acid Plant

In various newspapers the following advertisement has recently appeared:

"Offers are invited for the construction of a plant for manufacturing sulphuric acid, in accordance with the conditions which may be consulted by interested parties, in the Consulate-General of the Argentine Republic in the City of New York, 17 Battery Place, Room 227, on working days from 10 till 4.

"Offers must be presented in the office of the Secretary of the Council of Public Works of the Nation, in the City of Buenos Aires, before 3:30 p. m. on Nov. 8 next, on which day and hour they will be opened in the presence of the interested parties who may wish to attend on that occasion."

Inquiry at the Consulate reveals the information that the Argentine Republic has a flat area of land and the wish for a sulphuric acid plant producing 25 tons per 24-hr. day. This comprises the specifications upon which bidding is to be based.

New Pacific Coast Shipyard Started

At Alameda, Calif., near the present plant of the Union Iron Works, the Bethlehem Shipbuilding Corporation has just started a shipyard which will rank among the largest in the United States. The formal opening of the works occurred Aug. 13, when the first pile was driven. The plant will contain ten slips and will cover more than a third of a square mile. It is intended to build there first a large cargo vessel for the United States Emergency Fleet Corporation. Monks & Johnson of Boston are the architects and engineers, and the Aberthaw Construction Co. is the contractor. It is announced that the new yard will be known as the Liberty Shipyard.

Duluth Engineers' Club Organized

The Duluth Engineers' Club was organized at a meeting held Aug. 5, at which a committee on organization, appointed last May at a joint meeting of Duluth engineers, submitted articles of incorporation, which were adopted with a few minor changes. Officers were elected as follows: President, W. G. Swart; first vice president, E. R. Lewis; second vice president, W. N. Ryerson; secretary, W. H. Woodbury; treasurer, W. H. Gallagher; members of board of directors, F. E. House, T. W. Hugo, W. F. Schwedes and F. E. Downing.

Two Bids for 72-Inch Steel Pipe at Jersey City

Two bids for 34,590 ft. of 72-in. riveted steel pipe to duplicate the portion of the Jersey City water-supply conduit from the Boonton reservoir to the Watchung tunnel were received on readvertisement Aug. 13. The Riter-Conley Co., Pittsburgh, bid $23.72 per lin. ft. on 34,125 ft. of pipe from $\frac{5}{8}$-in. plate and $41.05 on 465 ft. from $\frac{7}{8}$-in. plate, making a grand total of $828,533. The James McNeil & Bro. Co., Pittsburgh, bid $26.50 and $30.75, respectively, making a total of $918,611. M. I. Fagen is director of the Department of Streets and Improvements, Jersey City. Rejection of earlier bids from the same companies was noted in these columns Aug. 8, p. 293.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

Personal Notes

W. A. WELCH, chief engineer of the Palisades Interstate Park Commission of New York and New Jersey, was given a leave of absence by the commission in July to accept a captaincy in the timber department of the Air Service, which is carrying on the work of getting out spruce for airplane construction in Oregon and Washington. Mr. Welch was made chief engineer of a large mileage of logging railways in the Northwest and has recently been promoted to major.

ANSON BURLINGAME MCGREW, who for the past twenty-five years has been assistant engineer in the Corps of Engineers, U. S. A., Cincinnati, Wheeling and Pittsburgh districts, has been appointed district engineer for the Nashville and Chattanooga districts, with headquarters at Nashville.

C. H. RUST, who for many years was city engineer of Toronto, has resigned as city engineer of Vancouver, B. C., which position he has held for the past six years, and will remove to Toronto to undertake work for a private corporation. Mr. Rust has been engaged in municipal and sanitary engineering work for the past forty years, entering the city engineer's office of Toronto as a rodman in 1877, after which time he successively served as assistant engineer and engineer in charge of sewers. In 1892 he was appointed deputy city engineer of Toronto, and in 1898 became city engineer.

W. T. NEVINS, marine architect and ship surveyor of Chicago and San Francisco, and formerly general superintendent of the Buffalo Dry Dock Co. (American Shipbuilding Co.) has been appointed superintendent of ship construction for the Chickasaw Shipbuilding Co. at Chickasaw, the new industrial center near Mobile, Ala., where the plant is now under construction.

C. F. WOMELDORF and T. G. HASTIE have been appointed assistant engineers in the capital expenditures division of the Northwestern regional district of the United States Railroad Administration. Mr. Womeldorf, with office at Chicago, will have jurisdiction over roads in Illinois, Iowa, Missouri, Wisconsin and Michigan; Mr. Hastie, with office at Spokane, Wash., will have jurisdiction of the roads in Montana, Idaho, Washington and Oregon.

JOHN GAUB, chemist in charge of the water-filtration plant at Washington, D. C., has resigned to become health officer of Montclair, N. J., succeeding Chester H. Wells, whose resignation was noted in *Engineering News-Record* of July 25, p. 201. Mr. Gaub is a graduate of Rutgers and served for a time as instructor at Cornell and as dairy inspector at New Brunswick, N. J., his home town.

ARTHUR REIMER, formerly engineer of water supply, East Orange, N. J., who recently was released from the Corps of Engineers as a major to assist in the work of perfecting sanitary arrangements in cantonments, has been transferred to the Muscle Shoals project, where he will have charge of the erection of homes for laborers engaged on the work.

R. P. WILSON, until recently division engineer on the Hudson Bay Ry., has opened offices in Vancouver, B. C., to resume private practice, in which he had been engaged for the past fourteen years, until his work on the construction of the last 90 miles of the Hudson Bay Ry. from Kettle Rapids to Nelson.

GEO. A. HARWOOD, engineering assistant to the vice-president of operation of the New York Central R.R. at the time of the appointment of a Federal manager, has been appointed corporate chief engineer of the New York Central R.R., Michigan Central R.R., Cleveland, Cincinnati, Chicago & St. Louis Ry., Pittsburgh & Lake Erie R.R. and the other New York Central lines. Mr. Harwood's service with the New York Central dates from 1900. In 1898 he was graduated from Tufts College, and for two years thereafter he was in the employ of the Boston & Maine R.R. In 1900 he came to the New York Central as draftsman. A year later he was made special assistant to the designing engineer. In 1904 he was appointed engineer of grade crossing elimination. Early the following year he was transferred to the electric zone improvement work in and near New York City as assistant terminal engineer of the new Grand Central Terminal. Before the end of the next year (1906) he was promoted to chief engineer of the electric zone improvements. This position he held until 1916, when, with the virtual completion of the electric zone improvements, he was made engineering assistant to the vice-president of operation.

W. L. BRECKINRIDGE, engineer maintenance of way of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer, succeeding A. W. Newton, who has joined the staff of the Burlington corporation.

WILLIAM H. ADAMS of the firm of Adams & Cummins, consulting engineers, Detroit, Mich., and Houston, Tex., has been commissioned as captain in the Quartermaster Corps, and is for the present stationed in Washington, assigned to duty with the Construction Division.

H. M. FREEBURN has resigned as assistant engineer of the Pennsylvania State Department of Health to become associated with the engineering staff of Wallace & Tiernan Co., Inc., manufacturers of chlorine control apparatus and sanitary engineering specialties. Mr. Freeburn became associated with the engineering branch of the Pennsylvania State Health Department while an instructor at Pennsylvania State College in experimental sewage work.

A. L. VALENTINE, for eight years and until recently superintendent of public utilities in Seattle, and for four years engineer of Kings County, Washington, has been appointed Seattle manager for the Coast Culvert & Flume Co., Portland.

M. Z. BAIR, for several years principal assistant engineer of the division of sanitary engineering, Ohio State Department of Health, has resigned for the period of the war to enter the Construction Division of the Quartermaster Corps, with the rank of captain.

J. G. RONEY and M. S. TOOPS have been appointed assistant engineers of the Texas & Pacific Ry. at Marshall and Big Springs, Texas, respectively. M. L. Ford, assistant engineer at Alexandria, La., has been appointed assistant engineer also of the Louisiana Railway & Navigation Co.

M. W. GRISBY, of the Grisby Engineering Co., East Peoria, Ill., has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps.

SAM G. PORTER, for the past five years assistant chief engineer and acting commissioner of irrigation of the Department of the Interior at Calgary, Alta., has been appointed superintendent of operation and maintenance of the Lethbridge Irrigation System, with headquarters at Lethbridge, Alta., under the direction of the Canadian Pacific Ry. Mr. Porter's work in connection with the Lethbridge project will be conducted under the direction of A. S. Dawson, chief engineer, department of natural resources, Canadian Pacific Ry., at Calgary.

S. NEWBOLD VAN TRUMP, assistant engineer of the water department of Wilmington, Del., has been appointed chief engineer of the department, succeeding Edgar M. Hoopes, Jr., resigned to enter Government service.

A. C. JESSEN, formerly assistant engineer of the International & Great Northern Ry. at Houston, Texas, has been appointed assistant engineer at San Antonio. T. S. Bond has been made assistant engineer at Palestine, Texas.

T. E. BLISS, assistant engineer of the St. Louis-San Francisco Ry. at Memphis, Tenn., has been appointed district engineer of the lines east of the Mississippi River, and the Birmingham Belt R.R., with office at Birmingham. Mr. Bliss, who was graduated from the University of Kansas in 1909, has been with the St. Louis-San Francisco since that year.

A. TAGGART ASTON, assistant port engineer of Seattle, has been appointed engineer of the recently organized port of Everett, Wash., and will immediately undertake soundings of the port and plans of improvement required by the port law.

B. B. BYERS has resigned as general superintendent of the Dravo Contracting Co. of Pittsburgh, to become associated with the Raymond Concrete Pile Co., with headquarters at Baltimore.

D. E. GELWIX, assistant engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed district engineer at the same point. H. B. Barry, district engineer at Memphis, Tenn., has been transfered to Springfield.

ALBERT J. FEENEY has been appointed assistant engineer of the water department, Wilmington, Del., succeeding S. Newbold Van Trump, appointed chief engineer of the department, as noted elsewhere.

H. M. BASSETT, formerly special assistant engineer of the New York Central R.R., has been appointed engineer of roadway and structures under the corporate organization.

LAVERNE J. RUDDOCK, city engineer of Wheaton, Ill., has been commissioned as captain in the Engineer Officers' Reserve Corps.

W. A. SPELL, assistant engineer of the Atlanta, Birmingham & Atlantic Ry., has been appointed principal assistant engineer of that line, the St. Louis-San Francisco lines east of the Mississippi River, and other lines under E. T. Lamb, Federal manager. O. T. Nelson has been appointed engineer maintenance of way. L. R. Brine has been made district engineer of the Atlanta, Birmingham & Atlantic. The offices of all are at Atlanta.

S. J. FORTIN, who has been attached to the Public Works Department of Ottawa, has been appointed deputy chief engineer of the city of Montreal, succeeding Alexander Martin, who has resigned.

THOMAS F. BOWE, consulting engineer, New York City and Rutherford, N. J., has been commissioned as captain in the maintenance and repair branch of the Quartermaster Corps, and assigned to duty at Camp Merritt, N. J.

A. H. PORTER, engineer of roadway of the Charleston & Western Carolina Ry., Augusta, Ga., has been made district engineer at the same point.

B. J. T. JEUP, chief engineer of the Indianapolis Water Co. and previously city engineer of Indianapolis, has been elected a director of the water company, succeeding Harry E. Jordan, who has entered military service.

E. M. VAIL, of Newark, N. J., has been appointed division engineer in charge of the office of the Northern division of the New Jersey State Highway Commission, which has been opened at 790 Broad St., Newark.

A. B. EDGE, division engineer of the Atlanta & West Point R.R. and the Western Ry. of Alabama at Atlanta, has been appointed district engineer at the same point.

B. M. THOMSON of the office of the city engineer, Charleston, S. C., has been appointed to the Sanitary and Drainage Commission of that city, succeeding Capt. J. W. Martin, recently commissioned in the Corps of Engineers.

J. M. SILLS, district engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed assistant chief engineer, with headquarters at St. Louis. Mr. Sills has been in the service of this railroad since his graduation from Kansas State University in 1903. He was promoted to district engineer in 1907.

WILLIAM PIGOTT, supervisor of wood ship construction for the United States Shipping Board in the Washington District, with headquarters at Seattle, has resigned to undertake other work.

A. O. POWELL, consulting engineer, Seattle, who was a retired army officer of the Corps of Engineers and who recently reëntered the service with the rank of captain, has been promoted to the rank of lieutenant-colonel. Lieut.-Col. Powell served as president of the Pacific Northwest Society of Engineers during 1912.

H. T. CORY, consulting engineer, of San Francisco, who has been in Washington on Red Cross work for some time, recently returned to San Francisco only to find there a telegram from Secretary Franklin K. Lane, recalling him to Washington immediately on arrangements for reconstruction work for soldiers and sailors returning from the battlefields.

OBITUARY

HENRY W. KLAUSMANN, city civil engineer of Indianapolis, died suddenly at his home Aug. 14. He was born at Centralia, Ill., Sept. 2, 1868, and went with his parents to Indianapolis in 1878, where he received his school education, after which he had some training in the office of an architect. From 1901 to 1910 he was county surveyor of Marion County, of which Indianapolis is the county seat. During that time several of the highway bridges across White River and Fall Creek were built. From 1910 to 1914 he was city engineer of Indianapolis and in January, 1918, was reappointed to this position. Since 1914 he had been engaged in private practice as an engineer and contractor.

AUGUSTUS MORDECAI, who had been engaged in railroad and consulting engineering work for the past forty-five years, died in Cleveland July 28, in his seventieth year. Born in Philadelphia, he graduated from the Polytechnic College of Pennsylvania, and then served for about a year as rodman in the construction of the Dutchess & Columbia R.R. During the next four years he was in charge of various railroad construction work. In 1872 Mr. Mordecai went to Cleveland as division engineer in charge of maintenance on the Atlantic & Great Western R.R., which was ofterward merged into the present Erie system. For twenty years he remained in Cleveland, associated with the Erie and with its successors, successively filling the positions of division engineer, resident engineer and general roadmaster. From 1894 to 1896 he was acting chief engineer at New York. For ten years thereafter he remained in Cleveland as assistant chief engineer in charge of construction and maintenance on all the lines west of Salamanca. Later he became associated with J. H. Stevens as office engineer in the valuation of the New York, New Haven & Hartford R.R., until the completion of that work. After 1909, Mr. Mordecai was active in Cleveland as a consulting engineer, being prominently connected with the construction of the belt line around Cleveland and with valuations of various railroad properties. He was also a member of the Cleveland River and Harbor Commission. He was a member of the American Society of Civil Engineers and the American Railway Engineering Association, and a charter member of the Cleveland Engineering Society. He was a member of the board of direction of the American Society of Civil Engineers in 1895-97.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Pooling of Resources in Prospect When Sand, Gravel and Stone Industries Organize

New Government Policy Hitherto Impossible Under Sherman Law Result of Meeting with War Industries Board

BY WINGROVE BATHON

Washington Representative, Engineering News-Record

The first admission for publication of the truth of rumors current in Washington, that the United States Government is endeavoring to find a way for the pooling of the resources of the industries represented, was made at a meeting in Washington last week between the War Industries Board and representatives of the various sand, gravel, crushed stone and slag associations. More than 200 producers of these materials met with the building-materials section of the War Industries Board, of which Richard L. Humphrey is chairman. Out of the meeting grew the formation of the war-service committee for these industries in one combination (although they had separate problems and have worked separately before), as well as the division of the United States into zones of production and distribution with the expectation of an agreement as to prices in these zones.

POSSIBILITY OF POOLING

Admission of a possibilty of a pooling system came from A. P. Sandles of Columbus, Ohio, secretary of the National Crushed Stone Association. "If pooling is done," Mr. Sandles said to the writer, "and I understand from the Priorities Board that it is likely that it will be, it will be under an arrangement by which some of the plants will be closed down and those closed down will share in the profits of those which are operated. Of course, in the old days before the war, such an arrangement would have been impossible under the Sherman Law, and under the Valentine Law of Ohio, as well as under other State laws, but the war alters everything." Such an agreement necessarily carries with it the fixing of prices.

While these indications of the possibility of a pooling arrangement will come as a surprise to some producers, especially in some of the other industries, who have not yet been called to Washington to confer with the Government, no surprise is expressed in well informed circles in Washington, where it has been well understood that if any such arrangement is to go through it will go through with the consent or at least with the passive knowledge of the highest legal officers of the Government. In this connection, too, the question is being asked in Washington how, if this is to be a Government policy, it will effect the industries engaged with cement, brick, terra cotta and sewer pipe.

QUESTION TO BE ANSWERED

Again, in industrial circles in Washington, these questions are being asked: On what basis will the earnings of those in the pooling arrangement be divided? Who will determine which factories shall be closed down and which shall operate? What percentage of payment will the plants shut down receive? Who will determine that percentage? As business increases or decreases who will determine what plants shall continue to operate or what plants shall continue shut down? Who will determine the differences in values as to management ability in the

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To Arbitrate Labor Problems in Lumber Industry

An agreement to arbitrate all labor difficulties was reached by Northwest lumbermen and Col. Bryce P. Disgue, commanding the air craft production of the United States Army. The conference was held in Portland, Ore., and representatives employing loggers and sawmill hands from Oregon, Washington, Idaho and Montana were present.

The problems discussed involved adjustment of wages and working conditions. The eight-hour day and the open shop will continue to prevail as a result of the conference.

Resolutions passed at the meeting formulated the procedure whereby the various questions that will arise may be arbitrated, as well as general regulations affecting the industry.

Prices of forest products were also a subject of the conference, and an adjustment was effected which is to continue during the period of the war and after peace is declared.

Government-Owned Equipment May Be Purchased

War-Material Contractors May Obtain Title to Machinery Furnished at Public Expense

Special equipment such as buildings, machinery or other facilities for increasing output, furnished at the expense of the United States to manufacturers with war contracts, may be purchased by such manufacturers under authorizations recently approved by the Superior Board of Review of the General Staff. Under this authorization manufacturers and the Government may reach an agreement whereby the manufacturers may take over such facilities at a fair valuation in diminution of the profit which they otherwise would make. Under the present terms of the contract the title on all such improvements or special facilities is vested in the United States. The new clauses in the contracts give the contractors an opportunity to take over these new facilities.

It is estimated that the cost of the increased manufacturing facilities created by the war demands, exclusive of the new industries serving the Navy and the Emergency Fleet Corporation, is approximately $400,000,000. This amount will have wide distribution and most of it has been or will be spent in sections outside the New England and Middle Atlantic States, which at present are declared a restricted area where further industrial expansion will be either discouraged or entirely discontinued during the war.

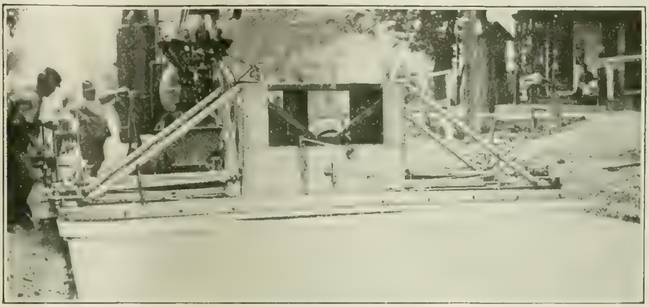
Contractors wishing to obtain title to these facilities under the new clauses of the contract may do so by making a written offer to the Government which, if agreeable to the latter, will obligate the contractor to pay for such facilities at their appraised value at the time the offer is made. They may be paid for either by lump-sum payment or by installments on an amortization plan. If the contractor is unable to make the Government an offer, or in case his offer, should he make one, is not acceptable to the Government, it retains the right to remove all facilities which have been provided at the termination of the contract and reasonable time is given to the Government to remove all facilities. The contract also provides that the Government may buy the land upon which such facilities have been erected in case it is desired to retain them, or in case a satisfactory agreement cannot be reached on the terms of purchase.

Road Finisher Produces Denser Concrete

Rapid Agitation of Aggregate Makes Possible the Use of Unusually Dry Mixture

A concrete road-finishing machine designed to eliminate voids and by means of which a coarser aggregate and dryer mix may be used is shown in the accompanying illustration.

The finishing device moves forward under its own power at a speed of about 7 ft. per minute and backs up at a speed of 28 ft. per minute. As the machine travels forward the strike-off spreads the concrete to the necessary height and proper crown. The tamper, just back of the strike-off, tamps the concrete the first time over with a long, hard stroke. The second time over a short, rapid, up-and-down movement is used, which may be decreased until it is subjecting the concrete to continuous agitation without applying pressure to the mixture. The stroke of the tamper is regulated by the operator and may be varied for different consistencies of concrete as well as for different stages of progress. The float, at the rear of the machine, produces a smooth finish by sweeping a belt across the surface at a comparatively low speed.



CONCRETE FINISHER PRODUCES DENSE ROAD

The claims made are that by subjecting the mixture to the continuous agitation caused by the tamper, the concrete is compacted and the air in it is brought to the surface. The larger stones and only enough mortar to cement them are brought together. Because of the agitating action of the tamper, a drier mixture can be used than would be possible where the work is done by hand. The results are stronger concrete and a surface free from laitance, silt and light particles which float to the surface of a wet mixture.

The device was designed in 1913 by E. G. Carr, while a contractor in California, and has been used on the construction of about 400 miles of California highways. With the assistance of the staff of the Lakewood Engineering Co., Cleveland, Ohio, the mechanical details have been improved and the machine placed on the market.

Limited Imports of Crude Rubber and Creosote Oil Permitted

Permission to import crude rubber and creosote oil for a limited time is announced in bulletins received from the War Trade Board at Washington. This decision has been reached, it is stated after a study of the needs of the country.

The bulletin covers the permission to import 2,000,000 gal. of creosote oil from Japan during the remainder of the present calendar year, and states that licenses for this may be issued during the remainder of the year when the applications are otherwise in order, with the proviso that such oil is to be shipped on vessels approved for that purpose by the Shipping Control Committee of the United States Shipping Board. The importation of crude rubber will be limited to 16,666 tons in the months of August and September.

The importations permitted by these bulletins will be distributed by the Bureau of Imports of the War Trade Board, and in the case of rubber the general lines of previous allocations have been subjected to certain changes.

Have It Shipped Now—Suggestion for Material User

A recent circular issued by the Navy Department urges navy contractors to have all or as much as possible of their raw materials shipped at once. It points out that at the present time the transportation situation is well in hand because of the improvement of rail conditions. From now on, however, the volume of traffic will increase more rapidly than terminal and storage facilities can be provided, and this will produce congestion. A repetition of the weather conditions of last winter will bring a corresponding congestion. This will create the danger of a complete shutdown of vital industries unless the situation is forestalled by careful study of the matter in order that needs may be anticipated.

City Truck with Labor Saving Catch Basin Cleaner

A city department truck equipped with a labor-saving device for cleaning catch basins, designed by L. F. Hastings, city engineer of Cambridge, Mass., and his associate, is shown in the accompanying illustration. It was adopted as a result of the extreme labor shortage in that city.

A 3½-ton Federal truck, equipped with the steel body of 3 cu.yd. capacity and a power dumping hoist, was purchased from the Federal Truck Co. and the special machinery for excavating the material and loading it into the truck body was made in a local machine shop from drawings made in Mr. Hastings' office. The excavating is done by a bucket of the "orange-peel" type, having four jaws which are opened and closed by compressed air. The power to drive the air compressor and the hoist is obtained from the motor of the truck by a sprocket chain on the truck propeller shaft.

CLAMSHELL OPERATED BY TRUCK CLEANS CATCH BASINS

Pooling of Resources

(Concluded from page 382)

different plants, the conditions of equipment, etc.? On what basis are prices to be fixed?

These difficult questions will press for a solution before it can be definitely determined whether there shall be a pooling arrangement, under what was known, according to the Sherman Law, in the old days before the war, as "a combination in restraint of trade." The new War Service Committee of the sand, gravel, crushed stone and slag industries will meet again in Washington in September with the representatives of the War Industries Board, by which time it is likely that there will be a definite determination of the Government's policy.

Personnel of Committee

In the following table will be found the members of the new committee, with the industries they represent, and the zones of control which they represent:

B. D. Pierce, stone; New England states.

James G. Shaw, stone; metropolitan New York, comprising the territory within the free lighterage limits of New York.

George D. Van Seiver, sand and gravel; metropolitan Philadelphia, comprising the territory in New Jersey south of and including Trenton, Pennsylvania east of and including Harrisburg, and the state of Delaware.

J. H. Rogers, sand and gravel; states of New York and Pennsylvania outside of the metropolitan districts of New York and Philadelphia.

Joseph J. Rock, sand and gravel; Maryland, District of Columbia, and the state of Virginia north of but not including Fredericksburg.

W. F. Shaffner, stone; Kentucky, Tennessee, Alabama north of and including a city yet to be selected, and Mississippi north of and including a city yet to be selected.

A. P. Burke, sand and gravel; South Carolina, Georgia and Florida.

W. F. Jancke, sand and gravel; Alabama south of a city yet to be selected, Mississippi south of a city yet to be selected, and Louisiana and Texas.

P. M. Lewis, sand and gravel; Wisconsin south of and including Racine, Illinois north of and including Joliet, and Indiana north of and including Crown Point.

G. A. France, stone and slag; Ohio and the southern peninsula of Michigan.

G. V. Miller, stone and slag; Indiana south of Crown Point, Illinois south of Joliet, Missouri east of and including a city yet to be selected, and Iowa east of and including Des Moines.

John Prince, sand and stone; Missouri west of a city yet to be selected; Iowa west of Des Moines; Nebraska, Kansas and Oklahoma.

A. J. Blair, stone; Wisconsin north of Racine, the northern peninsula of Michigan, North Dakota, South Dakota and Minnesota.

C. S. Lambie, sand and gravel; Montana, Wyoming, Colorado, New Mexico and Utah.

There are fifteen names in the above list, and it is intended that the committee shall number seventeen. There were no delegates present from Washington, Oregon and Idaho, for whom a committeeman will be selected later, and the same thing applies to the states of California, Nevada, and Arizona.

There was, however, a splendid representation from the industries all over the country with the exception of the six far Western states mentioned, and the meetings were spirited. The call for a meeting was sent out by Mr. Humphrey of the War Industries Board July 31.

Notwithstanding the desire of the War Industries Board that there should be a reasonably small and active and representative body in Washington at the meetings, about 100 members of the National Sand and Gravel Association came to Washington a day in advance of the scheduled meeting with the War Industries Board, under the leadership of Harry Donnelly, of Cincinnati, president of that organization, and also a day in advance of the Government meeting about 100 members of the National Crushed Stone Association came to Washington, under the leadership of A. J. Blair of Wisconsin, president, and A. P. Sandles, secretary.

Represented as One Industry

This was done because the members of both associations desired to be grouped separately and dealt with separately by the Government as two distinct industries, notwithstanding the desire of the Government, expressed in its call, that all of the sand, gravel, crushed stone and slag industries be represented as one industry under one war-service committee. Representatives of both associations held a meeting the day before the Government meeting and adopted resolutions declaring that they desired to act separately and have their problems considered separately.

These views were outlined to the Government the following morning, when Mr. Humphrey of the War Industries Board called the gathering together. A. J. Blair was elected chairman and E. Guy Sutton, secretary of the National Sand and Gravel Association, was elected secretary. Mr. Humphrey pointed out that it was to the best interest of the Government that all the producers present should deal with the Government through one committee, and that in the end that arrangement would be to the best interest of all the producers. As the result of compromises on all sides, the one committee was formed.

It was pointed out in the arguments that there are many phases of the stone industry which should be considered entirely separated from the sand and gravel industry. A large output of many of the quarries is now used for fluxing purposes. Much of it is used for agricultural lime purposes, beet-sugar making and chemical purposes, such as in nitrate and soda-ash plants, while the sand and gravel industries are not interested in the details of these uses. Crushed stone, it was also pointed out, is used for ballast and mineral aggregates, for concrete purposes and macadam-road building. Of all the stone produced, it was stated, only 25% is used for mineral aggregates, the other 75% being used for purposes entirely different from that in which gravel is used. The delegates to the meeting also told Mr. Humphrey that his War Industries Board section would be handling the whole production of the stone industries, when only about 25% of their output ought to come under the supervision of his section and the remainder ought to come under other sections of the War Industries Board, and possibly, even probably in the case of ballast, under the control of the Director General of Railroads. The sand men supported these views.

When it was found that the sand, gravel, crushed stone and slag men were all to be grouped together under one war-service committee, each association wanted to name one man for each geographical group or zone, which would have meant two committeemen all the way through, and three in districts where slag is produced. To this the War Industries Board was at first inclined to agree, providing the zone groups be reduced to five or seven. Committees from the associations, however, finally brought in a report dividing the United States into seventeen groups mentioned at the beginning of this article, and there is every expectation in Washington that the committeemen named to represent the groups will soon be charged in their respective districts, under the authority of the War Industries Board, if the Government policy works out, with the administration of the pooling arrangement proposed, the fixing of prices, the production and distribution of materials and above all with the curtailment of transportation and the saving of coal.

The sand, gravel and stone interests were represented officially by the officers of their associations already mentioned. H. J. Love, secretary, represented the National Slag Association.

Business Notes

L. R. Boyer, formerly with the Bureau of Standards, Washington, D. C., has joined the organization of E. & T. Fairbanks & Co., scale manufacturers, St. Johnsbury, Vt.

Henry Stroh, who has been connected for several years with the Elliott Frog and Switch Co., has joined the Walter A. Zelnicker Supply Co. in the sales department.

Engineering News-Record

Devoted to Civil Engineering and Contracting
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August 29, 1918

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
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AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Milwaukee Says "No"

MILWAUKEE has answered the question, "Is Sewage Treatment an Essential Industry?", which this journal raised editorially on Aug. 1, by postponing construction of its projected sewage-works until after the war. *Engineering News-Record* does not claim credit for the postponement; but the action is in line with its argument and follows the decision of Albany not to put its completed plant in operation.

Help-Win-the-War Water-Works Meeting

DENYING itself excursions, entertainments and exhibits the New England Water-Works Association will hold a strictly business meeting on Sept. 11-12. The program, outlined on p. 423, consists largely of help-win-the-war topics. These as well as the other items on the program are of vital importance today. Attendance at Boston will help the water-works superintendent and engineer in his daily tasks besides being a patriotic duty.

Action as Well as Denial a War Duty

SOME technical societies deny themselves their usual conventions as a war-time duty. Not so the water-works associations. They are adjusting their conventions to war-time conditions. This is notably true of the New England program, mentioned just above. All potential society forces must be utilized to the utmost—conventions, committees, each member. Conventions give unity, inspiration, push. Action as well as self denial is a war-time duty.

Drawbridge Operators Must See Entire Moving Span

IN THE layout of a drawbridge one thing is essential; the operator must have a clear view of the entire moving part of the bridge so as to be sure that the roadways are clear before opening the span. This seems elementary, but a recent accident in a San Francisco lift span makes its repetition worth while. On this bridge the operating house does not command a view of the far end of the lift and the attendant raised the span while an automobile was crossing the bridge. The four passengers jumped from the car and clung safely to the steelwork during the cycle of lift. The driver stuck by the car and was in it while it slid down the raised floor and into the water through the small clearance under the fixed span. In passing through the opening the top was scraped from the car but fortunately the driver escaped unhurt. Such an accident is rare, but that it can occur at all is sufficient evidence that it should be provided against.

Berlin or Bust

TURN to p. 421 and read "Berlin or Bust." Then ask yourself if your slogan is "Berlin or Bust" today and every day till the boys come home. "Berlin or Bust"—it's the only motto now for red blood and loyal hearts. We do not know who wrote "Berlin or Bust." The author did not sign his name. We would like to know him and shake his hand. And if he sends his name we'll print it—if his modesty will permit.

Water Control World Wide: Criminal Waste at Chicago

WATER resources the world over are being inventoried and conserved. On p. 407, studies, legislation, measurement and control of artesian supplies in far-away Hawaii are outlined, including the use of both the piezometer and the current meter on artesian wells. In our issue of Apr. 4, 1918, p. 657, a Russian hydrographic engineer told how measurement of water in Russian Crimea was being extended to hundreds of streamlets and springs. In this country, irrigation canals are being lined, closed conduits used, and various measuring devices introduced to save water. Municipal water waste is being located by surveys and prevented by the adoption of the universal meter system. Meanwhile Chicago and some other American cities are madly burning thousands of tons of coal in war time in order to pump almost unimaginable volumes of water to run to waste without serving a single useful purpose. It is high time they were halted—if not by their own volition then by the war-emergency powers of the Federal Government.

Contractors Sublet Worry

MANY schemes are being adopted, due to present conditions, which a few years ago would have been considered impracticable. New methods are being developed, new practices are springing up, and it is increasingly evident that a mixture of old and new is being fused, in the crucible of these strenuous times, into a combination which will have more or less fixed characteristics after the war. That the contract systems of the country are at present passing through such a change is evidenced by an article on heavy haulage contracts appearing in this issue. Large contracts are

the order of the day; the contractors are working for a nominal profit. Under these circumstances the general contractor is seeking ways to relieve himself of details. The new form of haulage contract accomplishes this by removing the multitudinous equipment repair and operation troubles. The haulage contractor for a certain rate per day furnishes the trucks, maintains them and supervises their operation. The general contractor utilizes them, but has sublet the worry. It is in harmony with the principle of division of labor.

New York Prepares for a Marine Revival

NEW YORK CITY has one of the great natural harbors of the world. Provided with many miles of protected water-front practically on the ocean itself, and backed by a rich interior convenient of access, it could hardly avoid developing into a great port. So favorable has been its natural endowment and so easy its inevitable development the impediments to future growth, if not forgotten, have often been disregarded. One of these impediments—the narrowness of the Manhattan peninsula—is natural; the other—the divided control of the two sides of the Hudson River at its mouth—has been part and parcel of our form of government.

Of the two, the latter is the more serious, because the cure for the former is within the realms of engineering and is therefore possible. Correcting the evils of the divided control, with its attendant jealousies, rivalries, and narrowness, is a harder task. Though it has become well recognized that the future of the port is menaced by a lack of co-ordinated policy, it has been the hardest thing in the world to get the various interests together for future planning. It is a literal fact that in the not very distant past there were influential men in New York City who would rather have seen a new industry or port development go to Boston or Philadelphia than to Jersey City or Bayonne.

Traces of this feeling may still exist, but the apparent smooth operation of the New York-New Jersey Port and Harbor Development Commission points to its early disappearance. How elaborate a problem the Port of New York presents is well shown by the latest report of that commission, abstracted on another page. After many efforts at joint action, the present commission seems at last to have perfected an organization which will see the Port of New York as a whole and will be able to state the problem and to offer a reasoned solution. How well the port will be able to profit by the investigation will depend on the ability of the state and municipal interests concerned to sink their individuality in the good of the port.

Other American ports must take notice of New York's awakening. Our mammoth post-war merchant marine must have business, and in marine transportation, as in all other transportation, terminals are of the first importance. The port is the marine terminal. Unless the coast cities of the country begin right away to plan. and actually to build the docks, wharves, warehouses, and terminals which most of them now so sadly lack, the great fleet of fabricated freighters now sliding into the water day after day will be useless.

Smashing Through to Victory

WASHINGTON is different today from what it was July 1. Then the spirit of last April prevailed—an active, energetic spirit, suffused with optimism as to the ultimate result of the war. It has been quickened by the presence of our men on the front. But the program was still a limited one—the man-power to be chosen only from the 21-31 ages. True, the military authorities were planning on extending the draft ages, but the temper under which Washington was working was that of a limited program, now running smoothly after a year of confusion.

Now all is changed. Victory has put Washington on its mettle. We have tasted success. Nothing may stand in the way of the most rapid possible mobilization of all our forces. The effort will be super-human. All our energy is to be brought to bear. As a keen observer, himself in the thick of the enlarged plans put it, "This means business."

Approximately 2,300,000 will come out of the new draft ages, exclusive of the boys, just 21, who enrolled last Saturday. They will all be in the field a year hence. Thus the man-power will be provided.

The home backing is also in course of very rapid mobilization. It is not coincidence that industrial restrictions have come with avalanche rapidity during the past 60 days. It is part of the new spirit and program, "Our full resources into the conflict with the utmost speed." Moreover, the 25 per cent. restriction of today will be a 50% restriction tomorrow, if the big program requires it.

And to none of this do we object. It means readjustment, possibly hardship—but it means a shortening of the war. It means a crushing defeat for Germany next year—and the saving of thousands of lives.

Our utmost energies are going into the conflict. Who will hold back?

We have the Germans on the run. The pace shall not slacken till their defeat is overwhelming.

Coercion Still by Valuation Bureau

GOVERNMENT valuation men who seek to better their lot still encounter attempts on the part of at least one district office of the Bureau of Valuation to bar them from employment by the railroads, according to information received by *Engineering News-Record*. This journal commented on the practice in its issue of Sept. 27, 1917, p. 577, at which time it was assured by the director of valuation that he had no knowledge of it. Now we are told that one railroad valuation engineer has agreed not to hire Government men within 90 days of the time they leave the Government service.

The Bureau of Valuation may have a shadow of an excuse for its attitude in the shortage of men, and the general policy of the Government to discourage competitive bidding for labor on war work. It is only a shadow of an excuse, however. While continuation of the valuation work was authorized by Congress recently, the work is far from a war necessity. Furthermore, the engineer with individuality and special proficiency along certain lines can not fairly be classed with the laborer who with his eyes, arms and legs does his

work about the same way as thousands of others. If the engineer can find a market for his special talents he should be allowed to sell them. Another arm of the Government, the Railroad Administration, has in fact helped him find that market by raising the scale of pay for its employees to something more in keeping with their value and the cost of living.

Engineering News-Record is not willing to believe the valuation engineer referred to would have consented to the 90-day clause unless considerable pressure had been brought to bear upon him. Appearances are, not that the bureau's district office, lately conscious of the necessity of its work to the winning of the war, and feeling the increasing shortage of men willing to accept its terms, has resumed a practice once condemned, but rather that it never abandoned the practice. And since district officials probably do not ignore the instructions of their superior, the director of valuation evidently now approves the coercion of which he had no knowledge last fall.

Making the War Help Win the War

SYSTEMATIC handling of army garbage, as practiced by the Conservation and Reclamation Division of the Quartermaster Corps of the Army, is making the war help win the war. Incidentally, the value shown to exist in garbage and the methods followed to raise them to the highest possible level afford a useful lesson to American cities. This will be made clearer by referring to the tabulation of bids for garbage at 35 Army camps, printed on p. 424 of this issue.

Contractors the country over recognize the value of garbage by offering to pay the government good money for it. That these offers are not mere speculative guesses is proven by the fact that 16 of the 19 contractors whose names were given in the partial list of 1917-18 contracts published in *Engineering News-Record*, Oct. 18, 1917, p. 731, appear in the 1918-1919 list as having secured contracts at the same camps as last year. One of these contractors operated at four camps last year, while for the current year he has the same four and one more.

A unique feature of this year's bids is that separate prices were requested on the component elements of the camp garbage. The highest, lowest and average prices

TABLE I.—RANGE AND AVERAGE PRICE PER TON OF CAMP GARBAGE COMPONENTS

	Low	High	Average
Breads	$3.50*	$100.00	$29.20
Meats, fats, grease	3.50*	160.00	62.60
Bones	3.50*	30.00	16.60
Other garbage	.50	8.20	2.70
Dead animals, each	1.00	3.00	2.10
Estimated total yield per ton	2.41	22.18	9.38

*All at Camp McClellan, Ala.

under this plan of bidding are summarized in Table 1 herewith. At army camps, where military discipline prevails, it appears to be feasible to carry the separation of wastes as far as the authorities see fit. In many cities it is difficult to get even a separation of garbage from all other refuse. When our cities see that separation pays, the difficulty will be more readily overcome. Even though waste separation cannot yet and perhaps never need be carried as far in cities as in camps, the segregated camp bids will be of much value to garbage disposal engineers and contractors and to city officials who are giving careful attention to getting the most possible out of municipal wastes.

Estimates of the yield per ton of garbage are given for each camp in the large table on p. 424 and appear rearranged from lowest to highest in Table 2 herewith. The average for 30 camps is $9.38 per ton. This is as close as could be expected to the median figure, there being 15 camps at which the yield per ton is estimated at $9.40 or less and 15 at which it is $9.44 or more.

Geographical distribution of the bids does not seem to have been much of a factor in the variation in estimated total yield of garbage per ton. It is true that the four lowest bids are from the South, but a number of other Southern bids are very near the average and some are quite high. Of the two highest bids, one is from a camp in Massachusetts and one, the very highest, from a camp in California.

Figures showing the total yield from the garbage from all the camps after records have been kept for a number of months or a year would be valuable. They will doubtless be compiled by the Conservation and Reclamation Division for its own benefit, and it is sincerely to be hoped that they will be made public. Even though there be material differences between camp garbage and city garbage, all the evidence that can be accumulated regarding camp garbage will be of immense value to

TABLE II.—ESTIMATED YIELD PER TON FROM ALL CLASSES OF GARBAGE AT 30 ARMY CAMPS

Camp	Yield	Camp	Yield
Greene, N. C.	$2.41	Doniphan, Okla.	9.784
McClellan, Ala.	3.50	Sherman, Ohio	9.86
Sevier, S. C.	5.02	Grant, Ill.	10.15
Newport News, Va.	5.655	Pike, Ark.	10.40
Lewis, Wash.	5.69	Taylor, Ky.	10.76
Lee, Va.	6.05	Upton, N. Y.	11.05
Logan, Tex.	6.20	Sheridan, Ala.	11.39
Custer, Mich.	6.654	Wheeler, Ga.	11.39
Dodge, Iowa	7.41	Beauregard, La.	11.76
Cody, N. M.	8.86	Dix, N. J.	11.98
Jackson, S. C.	8.97	Meade, Md.	12.04
Funston, Kan.	9.11	Travis, Tex.	12.13
Johnston, Fla.	9.17	Devens, Mass.	15.07
Merritt, N. J.	9.38	Fremont, Calif.	22.176
Gordon, Ga.	9.40		
Hancock, Ga.	9.44	Average	9.38

our cities and will unquestionably stimulate them to utilize their garbage in the future as never has been done in the past.

Assuming that camp garbage yields attain the estimated average of $9.38 per ton, no one should suppose that this is all profit. The military authorities have to collect the garbage and deliver it to the contractors. But, once collected, the garbage must be got rid of. Until recently it was assumed that the only sanitary way that camp carbage could be disposed of was by burning. Today, instead of paying money for fuel and labor to consume garbage, contractors pay for it handsomely. Whether or not camp garbage yields the estimated average total of $9.38 a ton, city garbage will not bring anything like that average. But in every city it can and should be made to contribute materially to the cost of collection and disposal. To get every possible dollar from it the problem of both collection and disposal must be handled by competent engineers.

For the present and probably for a long time to come there is a double reason for utilizing garbage and other city wastes to the utmost. Food, fiber, fertilizing material and metals running to millions of tons a year go into our garbage and rubbish cans. Besides the revenue that our cities and our military camps get from the material reclaimed, the material itself is of vital importance to winning the war and to the success of reconstruction efforts.

Nelson River Crossed by Hudson Bay Railway on Large Continuous-Truss Bridge

Cantilever Erection of 400-Ft. Span Made Necessary by Deep Water With Rapid Current—Ice Gorges Dictate Clearance Height—Floor Between Chords—Material Transferred to Far Bank by Cableway

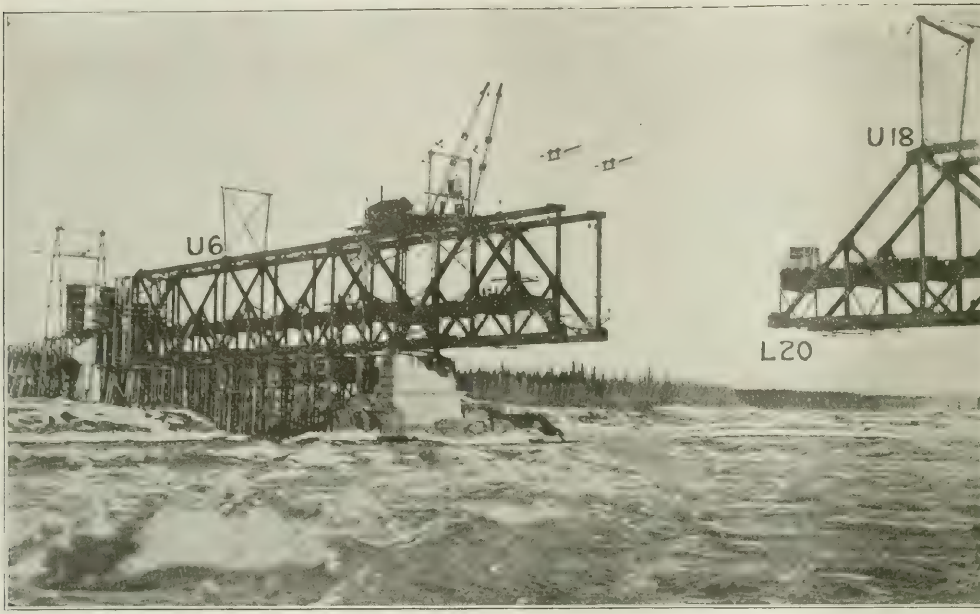


FIG. 1. KETTLE RAPIDS BRIDGE, NORTH HALF CANTILEVERED OUT BY TOP-CHORD DERRICK TRAVELER SUPPLIED WITH MATERIAL FROM SOUTH BANK BY CABLEWAY

REACHING Mile 332 on its way to its northern terminus, the Hudson Bay Ry. has crossed the Nelson River at Kettle Rapids by a bridge of highly modern type—a three-span continuous bridge 1000 ft. long. The structure is the most important one on the railway, which is now completed for three-quarters of the total length of 424 miles from The Pas, on the Saskatchewan River, northerly to Port Nelson on Hudson Bay.

The physical conditions at the Kettle Rapids crossing gave the continuous structure a distinct superiority over other types. Rapid current, a deep channel, and remarkably severe winter ice conditions made erection by the cantilever method imperative. Simplicity of design was secured by use of parallel chord continuous-truss construction in a degree that made the erection unusually rapid. That the precision of modern bridge shop and field erection methods is of value in continuous bridge work was evident when closure was made at the middle of the channel span. The position of the structure and the reactions at its supports corresponded to those predicted by calculation, within very close limits, so close that no further adjustment was required. Rock foundations of piers and abutments assure the permanence of the structural adjustment.

Though the Nelson is among the large rivers of Canada, two islands at the point of crossing, narrowing the channel to 350 ft., made it possible to cross by a bridge of moderate size. In this narrow channel, however, the water is 200 ft. deep (estimated), and the current is so swift that the river never freezes over at this point, though it does directly above and below the site. The side channels, on the other hand, are narrow and shallow and have a slow current; the bottom here and the islands are tough granitoid gneiss, which is also the foundation material of the abutments on the banks.

Both water and ice conditions are unique. The Nelson River has almost no variation in stage throughout most of the year (maximum observed, 3 ft.), because of the equalizing effect of Lake Winnipeg. In winter, however, rises of 20 ft. and more occur, due to ice jamming. The peaks of the ice rise 5 or 6 ft. above this level, the highest occurring on the islands on which the two river piers are situated.

A clearance height of 15 ft. above the maximum recorded height of ice was decided upon, for due safety in all future winter conditions. In the winter of 1917-1918 the severest weather of which there is any official record along the line of the Hudson Bay Ry. was experienced, but the maximum height of the ice peaks at Kettle Rapids exceeded previous records by only ½ foot.

Track grade on the approaches was at such height

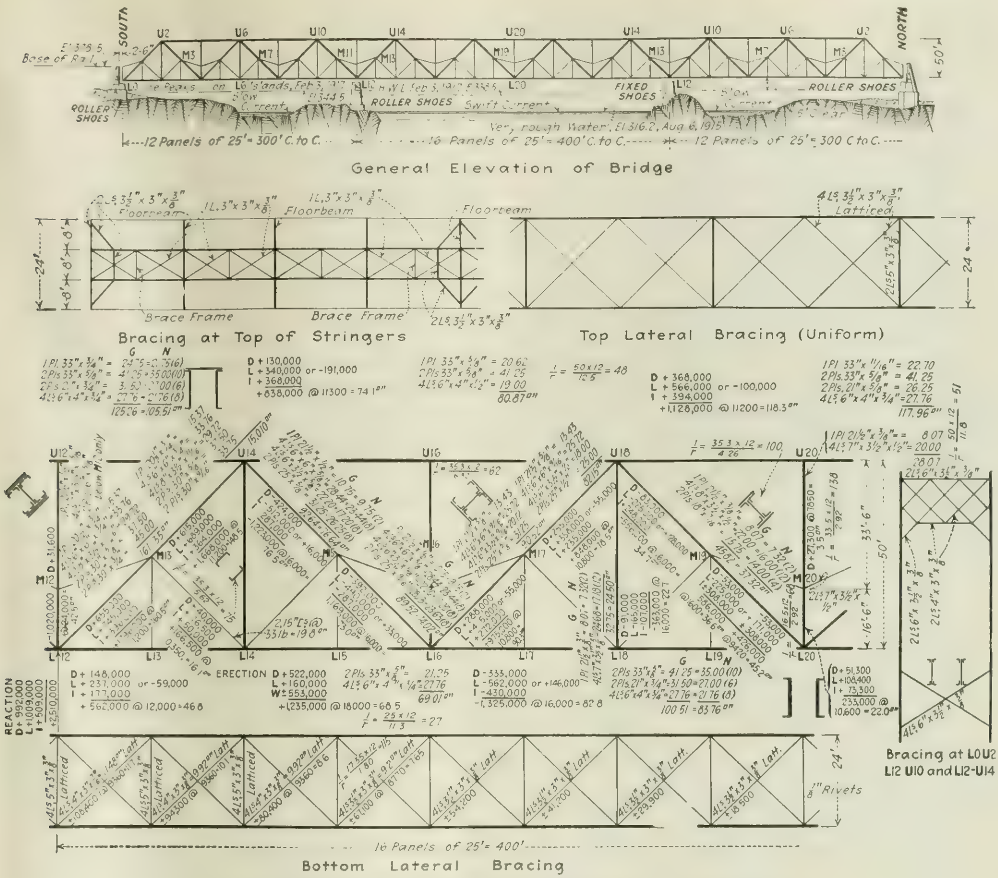


FIG. 2. ELEVATION OF BRIDGE AND STRESS SHEET OF MAIN SPAN

that, keeping the bottom chord down to the clearance level mentioned, for economy in pier masonry, the bridge floor came near mid-height of the trusses. This position and the engineer's choice of the Warren web system in the trusses resulted in an unusual appearance and detail arrangement of the structure, as may be seen in the outline elevation, Fig. 2. The floor stringers are braced to the truss posts at main panel points to stiffen the floor against longitudinal or braking forces, and from the posts these forces are transferred to the carrying members of the web system by slightly inclined longitudinal struts.

That the continuous-span type of bridge was chosen in preference to a normal simple-span or cantilever design resulted from a careful comparison of the three forms of bridge. The location required a structure 1000 ft. long, with three spans of 300, 400 and 300 ft. The side spans could be erected on falsework, while the center span had to be built by cantilevering. Simple spans could have been adapted to these conditions without difficulty, but a considerable excess of metal would have had to be provided on account of heavy erection stresses. In either a cantilever or continuous structure, on the other hand, no excess metal for erection was required except a small amount in the bottom chords adjacent to the main piers. The simple spans were rejected as uneconomical. A cantilever structure was considered undesirable because of the articulation at the connection of suspended span to cantilever arms, and also, as the design in this case would have employed greater depth over the piers than at midspan, because of the extra cost of shopwork involved by inclined

FIG. 3. HEAVY HOAR FROST DUE TO EVER-OPEN WATER IN RAPIDS AND EXTREMELY LOW TEMPERATURE

chords and irregular webbing. The continuous bridge afforded maximum economy, and, with a parallel-chord design and without moving joints or points of adjustment, was by far the simplest in shopwork and in erection. The sizes of parts were well within the limits for full riveted construction, as desired to avoid slack in members subject to stress reversal.

Continuous-span construction was adopted for the reasons stated. A truss depth of 50 ft., uniform throughout the length of the structure, 24-ft. spacing of trusses, and panels 25 ft. long, were decided upon. The truss web was arranged on the Warren system with intermediate verticals and subpaneling—the main panel length being 100 ft., diagonals sloping at 45°. Warren webbing was adopted, says W. Chase Thomson, because it is the most economical, especially where many of the web members are subject to alternating stresses, and because of its simplicity and good appearance.

Locating the track floor between the chords—which resulted from keeping the steelwork down to the river-clearance limit—not merely effected a considerable saving of concrete in the piers and abutments, without adding to the weight of the steelwork, but also gave several other advantages: (1) The structural details were simplified by keeping the floorbeam connections clear of the lower panel point; (2) a better distribution of stress among the component parts of the main members was secured by applying the floorbeam concentration well away from the end connections; (3) change of length in the floor due to lengthening or shortening of the truss chords under load was greatly reduced by placing the track stringers near the neutral axis of the trusses.

Although far from other lines of traffic, the bridge was proportioned for rather heavy loading—slightly less than Cooper's E50. As is provided in the 1908 railway bridge specifications of the Canadian Department of Railways and Canals, which governed the design, a live load consisting of two consolidation locomotives with 49,400 lb. driving-axle load, followed by a uniform train load of 4750 lb. per linear foot of track, was assumed. The dead load was distributed to top-chord, middle and bottom-chord points as it actually occurs. Wind of 400 lb. per linear foot at rail level and 400 lb. (moving) at 8 ft. above rail was allowed for; however, the bottom laterals were proportioned for the whole amount, and the chord stresses arising from the overturning moment were added to the other chord stresses. For the erection period the dead loads actually occurring, together with either a 150,000-lb. derrick car or a 120,000-lb. creeper traveler, and wind of 600 lb. per linear foot at rail level, were taken into account; unit stresses increased 50% were allowed for the resulting erection stresses.

Working stresses are fixed by the specifications men-

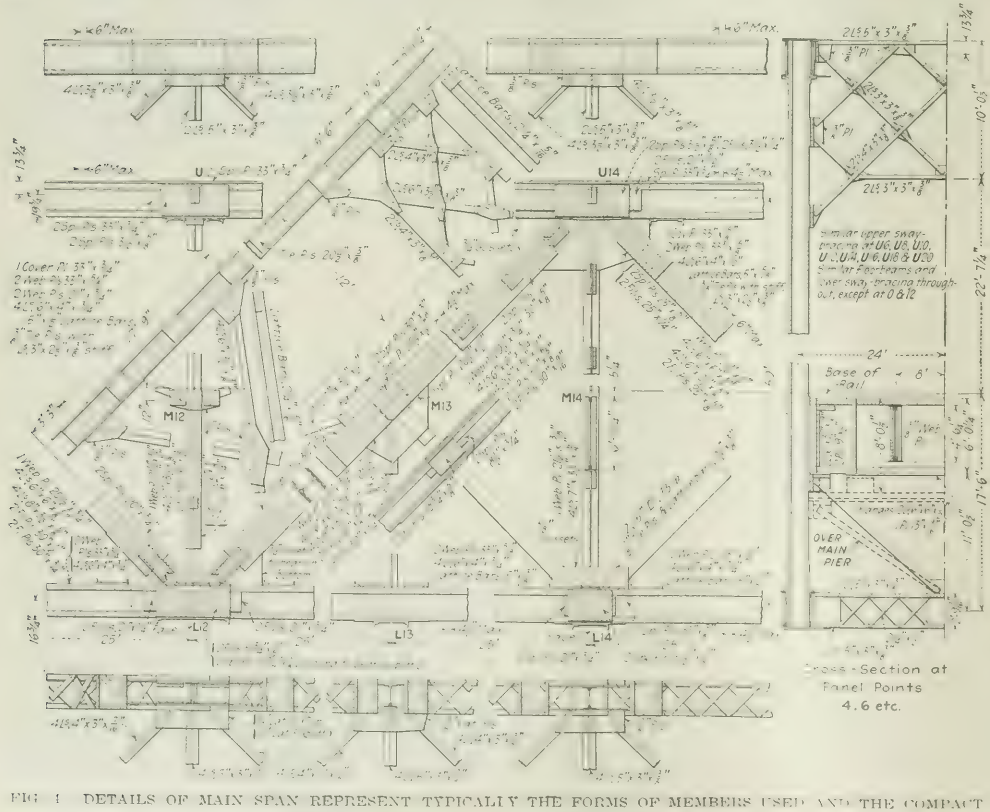


FIG. 1 DETAILS OF MAIN SPAN REPRESENT TYPICALLY THE FORMS OF MEMBERS USED AND THE COMPACT CONNECTIONS SECURED BY OUTSIDE SPLICE PLATES

tioned at 16,000 lb. per square inch for tension, and at the same figures as base stress for compression with reduction by Gordon's formula using a constant of 9000 for pin-end struts. However, in designing the Kettle Rapids bridge the compression base stress was fixed at 12,000, and the reduction constant in Gordon's formula at 36,000. Another important variation from the deportment specifications was made by reducing the impact allowance in case of live-load stresses of opposite kind. The impact formula of the specifications, I = range^2/(max. stress), was modified in application by making the range not the sum of greater (positive) and lesser (negative) live-load stress, but the sum of greater and four-tenths the lesser. Where the live-load stress did not reverse, the formula was applied as originally intended, the range being simply the maximum live-load stress, so that the impact is $I = L^2/(L + D)$.

Of the details of the bridge, shown typically in Fig. 4, the longitudinal diaphragms of the principal compression members attract notice. The designer sought to avoid latticing where possible, except for service in staying the open sides of members. The main compression diagonals have their outstanding flanges stayed by tie-plates.

One of the two pier bearings is fixed; all the other bearings have expansion rollers (8-in. on the main pier, 6-in. on the abutments). The expansion rollers are effectually prevented from skewing and creeping by cut-tooth pinions, attached to both ends of two rollers of each nest and gearing with racks on the shoe- and bed-plates. All four bearings are of the pin type, upper and lower shoes being steel castings. The lower shoe (in the case of the expansion bearings, the steel bed plate of the rollers) was cushioned on a $\frac{1}{8}$-in. sheet of lead, the bridge seat being previously dressed to exact elevation and level.

Splices and connections were made with rivets sufficient to develop the full value of the connected parts. That the gusset plates are small, as may be seen from Fig. 4, is largely due to the use of outside splice plates at the connections of the main diagonals. The connections at the middle panel points and the bottom connections at panels 2, 6, 10, 14 and 18 have gusset plates only $\frac{3}{8}$ in. thick. At the upper panel points 10 and 14 the size and thickness of the gusset plates were determined by the shearing forces acting on the plates.

At the main-pier panel point (L12), where the bottom chord because of the camber is slightly inclined to the horizontal—$\frac{1}{64}$ in. per foot—a level bearing on the shoe casting was secured by extending the gusset plates $\frac{1}{8}$ in. below the chord. Additional bearing area was obtained by placing tapered fillers under the bottom flange angles of the chord. The outside splice plates of the chord at this panel point were ground along the lower edge to bear on the inner surface of the flange angle so that they might assist in transmitting the vertical load to the flange (and by way of the tapered pillars to the shoe). For this service the splice plates have additional rivets over and above the number required for splicing the bottom-chord sections.

Since the bridge had to be erected with its ends low, to permit junction at midstream under no-stress conditions, provision for jacking up the bearings was necessary to enable the desired adjustment of stresses in ac-

FIG. 5. STRUCTURAL ARRANGEMENT OF BRIDGE SEEN IN END VIEW OF SOUTH HALF DURING ERECTION

cordance with calculations to be obtained. Jacking may also be required in future when bearings need to be examined or replaced, or when it might be desired to shim up one of the supports for readjustment of stresses. The floorbeams at the four bearing points were therefore constructed strong enough for the purpose. The end floorbeams—which unlike the intermediate floorbeams carry the stringers on their top flanges—were fitted with stiffeners and bearing plates at points 16 ft. apart, where jacks were applied later. The floorbeams over the main piers were built 96 in. deep in place of the 72-in. depth of the ordinary floorbeams and were fitted with double webs in the end section; these floorbeams are capable of lifting the bridge, with unit stresses increased 50 per cent.

The bridge was cambered without regard to securing a level position of the bottom chord under any particular condition of loading. The unstressed form is as shown to exaggerated vertical scale in the upper sketch in Fig. 7. This shape was secured by increasing the length of the top-chord panels $\frac{3}{8}$ in., except the two panels U10 U12 and U12 U14, which were shortened an aggregate amount of $1\frac{7}{8}$ in. The post over the main piers were lengthened $\frac{3}{4}$ in. to straighten the top chord. Minor adjustments of the lengths of diagonals were made. The abutting chord ends at L12 were beveled to give perfect contact when the trusses are fully loaded.

For erecting the bridge, a 75-ton derrick car with 50-ft. boom placed the members of the southern anchor span (on falsework) and, after the anchor span had been fully riveted, also erected the south half of the channel span as a cantilevered structure. In this span riveting followed close behind erection. In all this work material was handled directly from the bridge floor. A radically different procedure had to be followed on the north side, however, because the material arrived on the south bank. The essential feature of this part of the work was transportation across the river by a double cableway, supported directly over the bridge.

FIG. 6. FOR TRANSPORTING MATERIAL TO NORTH SIDE, A DERRICK CAR ON SOUTH END SUPPLIED MATERIAL TO DOUBLE CABLEWAY FITTED WITH EQUALIZER BEAM

Two of the photographs shows the cableway in operation. A 40-ft. bent standing on the south half of the bridge at panel point 18, and a 120-ft timber tower located back of the north abutment supported the cables with a span of 611 ft. For the later part of the north bank work, however, the span was reduced to 400 ft. (decreasing the sag under maximum load from 46 ft. to 22 ft.) by placing a 40-ft. bent on panel point U6, north half, as intermediate support. A triangular equalizer beam supported by the carriages on the two cables served for lifting the loads and distributed their weight equally to the two cables. Falsework, parts of the north-bank erection traveler, and bridge members were transported across the river by this cableway. The heaviest piece handled weighed 14 tons.

The order of erection work was in other respects similar to that followed on the south half, except that in place of the derrick car a top-chord traveler carrying two 62-ft. booms at its front end was used. This traveler weighed 60 tons including counterweights. In placing the members of the north shore span it operated at the floor level, being carried on extension bents of the falsework, reaching up to floor level. For the cantilever work it traveled on the top chord. Here the weight of the traveler made necessary temporary support of the top-chord members at their middle points by timber posts.

Starting steel erection on the south bank June 6, 1917, the half length of the bridge was completed in eleven weeks, or by Aug. 18; riveting was finished within another week. Building the cableway and placing the falsework for the north shore span took until Sept. 17, when steel erection was resumed. The traveler began its work at the river pier and moved backward toward the abutment, placing floor system, bottom laterals and lower half of the trusses and removing the falsework extensions. Upon arrival at the abutment the traveler was blocked up to the top chord level; moving forward toward the pier it erected the upper half of the trusses. Then it worked out along the top chord, erecting the channel span as cantilever work.

By the end of November the two halves of the bridge met at midspan, and the bottom chords were joined at panel point 20. The trusses were in perfect alignment and the two cantilever halves were at the same level, so that is was only necessary to jack the south half of the structure forward on its rollers (it had originally been set back 5 in.), to make the connection at L20.

In starting steel erection the end panel points had been set 10 in. low, in order to allow the bottom chord to be joined at midspan, and yet allow the closing top-chord section to be set freely. When the top-chord member was placed, there was a 1-in. gap. It remained to raise the end supports up to their proper level in order to close the top-chord opening and put the full calculated dead-load stress in the central section of the top chord.

Cold weather interfered with making this adjustment during December, however, except for a lift of 3½ in. (accomplished Dec. 22), just sufficient to bring the ends of the top chords at U20 to firm bearing. Further jacking was deferred until riveting of the main connection was completed, which took the rest of the month. On Jan. 2 the ends were jacked up 4⅞ in. further, permitting the upper shoe castings to be slipped into place, without the 1⅝-in. shims which had been provided as means of give and take. Though the ends were below normal position, the load at each of the four end bearings, as read from the gages of the hydraulic jacks, was exactly equal to the desired dead-load reaction, or 118½ tons, but whether the adjustment was perfect could not be told because there was a large weight of ice and snow on the bridge, whose influence on the load distribution was uncertain.

Resuming work in June, 1918, the erection forces completed some remaining items of structural work; the permanent track was also laid. Upon now weighing the end reactions by the jacks, the engineers found the dead-load reaction at each of the corners to exceed the computed 118½ tons by exactly 5 tons, or about 4 per cent. This meant that the ends were slightly too high for the desired load adjustment, although a trifle below the originally intended level. The divergence from the theoretical reactions was within the limits of accuracy of jack weighing, and in any event was considered too slight to call for any effort to lower the ends—which would have required chipping the bridge seats or altering the shoes. The bridge was therefore left with ends 1⅝ in. low, as represented in the lower diagram in Fig. 7.

Referring to the slight departure from the intended position of the trusses, Mr. Thomson says, "This result

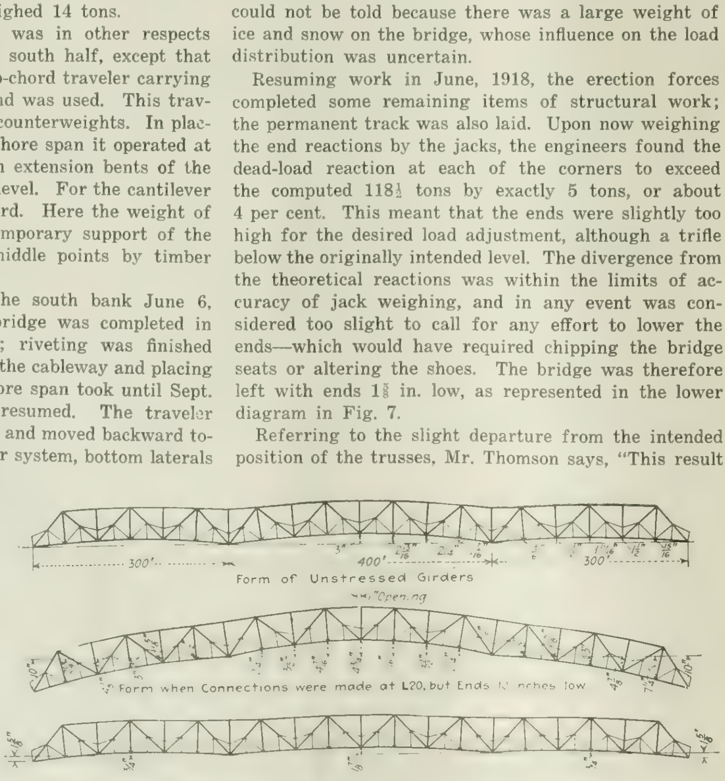


FIG. 7. CAMBER DIAGRAMS FOR VARIOUS STAGES OF WORK

is as might have been expected. The cantilever erection of the channel span tended to increase the length of the top chord throughout, resulting in lowering the ends, though but slightly."

The total weight of steel in the bridge is 4,415,000 lb. The piers and abutments required about 3000 cu.yd. of concrete.

The design was carried out in all detail by W. Chase Thomson, consulting engineer, Montreal, retained for the work. It was under the general supervision of W. A. Bowden, chief engineer, Department of Railways and Canals of the Dominion of Canada, at Ottawa, and J. W. Porter, chief engineer, Hudson Bay Ry., at The Pas. The superstructure was fabricated and erected by the Canadian Bridge Co., Ltd., Walkerville, Ont. C. B. Campbell, bridge engineer, Hudson Bay Ry., was in charge at the site. I. E. Mahon was superintendent of erection for the superstructure contractor.

Weighing Concrete Materials Saved Cement on Three Big Dams

Cost of Equipping Mixer Plant for Weighing Not Excessive — Proportioning by Weight Gave Better Concrete With Less Cement and Without Loss of Speed

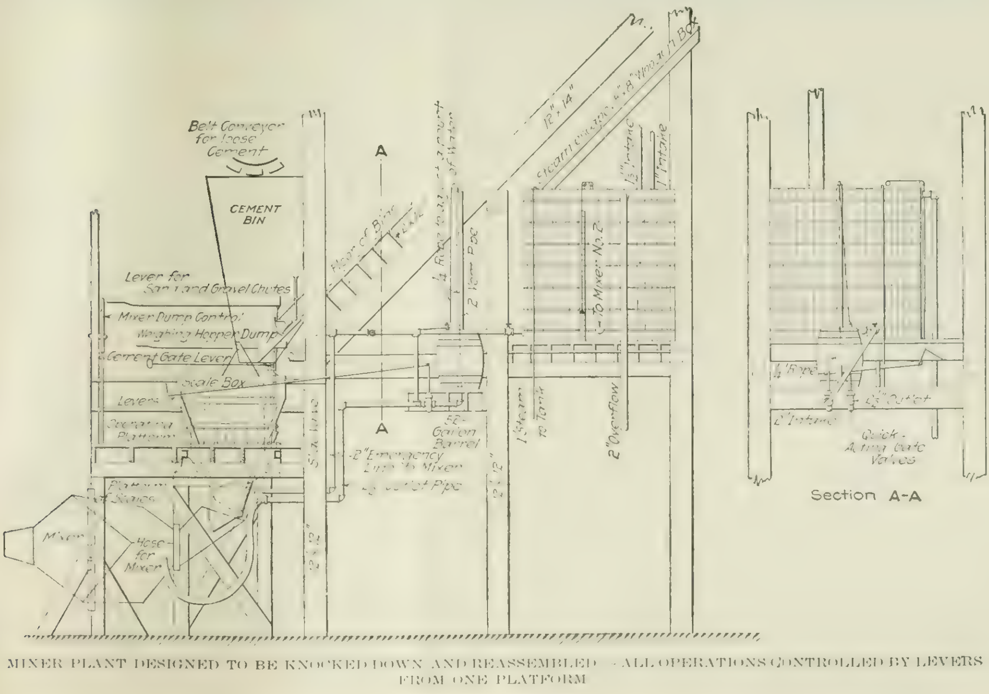
By H. H. Hunt

Fargo Engineering Co., Jackson, Mich.

CONCRETE proportioned by weighing the cement, sand and gravel reduced the volume of cement used on three hydro-electric developments completed recently in Michigan and Minnesota. For a total of 130,000 cu.yd. of concrete placed, the cement used per cubic yard ranged from 1.18 to 1.23 bbl. Void tests and occasional changes of the relative weights of the component materials kept the mixture uniform. Making the operations of the mixer plant as nearly as practicable all-mechanical the labor force was not increased and there was no appreciable loss of time due to the more exact methods of proportioning by weighing. One design of mixer plant was used for all three jobs.

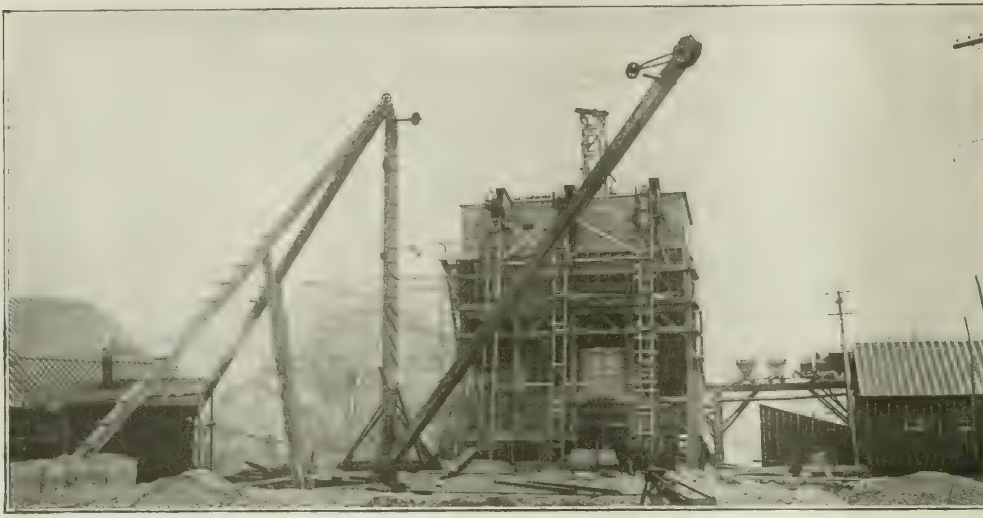
In 1917 and 1918 the following hydro-electric plants, for which the Fargo Engineering Co. were designing and supervising engineers, were completed and placed in operation: Wissota dam, near Chippewa Falls, owned by the Wisconsin-Minnesota Light & Power Co.; Junction dam near Wellston, Mich., and Foote dam near Oscoda, Mich., the two latter dams being owned by the Consumers Power Co. Wissota dam was of 60-ft. head and comprised 61,000 cu.yd. of concrete; Junction dam was of 50-ft. head and contained 47,600 cu.yd. of concrete, while Foote dam was of 35-ft. head and the volume of concrete amounted to 21,000 cubic yards.

The concrete specifications for these three develop-



MIXER PLANT DESIGNED TO BE KNOCKED DOWN AND REASSEMBLED — ALL OPERATIONS CONTROLLED BY LEVERS FROM ONE PLATFORM

ments were drawn in such a manner that the proportions were dependent upon the voids found in the sand and stone, and on account of the varying values of voids to be expected it was considered desirable to have a ready means of changing the relative amounts of sand, cement and stone. It was, therefore, decided that all material should be weighed so that any desired proportions could be obtained with a minimum of trouble. While this method has been used previously in a few cases, because of the exceptional success obtained here, plant was not in use, transportation of materials from the screening plant would have been stopped when the bins were filled. As it was, a uniform output at the screening plant could be maintained, excess material over that used on any given day by the mixing plant being placed in storage, and, conversely, being taken from storage on those days when the output of the mixing plant exceeded the capacity of the screening plant. Steam pipes were provided in each bin to prevent freezing of sand and stone in cold weather.



DERRICK AND CLAMSHELL COULD SUPPLY BINS FROM EMERGENCY STOCKPILES

a description of the plant layout, together with an outline of the steps involved in the determination of pro portions, is of interest.

Details of the mixing plant used in constructing the Foote dam are shown by the drawings. This plant layout is typical of those at the other two jobs, though each differed from the others in details. The following description refers especially to the Foote dam operations.

Sand and stone from the dump cars were unloaded into the boots and elevated to the overhead bins by means of continuous bucket elevators 71 ft. 6 in. long, each elevator being provided with an individual motor drive. The capacity of the storage bins was 80 cu.yd. of sand and 160 cu.yd. of gravel, it being considered advisable to have enough material in storage so that a break down in the transportation system would not seriously interfere with the continuity of concreting operations.

As an additional insurance against shut downs, storage piles of sand and stone were provided adjacent to the mixing plant and a stiff leg derrick handling a clamshell bucket was so located that it could take material from storage and place it in the boots of the bucket elevators. The use of these storage piles made it possible to transport screened sand and stone at a more uniform rate than could have been done if dependence had been placed upon the storage capacity of the bins only, inasmuch as at such times as the mixing

When the mixer plant was in operation cement was loaded onto a push car and transported to a dumping pocket located over the lower end of a belt conveyor. The sacks were emptied into this pocket and the empty sacks were stored in a small shed nearby. Before being bundled for return to the cement mill the sacks were placed in a cleaning machine and thoroughly shaken. The dumped cement was taken by the belt conveyor and discharged into a bin located at the front of the sand and stone storage bins and directly above the charging hoppers of two cube mixers. Sliding cut-off gates were provided on the cement bins and proved very satisfactory.

The charging hopper of each mixer was supported on the framework of a Standard hopper scales provided with a four-beam charging box. Three of the beams were graduated to 1600 lb. by 5-lb. intervals and one beam to 3000 lb. by 10-lb. intervals. In operation, only three of the beams were used; one each for cement, sand and stone. A testing engineer was responsible for setting the scales to give proportions which tests showed were required under the specifications, and after setting the beams the charging box was locked.

The various scales were placed in operation by means of levers projecting through one end of the box. Under this arrangement the man on the charging platform would throw a lever to place the beam for stone in operation and would then admit stone to the charging hopper

until the beam balanced, when the cut off valve was closed. In the same manner cement and sand were added. If through carelessness too much stone or sand was added, a correction was made by means of a plus or minus attachment so that each batch contained the computed amount of cement.

Water was supplied to the mixers from an elevated tank which was provided with an adjustable discharge pipe by means of which the amount of water supplied to the mixer could be regulated or maintained constant. A steam connection was provided by means of which water could be heated in cold weather.

The number of men required for operating the mixing plants was as follows: Operating cement conveyor, 1 man; sand and gravel bins, 3 men; charging mixers, 2 men and operating mixer, 2 men. In addition there was a gang of men who transported cement from storage to dumping pocket.

After being dumped into hopper bottom cars the concrete was hauled or pushed to the forms on a narrow gage track on an overhead trestle, though some concrete was spouted directly into place. A kerosene burning locomotive was used for hauling cars and proved entirely satisfactory.

Costs of plant construction, including equipment for proportioning, are given for the Junction dam plant as follows, based on 1916 prices:

PORTABLE SCREENING PLANT

Labor.	
Framing timbers, 140 hr. at 35c	$49 00
Erecting bins, 1,210 hr. at 35c	423 50
Placing screws and motors, 150 hr. at 35c	52 50
Installing elevator (estimated)	50 00
Total labor	$575 00
Material:	
9,200 ft. B.M. timber at $33	$303.60
3,500 ft. B.M. plank at $24	84.00
1,130 lb. bolts and rods at 6c	68 00
780 lb. sheet metal at 8c	62 40
2 bin gates at $22	44 00
8 track wheels at $20	160 00
2 revolving screens, 42 x 14 in	1,018 00
1 bucket elevator, 35 ft. centers	830.00
Total material	$2,570 00
Grand total	3,145.00

BINS AND MIXER PLANT

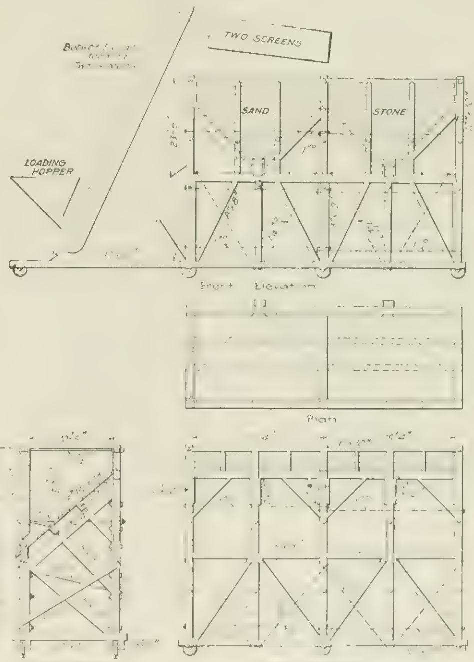
Labor:	
215 hr. framing timbers at 35c	$75 25
1,945 hr. erecting bins at 35c	375 75
780 hr. erecting bins at 25c	
120 hr. building house at 35c	57 00
60 hr. building house at 25c	
240 hr. setting scales and mixer at 35c	114 00
120 hr. setting scales and mixer at 25c	
Concrete footings, 27 cu.yd	28 50
180 hr. heating pipes in bins at 30c	99 00
180 hr. heating pipes in bins at 25c	
Elevators and belt converyors (estimated)	200 00
Total labor	$1,458 50
Material:	
Pipe, etc., for heating system	196 00
2,700 lb. sheet steel at 8c	216 00
3,500 lb. bolts and rods at 6c	210 00
4 bin gates at $22	88 00
Concrete for footings	140 00
14,000 ft. B.M. plank at $24	336 00
15,500 ft. B.M. timbers at $33	511 50
Total material	$1,697 50
Equipment	
71½ ft., 18 in., 4-ply belt	400 00
3 No. 4 elevators	2,000 00
2 No. 1618 Standard hopper scales	280 00
2 Mixers	2,300 00
Total equipment	$4,980.00
Grand total	$8,136.00

It should be noted that the above plants are so built that they can be used on future work at slight expense for moving and re-assembling so that the figures given do not represent the amounts to be charged against any one development.

Sand and stone for all three developments were obtained from nearby deposits of bank gravel of which 2% was retained on a 1½-in. screen and 40% on a ¼-in. screen, and 58% passed a ¼-in. screen.

All gravel was excavated by steam shovels or drag line excavators and screened into sand and stone bins using vibrating screens in one plant and revolving screens for the other two. Though the vibrating screens required more repairs than the rotary screens, the results obtained, especially in damp weather, were more satisfactory, as it was found almost impossible to keep the rotary screens from clogging after rains. Portable screening plants were used at two points. Electric power operated belt conveyor and screens.

Cement in cloth sacks was used for the Michigan jobs being unloaded from cars directly into a storage shed having a capacity of 10,000 bbl. and located in close proximity to the mixing plant. Each carload was kept in a separate pile and marked with car number and date received. Bulk cement was considered, but a decision was made in favor of the use of cement in cloth sacks because it was found that it would be easier to obtain the latter from mills within a reasonably short shipping

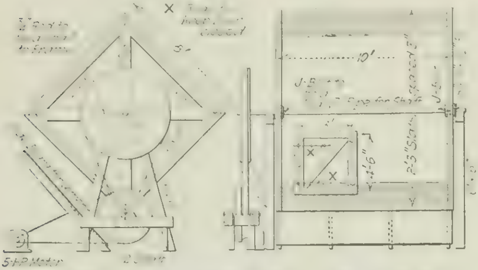


PORTABLE SCREENING PLANT PREPARED PIT GRAVEL FOR EXACT PROPORTIONING

distance. At Wissota dam, however, bulk cement was used with very satisfactory results as to economical handling.

A testing engineer, reporting to the resident engineer, was placed in charge of void tests from which concrete proportions were computed. After setting the scale beams to produce the proper proportions this assistant engineer made frequent inspections to make certain that

mixer attendants used proper care in balancing the scale beams. As all work was being done by the owners, the presence of a concrete inspector at the plant continuously was not considered necessary, but such inspection should ordinarily be provided on contract work. Frequent tests were made of voids in sand and gravel as they arrived at the job and when it was found that void percentages had changed, the mixer scales were re-set without interference with concreting opera-



CEMENT SACK SHAKER SAVED LAST CLINGING PARTICLES OF MATERIAL

tions. This method of charging the mixer hoppers worked out very well and a much more uniform mixture of concrete was obtained than was possible where proportioning was done by levelling to marks in the charging hopper.

Samples of concrete were taken from the forms at frequent intervals and poured into 8-in. cylindrical molds 16 in. long. These cylinders were stored in damp sawdust or sand and were later sent to a laboratory for tests of compressive strength when 30 days old. The results of these tests were satisfactory and showed that the methods of proportioning and mixing were such as to insure good concrete. Occasionally a low crushing strength would be shown but it was usually found that this was due to the presence of a stone pocket in the cylinder. In addition to taking sample cylinders for testing, frequent 1:3 briquet tests were made at the job as a check on cement tests made before shipment.

In order to determine the advisability of using waterproofing material in concrete subjected to water pressure a series of tests were made of the permeability of concrete mixed according to different proportions. Blocks of concrete were made, nine different proportions being used. The tests showed that there was no reason to expect seepage under heads up to 50 ft. if mortar for concrete was mixed even as lean as the proportions of $1:2\frac{7}{10}$ by volume. The tightness of the finished concrete which is subjected in some cases to a head of 40 ft. is a satisfactory confirmation of the conclusions resulting from the permeability tests on small samples.

The screening and mixing plants described were used on work involving the mixing and placing of approximately 130,000 cu.yd. of concrete. It has been demonstrated that proportioning by void determination insures excellent concrete with less cement than required to obtain concrete of equal quality with predetermined, fixed proportions. The amount of cement used per cubic yard of concrete ranged from 1.18 to 1.23 bbl. on the several jobs where use was made of the proportioning methods described above. The use of scales for charging the super-hoppers of the mixers was essential to provide for convenience in changing proportions from time to time and furthermore it made almost certain the absolute uniformity of successive batches, since it obviated the difficulty of measuring volumes by bringing the several materials to fixed points in a hopper.

While the quantities of concrete involved are greater than found in the average case, there is no question that void determination and the use of scales would work out very satisfactorily on comparatively small jobs. In cases where it is desired to adhere to the usual method of arbitrarily selecting fixed proportions the use of scales would still be of great value in insuring uniformity of mixture and preventing disputes as to the use of the proper amount of sand, stone or cement.

The details of this system of proportioning and weighing concrete ingredients were first developed by J. D. Justin, resident engineer for the Fargo Engineering Co. at Wissota dam. H. N. Tuley was resident engineer at Junction dam and F. W. Howard was resident engineer at Foote dam, being later succeeded by Holton Cook. The writer is construction engineer with the Fargo Engineering Co. and the mixing plants at Foote dam and Junction dam were designed and built under his direction.

The Railroad Engineer Has a New Opportunity

Protection of the Corporate Interests Is Without Precedent and Calls for Engineering Skill of a High Order

By Former General Manager

PRIMARILY the physical operation of railways is an engineering function. The scientific training of the engineer peculiarly adapts him to solve the various problems entering into the actual operations of transportation systems. The policy of the Pennsylvania R. R. system in selecting the chief operating officials from its engineering staff has resulted in making it one of the greatest transportation systems in the world.

The opportunities afforded the engineer under the Federal operation of the railroads are numerous and manifold, as many new problems have arisen that demand solution. Among these problems are the unification of terminals and other facilities; the rapid extension of existing and the building of new facilities, and the promotion of increased efficiency of present facilities of all kinds. Then, again, the railways during Federal control will be divided into two distinct and separate organizations—one under Federal control, directly concerned in the physical operation; the other, under corporate control, representing the owners of the property.

Corporate Problems Unprecedented

Each of these organizations will require its proper staff, and on each the engineer will assume a prominent part. The Federal organizations will probably absorb most of the engineering organizations now prevailing on the various railway systems, and perform practically the same duties as under private management,

except that under unified control many new problems will arise not heretofore encountered, such as unification of facilities and modifications necessary to centralized operation and control. The corporate organization, however, will represent an entirely new departure in railway history, and, being without precedent, opens up a wide field of opportunity for the exercise of originality of thought and action.

The function of this organization will be of a character requiring a combination of skill, diplomacy and resourcefulness, not heretofore called for in the operation of railways. The principal duty of the organization should be to see that the rights and interests of the corporation are properly conserved and safeguarded during the time the property is in use by the Government and that it is returned to its owners in substantially the same condition as when taken over by the Federal administration. This function of the corporate interests will demand the closest possible supervision. The Government being merely a tenant and user of the physical property during the period of control, it is essential that the use made of the property shall not affect its value as a going transportation entity, and that its physical condition shall not be depreciated.

Functions of Corporate Engineer

Important elements entering into the problem may be briefly outlined, as follows, all of which call for engineering knowledge and skill and railway operating experience of the highest order:

1. The property should be maintained in substantially as good condition during Federal control as during the "test period"; that is, the three years prior to June 30, 1917. Any depreciation in maintenance of way and equipment the corporate interests should have cognizance of and be able to prove as a basis of claims for reimbursement. If excess expenditures are incurred for maintenance, the Government will likely charge such items to the corporate interests and probably deduct such excess from the rental due for the use of the property.

2. Additions and betterments to the property, if made solely for the purposes of the Government, will likely be paid for by it as operating expenses. Such additions and betterments as are made necessary for the benefit of the property and its efficiency as a normal transportation machine, will be, and properly so, charged to the corporate interests. Fine distinctions will present themselves under this head, and the application of the closest check on all expenditures should be made to safeguard the corporate interests.

3. Federal control will necessarily be exercised in such manner as to serve its purpose, regardless of the individual identity of the various systems or companies. This method of operation will take the form of diversion of traffic from one line to another, and will result in material loss to those carriers which have expended vast sums in perfecting an organization to build up and secure such traffic. The establishment of claims for this loss will call for a high order of operating and traffic experience, as well as a knowledge of the legal phases of the problem.

4. Unification of terminal and other facilities which is now being made and will be extended will call for an adjustment as to the use of the property of one road by another, as obviously it is not within the rights of a tenant to permit another party to use the property of an owner without the latter's consent, nor without proper and aadequate compensation. Many interesting questions will arise, and claims involving careful analysis and supervision to substantiate such claims made thereunder will doubtless be filed for compensation for such use.

5. Determination of proper compensation by the Government for the use of the property will give rise to controversies and claims for damages. Additional rental for property will be sought by the corporate interests to increase such compensation, while the Federal management, on the other hand, will naturally endeavor to offset such claims by every possible charge it can support against the corporate interests. It is therefore important that a proper check be kept by the corporate interests on the operations during the period of Federal control in order that their rights may be fully protected.

6. Finally, at the end of the period of Federal control, it will be incumbent upon the corporate interests to see that the contract obligations are fulfilled—to return the property in substantially as good condition and without impairment of value as a going transportation industry as when such property was taken over by the Federal Government—and to be prepared to require such adjustments to be made as they will be justly entitled to under the terms of the contract and in law and equity.

The importance, therefore, of such an organization to the corporate interests as will enable them to conserve their rights and interests fully cannot be overestimated. As already stated, it will call for engineering and railway operating experience and ability of the highest order, and the engineer possessing such qualifications will be indispensable and in great demand.

Joint Commission Rushes Study of Port of New York

For Present as Well as Post-War Development It Investigates Railways, Steamships, Lightering and Trucking

WAR-TIME activities which make New York the busiest port in the United States if not in the world have not interfered with the work of the New York-New Jersey Port and Harbor Development Commission. On the contrary the newly formed interstate commission is coöperating with the various Federal agencies using New York harbor in the prosecution of the first really comprehensive study of the port, a study which should result in information leading to a scientific development of the port.

The commission, which was formed in the summer of 1917, is now working under an appropriation of $200,-000, half of which was supplied by each of the two contributing states. This is supposed to cover the first year's work, and another year at similar cost is expected to complete the preliminary studies. What those studies are have just been outlined in a report of the

commission, from which the following extracts are taken:

In order that no radical changes should be made in the operation of the port, and in order that no construction should be undertaken by the Federal Government under the pressure of the war which might interfere with the general planning of the port, the commission addressed a communication to the Secretary of War, to the Secretary of the Navy, to the Director General of Railroads, and to the chairman of the United States Shipping Board, requesting that before any construction work was done in the port the plans should be submitted to the commission for an expression of opinion as to whether the plans would interfere with the carrying out of a comprehensive port plan. The authorities in Washington readily agreed to this, and there is now scarcely a week that no project is referred to the commission by the authorities in Washington.

The commission is closely coöperating with the Port and Harbor Facilities Commission of the United States Shipping Board, which is investigating all the ports of the United States, and is also closely in touch with the Fuel Administration to coöperate in the working out of a plan to prevent a recurrence of the scarcity of coal of last winter.

Furthermore, the commission is closely in touch with the Railroad Administration, and through the courtesy of the Eastern regional director has obtained the services of a railroad man to aid in its investigation and planning. The regional director has appointed a committee consisting of the managers of all of the trunk lines entering New York, as a point of contact with the commission, and the fullest coöperation has been extended in getting permission to go upon the property of the railroads and to abstract information from the records of the railroads in the field and the auditors' offices.

What Points Are Being Studied

The engineering investigation resolves itself into three phases: (1) Study of existing conditions; (2) analysis of the handling of commerce under existing conditions, and (3) the planning of new methods and new facilities.

The study of existing conditions covers railroad, steamship, lighterage and trucking facilities. Under these investigations the commission decided to send men into the field to make actual observations of the passing of freight, to record all movements of freight and to work out the cost of each of the individual movements.

At first the commission intended to employ outside engineering organizations to conduct these four investigations. This was principally in order to obtain as nearly as possible a simultaneous picture of the operations in the port. When the analysis of what would be needed to conduct simultaneous investigations was finally made, it was determined that this could not be done, owing to the great number of men needed, and the difficulty of instructing these men. As an example, in order to gather a complete picture of railroad operations simultaneously it would take a force of approximately 1000 men.

The commission, therefore, decided that instead of calling on existing engineering organizations, it would organize a field staff which would be large enough to cover 24 hours at each point to be investigated. A force of 25 men was formed rapidly, detailed instructions were given them and they are now at work taking 24-hour observations of the detailed railroad operations at all of the yards and pier stations. This force, after it has concluded its observations at all of the railroad yards and pier stations, will probably be assigned to one of the other investigations, as, for instance, trucking. The value of having a continuing force is that it is becoming increasingly familiar with the character of the information needed, and a great deal of time is saved over what would be required to instruct four individual organizations.

One of the special values of this railroad study will be in the comparison of the operation of the different railroads and in the aid it will give to the allocation of costs of the different movements. The records of the railroads will give certain costs in detail, but it will be necessary to subdivide these costs further than the books show, and for this purpose the observations in the field will be of great value.

A party has been placed in the field to locate an exterior belt-line railroad in New Jersey. The necessity for such a railroad is widely recognized, and officials in Washington have expressed their opinion that it is a war measure. The commission has set aside a sum of money which it believes will be sufficient to locate such a railroad, and expects to be in position to advise the Federal Government that the line is surveyed and located and ready for construction.

The commission has taken up with the Public Service Commission for the First District of New York the matter of the west side Manhattan railroad tracks, and the engineering departments of the two commissions have come to an agreement on the general physical plans. It is believed that the two commissions themselves will come to an agreement upon not only the physical plans but also upon a method of procedure, and when this is done the matter of the west side tracks and the New York Central surface tracks will be taken up by the commissions and prosecuted vigorously with a view to settling this long controversy.

The commission has a list of some 400 warehouses and storehouses in New York and in New Jersey within the metropolitan district, and is sending out a questionnaire in order to determine what facilities exist, and get full information as to their operation.

Warehousing and Trucking to Be Studied

An investigation has been started into the operation of lighterage, with a view to obtaining all existing information that is available prior to the actual observations of the field force. A further investigation has been undertaken into the markets and food distribution, and the commission is collecting all information available on the subject as to the operation of public and private markets with a view to following this up to obtain the groundwork for a recommendation as to methods and facilities needed to modernize the food distribution of New York.

Trucking conditions will be looked into especially to determine the trucking delays, costs, etc., at this time in order to compare them with operations under the proposed modified form of store-door delivery which is

soon to be put in force at the port. This investigation will not cover an elaborate checking in the field of trucking delays, but will take up certain physical routes and certain typical movements, and will give certain information which will be of value when the commission comes to the actual checking in the field by the field force.

Further studies are being made in regard to the electric power situation at New York. This includes listing of the various power houses throughout the port, and their development and reserve.

Facilities for the interchange of commerce on the New York State Barge Canal are being examined. The terminals in the harbor, with their description, which have been built and which are contemplated will be studied, and general details will be prepared for additional terminals. All of these are within the state of New York and funds for their creation have been supplied by the state. Certain locations are now available in New Jersey, where good interchange of commodities can be had between railroads and the vessels operating on the Barge Canal.

Among other investigations to be taken up are a study of banking and commercial relations in financing New York's commerce, methods of handling express business, the operation of private terminal companies, the handling of fuel and grain, the pollution of the harbor and the mechanical equipment of the port structures.

The engineering office of the commission, at 14 John St., New York City, is under the direction of B. F. Cresson, Jr., consulting engineer.

Bridge at Lyons Named in Honor of President Wilson

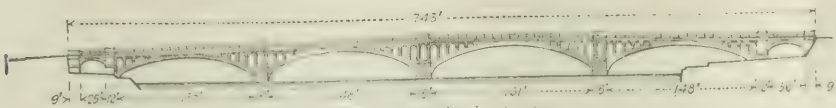
Arch Structure with Twin Masonry Ribs Carrying Reinforced-Concrete Floor Peculiar to French Design

BASTILLE Day this year was celebrated in Lyons, France, by the dedication of a new masonry arch bridge, across the River Rhone, to which has been given the name Pont Wilson in honor of the President of the United States. Aside from this grateful act on the part of the municipality of Lyons, which built the bridge, it should interest American engineers because it is the latest example of a French type of bridge that combines all of the recognized architectural qualities of the stone arch with many of the structural advantages of the reinforced-concrete floor. The bridge is noteworthy, too, because it has been carried to successful construction through the past four years of war.

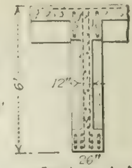
Lyons, like Paris, has many bridges, crossing both the Saone and the Rhone Rivers, which run through the city. The latest bridge occupies the site of an old suspension bridge built in 1839. This bridge was taken down in 1913 and replaced temporarily with an adjoining wooden trestle bridge which carried the street traffic during the past five years. Work was started on the foundation of the new Wilson bridge in October, 1912, and rapid progress was made until the outbreak of the war. Since then construction has been steady but slow. The bridge was opened, as stated, on July 14, of this year.

The Wilson bridge consists of four elliptical arches,

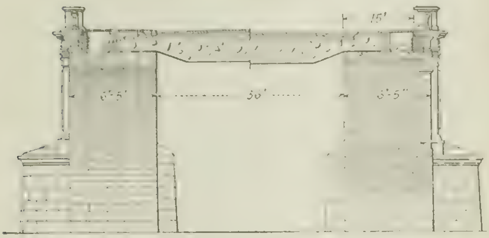
PROCESSION OVER THE WILSON BRIDGE AT LYONS, FRANCE, ON ITS DEDICATION DAY, JULY 14, 1918



Elevation

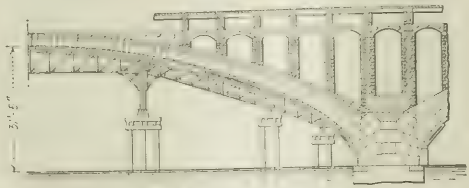


Section A-A Enlarged

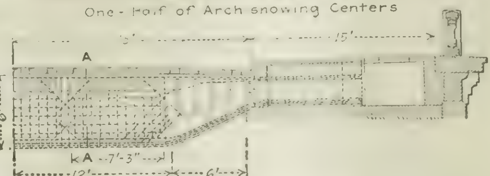


AT CROWN THROUGH SPANDREL ARCH

Cross - Sections



One-Half of Arch showing Centers



One-Half of Floor Beam

NEW BRIDGE AT LYONS, FRANCE, HAS MASONRY TWIN ARCHES WITH CONCRETE FLOOR SYSTEM

138 ft., 148 ft., 161 ft. and 148 ft. in span, with an approach arch at each end, making the total length of the bridge 743 ft. It carries a roadway 36 ft. with railway tracks, and two sidewalks each 15 ft., making a total width of 66 ft. Except for differences in dimension the arches are all similar, each arch being composed of two independent ribs, 16½ ft. wide and 36 ft. apart, resting on independent piers which extend down to a common pier footing. While the piers and the arch ribs are of cut stone, they carry a reinforced-concrete roadway on cut-stone spandrel piers, which are braced longitudinally by continuous concrete jack arches. The concrete fill also extends from the last spandrel pier, about over the haunch, to the crown. These jack arches have cut-stone fascia arches on the outside walls of the arch ribs.

The floor system comprises floor-beams at each spandrel pier spanning the twin ribs and carrying a reinforced-concrete floor. These floor-beams, which rest on the concrete fill near the crown and on the spandrel piers for the remainder of the arch, are deeper between the arches than they are at their supports on the ribs. They are heavily reinforced, as shown in the drawing, and have panels of concrete removed from the shaft of the beam between the stringers of the floor, to save weight. The floor itself is a slab 3½ in. thick spanning between 8 x 18-in. longitudinal stringers framing into the floor-beams over the full-thickness sections—that is, above the shafts in the paneling. The roadway itself is of creosoted block, while the sidewalks are of asphalt. An ornamental railing of cut stone finishes the architectural appearance.

TRAVELING GANTRY USED TO SET STONE ON RHONE BRIDGE

Arches Built on Steel Centers

Except for difficulties in getting labor and material during war times, there were no extraordinary incidents in the construction. The foundations were put in under compressed air in the sand-and-gravel bottom of the Rhone. The formation here had been made quite familiar by previous construction, and no difficulty was experienced in sinking the caissons to the necessary depth of 30 to 40 ft. The arches, which were of different lengths on account of the channel necessity, are built on steel centers supported from six timber pile platforms in the river. Variations in the blocking under the lagging permitted the use of the same forms on all four arches. They were lowered by sand boxes on platforms. Arch ribs were set up in two rows of stone at the crown and three at the springing line, and staggered in plan to guarantee bond. The loadings were spaced along the arch ribs so as to insure the least deflection in the centering. Control of all the stone-setting and concreting operations was had from a gantry crane which traveled on tracks running on each side of each arch rib.

The bridge was built by force account under the direction of M. Chalumeau, chief engineer of the City of Lyons. Its total cost amounts to about 2,150,000 francs, or $430,000. A description of the bridge, from which many of the above figures are taken, appeared in *Le Génie Civil* for July 13, 1918.

Americans Build Sewer and Water Systems for Three Uruguayan Cities

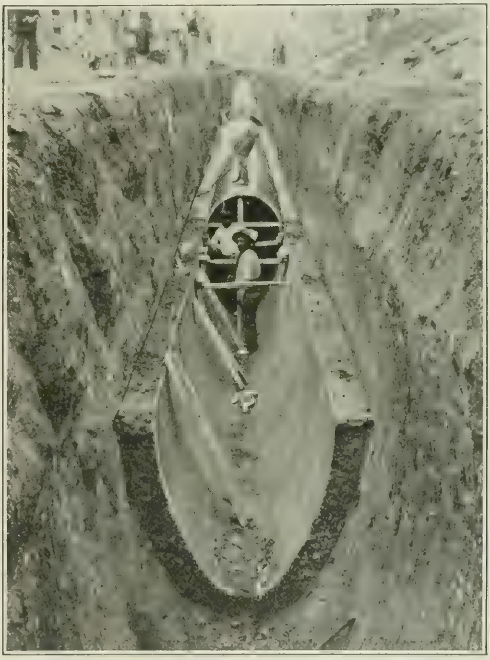
Work Requiring Five Shiploads of Materials 7,000 Miles From the Base of Supplies Completed Year Ahead of Time—Cement Pipe Manufactured on the Ground

BY ALBERT A. NORTHROP
Hog Island, Pa.

IN spite of the handicap of war times and of carrying on the construction operations so far from the base of supplies that it took two months or more to get repair parts by water, the Ulen Contracting Co. of Chicago has just finished three complete water supply and sewerage systems for the government of Uruguay a year ahead of schedule. Except for the cement, which was made in Montevideo, all the construction equipment and materials had to come ten thousand miles by water from Savannah, Ga. Because of the difficulty of shipping clay sewer tile, cement tile was manufactured at a plant set up at each of the three cities in turn. The construction was carried out with local labor, which proved very efficient, under American supervision.

The improvements, which were financed by the progressive National Government of Uruguay, consisted of a filtered water supply and a sewerage system for each of the cities of Salto, Paysandu and Mercedes. Next to Montevideo, these are the three largest cities of the republic, having populations ranging from 16,000 to 25,000. They are located in the same relative latitudes as Charleston or San Diego, and are as far south as Cape Town, South Africa. Salto and Paysandu are on the River Uruguay and Mercedes is on the Rio Negro. Each has an abundant water supply right at its door, but heretofore water has only been available as it was peddled from house to house in two-wheeled carts. Cisterns were also used, but in a region where the rainfall hardly exceeds 32 in. a year, these cannot be relied on as the main source of supply. Wells, used extensively by the poorer classes, helped supply typhoid fever as well as water.

The water system in each town consists of low and high pressure pumps in duplicate with a capacity of 1543 gal. per minute. Rapid sand filters with an equal capacity were designed on the assumption that they would pass 120,000,000 gallons per acre per day. Two steel stand pipes 20 and 30 ft. in diameter respectively and 100 ft. high act as storage and pressure tanks for Salto. A similar set was built for Paysandu, but at Mercedes there was a conveniently located hill of sufficient height to make possible a covered concrete reservoir. A few of the hydrants installed resemble those in the United States, but have in addition a service valve from



LOWER HALF OF EGG-SHAPED CONCRETE SEWERS CAST AGAINST TRENCH SIDES

SECTIONAL ARCH FORMS USED

CAST-IRON PIPE ARRIVES IN MONTEVIDEO AFTER A 10,000 MILE VOYAGE

which water can be drawn for horses. All other hydrants are set flush with the sidewalk and covered with an iron plate, as is usual in Uruguay.

The sewerage systems provide for the removal of storm water as well as sewage. Up to the 22-in. size the pipe was precast. Larger sized sewers were built of concrete poured in place, being circular to a diameter of 40 in. and egg shaped above that size. Sewage is discharged directly into the rivers well below the towns. Disposal plants are not necessary because of the very high dilution and the scarcity of population for many miles down stream.

WORK DIVIDED BETWEEN THREE CHIEF CITIES OUTSIDE OF CAPITOL

Five ship loads of plant and materials were carried from Savannah, Ga., to the River Plata, at the mouth of which Montevideo is located, the average voyage taking about 80 days. One of the schooners drawing 24 ft. of water delivered 2000 tons of cast-iron pipe directly alongside the wharf at Paysandu, 300 miles up the Uruguay River. The other four were unloaded in the $25,000,000 harbor of Montevideo, which is fully equipped with electric cranes, telpherage systems and all modern appliances for the rapid discharge of freight. Railroad lines run directly on the dock front so that little English "wagons" were loaded in one operation from ship to car. The cast-iron pipe piled high in them was held on by means of chains.

Most of the railroads, having been built by British capital, look very English. Locomotives usually burn briquettes of Cardiff coal. This has now advanced to $40 per ton and is scarce at that price, so that the heavy wood called "quebracho," or "break-axe," is extensively used for fuel. It makes an excellent substitute.

Some 13,000 tons of cement were used in the work, all of which was made in Uruguay in an up-to-date plant manufacturing an excellent product. It is sold net without charge for the sacks, but the customer must pay 6 cents apiece for those lost or damaged. The industry is protected and the cement sold a little under the import price. Owing to the extremely high price of coal, cement has risen until it costs from $8 to $10 per barrel. In normal times it cost about $3.50.

Sand and gravel were dredged from the Uruguay River with a maximum haul of 100 miles. Both were of excellent quality, composed almost entirely of agate quartz, brilliant in coloring and of great hardness. In fact, it is from the vicinity of Salto that before the war large quantities of agate were exported to Germany, where a considerable industry was maintained in polishing it for sale.

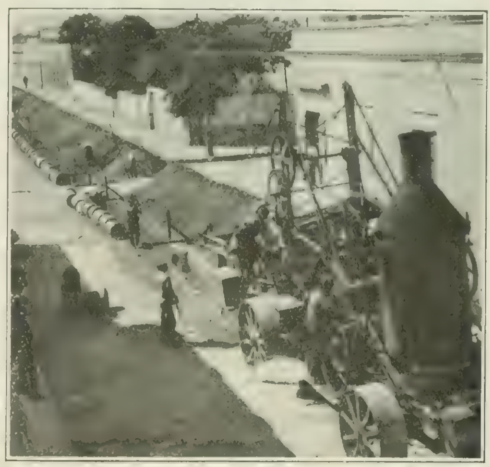
FORMS READY FOR CONCRETE AT SALTO CLEAR WATER RESERVOIR

The manufacture of sewer pipe on the ground proved very satisfactory. Under government test the pipe showed a bursting pressure of 61 lb. per sq.in., and a crushing strength, supported only at top and bottom, of well over 2 tons per sq.in. The pipe was made by a MacCracken machine, which is rotary packer of very quick action. Horizontal blades on a rotating shaft moving at high speed pack the mortar inside the mould, which is a steel form in two halves, set bell down for casting. A cement and sand mixture containing only sufficient water for proper setting is dropped into the top of the form on the blades, which revolve so rapidly that none of it can fall through. The blades travel from bottom to top, and leave an almost glazed finish on the inside of the pipe. On the 6-in. size the average for the day frequently equals a pipe every 40 sec. When 3 shifts were put on, the Uruguayans' sporting blood was aroused and keen rivalry developed. One night a small riot broke out because the graveyard shift, eager to begin, claimed that the others were working overtime to help their record.

After being cast, pipe and mould were picked up by a two-wheeled "sulky," turned end for end and sent out to the covered storage yard, where the forms were removed after a few hours and the pipe left to cure. The cement pipe plant was set up at each of the three cities in turn far enough in advance of the trench excavation to have the pipe completed before the work was ready for laying.

The excavating equipment consisted of two trench machines and a 35-ton revolving shovel with an extra long boom for trench work. The steam shovel, on account of the heavy freight charges on it and the enormous cost of fuel, proved hardly able to compete with hand labor in the trench work. However, this shovel was fitted with a boom and used as a locomotive crane during unloading periods. The trench work was laid off in "tasks" of such length as to include a volume of 5 meters, which was a day's work and the basis of a day's pay. Each laborer took a section, and when he completed it could quit for the day or have another one assigned him. Six and one-half yards per day per man may seem a good high average, but the star member of the excavating forces on one occasion completed three of these tasks in one day, earning thereby the proud title of "Little Marion."

The material excavated above the alluvial lowlands



TRENCHING MACHINE USED IN LAYING LARGE MILEAGE OF SEWER PIPE

near the rivers was either largely gray clay, or "tosca." Rock was encountered, but the other materials predominated. "Tosca" is sometimes translated "rotten rock," but it is often far from rotten. It is as general a term as hardpan, and quite as indefinite. The contractor accurately described it by saying "When you are losing money, it's tosca, and when you are making money, it ain't." It appears to be a sandstone conglomerate held together by a crystalline cementing material. It is in effect a concrete, varying in hardness and composition just as cement concrete does between "initial set and 90 days," depending upon its depth from the surface.

Trench and form lumber was largely Brazilian pine, which, though not so good as northern pine, is comparatively free from knots and answers very well. Quebracho piles from Paraguay were used to support the sewer outlets. This wood cannot be excelled where resistance to decay is required and where unusual weight is not objectionable. It is a dark red wood, 1 1-3 times as heavy as water, and very rich in tannic acid used in tanning leather. The extract is exported in large quantities. As a railroad tie the life of this

CONSIDERABLE YARDAGE IN CONCRETE SEWER OUTFALL AT PAYSANDU

wood is only limited by its capacity to receive spike holes, which must be bored into it because of its hardness. The chief engineer of the Paraguay Railroad tore down a stockade of quebracho built 90 years ago as a protection against hostile Indians and used the posts for a right-of-way fence. They were still in excellent condition. The tree is of slow growth and very crooked, straight piles rarely exceeding 15 ft. in length.

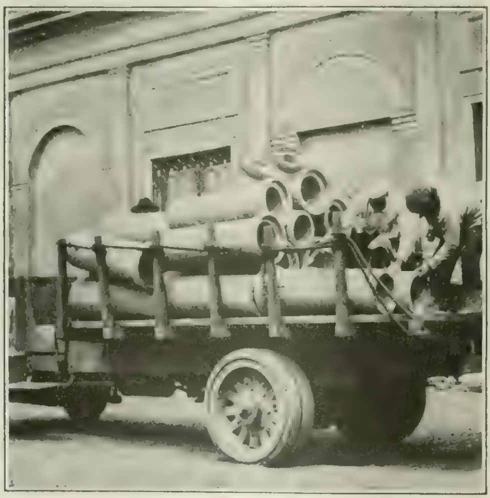
The work was carried forward continuously notwithstanding the ever rising freight rates and the difficulty of securing ocean carriers.

Actual construction work was begun in August, 1916, and finished in December, 1917.

Salto, the city containing the most rock and farthest from headquarters, was started first, the others following just as soon as the cement pipe machine could be moved to them.

A Blystone mixer of the troweling type was used with satisfactory results for the pipe machine. For the monolithic concrete the usual drum type mixer was used, the best results being obtained by frequent shifting of the mixer and chuting direct into the trench.

Quite often hand mixing was resorted to, in which case two mixing boards were used, one being charged while on the other the material was being turned over. It was difficult at first to keep the men



CONCRETE PIPE DISTRIBUTED FROM PIPE PLANT TO TRENCH BY MOTOR TRUCK

from working in the concrete in bare feet. They soon learned the error of their ways, however!

Exceedingly fair treatment was accorded by the Uruguayan government, of which Señor Rivas is Minister of Public Works. Señor Pedro B. Magnou was engineer in charge of the work. The contract was carried out by the Ulen Contracting Co. of Chicago, of which Henry C. Ulen is president. Thomas Shepperd, vice-president and general manager, was in charge of the job on the ground. Earl Ulen was office manager; Edward Trueheart, chief engineer, and Señor Alberto F. Canessa, consulting engineer. The field superintendents for each of the three cities were respectively, Herbert Hengst, Merton Keefe and Thomas Caldwell. Stone & Webster and the American International Corporation were associated with the contractor on the work, being represented by the writer.

Heavy Construction Hauling Practice Modified by War Conditions

Hiring of Private Trucks by the General Contractor Superseded by Subletting to Haulage Contractor Who Maintains Operating and Repair Force—General Contractor Loads Trucks and Maintains Roads

BY GEORGE H. PRIDE
President of the Heavy Haulage Company, New York City

HEAVY construction hauling has been revolutionized during the past year by the many problems resulting from the building of large cantonments and war manufacturing establishments. Thinly as well as densely distributed hauling over the sites of many such contracts has shown that the use of the motor truck can be economical, even when used for short hauls within limited areas. On a typical job, by intelligent management and the use of well-selected and easily transported mechanical appliances for unloading cars and loading trucks, one firm of general contractors saved more than 25% of what it would have cost to haul the material by teams, or industrial roads combined with teams.

The meaning of thinly distributed hauling is amply illustrated by conditions at cantonments, which require large volumes of material to be distributed more or less uniformly, in comparatively small volume, over a very wide area. By densely distributed hauling is meant the delivery in small areas of large volumes of construction material, such as the materials required for very heavy concrete foundations for large structures. In the first instance, the motor truck must compete successfully with the horse, and in the second instance, the motor truck must excel the temporary standard-gage or industrial railroad.

Within the past year there have been several operations where the motor truck has successfully competed with both of these forms of transportation. Thus, abnormal transportation conditions due to the war, combined with the necessity for speed, led to intensive study of haulage problems. New methods of handling and transporting were tried out; changes in the contract system, whereby the haulage was let by sub-contract, were made, and higher efficiency has resulted.

The transportation contract, as described herein, has developed through many stages. At the beginning of war construction last year, it became the custom of general contractors to hire motor trucks at a stated price per day, agreeing to furnish the gasoline and oil, maintain the trucks in repair and return them to the owners at the ends of the contracts in as good condition as when received, barring reasonable depreciation. The general contractors undertook to employ and pay, through their own employment departments, the chauffeurs necessary to run the trucks. Such a rental contract proved unsatisfactory, because it was more attractive to the owner of trucks in poor condition than to those who had trucks in good condition, and high maintenance charges resulted.

In the second phase, some of the general contractors bought their own trucks, but as the greater portion of the large number of vehicles necessary are required for only a short period, the general tractor soon had a heavy investment tied up in motor trucks of questionable salvage value at the end of the contract.

The third phase of the practice developed renting trucks from owners at a stated price per day, the general contractor furnishing the gasoline and oil, and paying the salaries of the chauffeurs, but requiring the owners of the trucks to maintain them in working condition, make all necessary mechanical repairs, furnish tires as required and also to supply the necessary chauffeurs. When a truck was out of service from mechanical defects or absence of the driver, the owner was not compensated for such time as it was idle.

In the fourth phase the general contractor, instead of making individual agreements with numerous truck owners, made an agreement with one truck owner for the entire number of vehicles required. The latter could sublet or own them as he saw fit, but was under obligations to furnish the general contractor with the necessary number of trucks at all times.

Through the fifth and latest form of contract the general contractor bargains with a motor transportation company to supply the necessary motor trucks for the prompt execution of the contract. It requires the transportation company to furnish the necessary shop facilities for repairs—with the exception of the building, which is provided by the general contractor—and to maintain an adequate supply of parts, so that there may be no unnecessary delay in repairing trucks. The transportation company must also maintain, at its own expense, a competent master mechanic, a sufficient force of mechanics to make repairs, an office man to keep records and an operating superintendent. It is required that all trucks be of the same make and all must be owned by the haulage contractor. It is further stipulated that, although the chauffeurs are paid on a scale determined by the general contractor, which scale can be modified as labor conditions require, the transportation company must furnish to the employment department of the general contractor a sufficient number of skilled chauffeurs to man the trucks. If any of the trucks are idle, owing to lack of drivers, the transportation company is not paid for them.

As in the previous forms of contract, the general contractor agrees to furnish the necessary gasoline and oil, and this is taken into consideration in the rental price. The transportation company is compensated at a stated price per truck per day, being allowed straight time for any overtime or Sunday work. Ordinary delays, such as would occur in regular running, are not deducted from the time of the trucks, but should any truck be out of service for mechanical repairs or adjustment for a period in excess of 30 min., the entire time that it is idle is deducted from its day's earnings. All loading, and unloading, where material cannot be dumped, is done by the forces of the general contractor.

Under this form of contract the general contractor knows exactly what his transportation units will cost per day, before the operation is started. His purchasing

department has none of the worry or bother of getting the multitude of small parts necessary to keep the trucks in operation. As the contract stipulates that all the motor trucks shall be of the same make and that they shall all be owned by the transportation company, it is obvious that a higher degree of working efficiency can be maintained.

Under this last form of contract, it is evident that the transportation company supplies a transportation service to the general contractor, rather than merely a number of rented trucks. Having no responsibility for the trucks or their operation, with the exception of routing them to the various points where transportation is required, he can direct all his energy toward promptly loading and unloading them.

A contract of this type has been entered into by the Heavy Haulage Co., of New York, which is furnishing the transportation for one of the large war munitions plants being built for the Government. The magnitude of the operation is indicated by the following items: Material for 150,000 cu.yd. of concrete; 28,000,000 bricks; 72,000,000 ft. of lumber; materials for more than 40 miles of macadamized road; and several thousand tons of machinery. In addition to the above the hauling includes all the household furniture, commissary, electrical, mechanical and sanitary supplies, ice, pipe, etc., required for building the plant and housing for the many employees. The area covered by the operation has railroad sidings so distributed that the average haul is ½ mile.

To handle this traffic 50 five-ton motor trucks, divided between those having hydraulic-hoist dump boxes and those of the platform and rack type, were purchased. All material not fragile, such as stone, sand, brick, and in some cases cement, is dumped. Other freight, such as tile, machinery and electrical apparatus, which are hauled upon platform trucks, is unloaded by hand.

Mechanical apparatus for unloading stone and sand from the cars to the stock piles is used by the general contractor. Self-propelling loaders convey the material from stock piles to the tracks. Heavy pieces are loaded on the trucks by derricks and cranes. Merchandise, and light and fragile pieces, are loaded by hand.

Care was taken to house the organization properly. It consists of a superintendent, an assistant superintendent, a master mechanic with his assistant, mechanics and helpers, and the truck drivers. A comfortable building was provided by the general contractor, giving about 50 ft. of floor space to each man and having modern conveniences and a shower bath for every six men. The men take their meals at the eating houses for the employees on the general contract. Under these conditions, the subcontractor having his own organization, which assures his men of steady employment, is able to hold them, a thing difficult under the old system.

When hauling commenced, the great problem was the condition of the roads. The soil was clay and when dry made an excellent roadway; in wet weather, however, the roads were almost impassable. At a conference between the general and the haulage contractor it was concluded that proper drainage, with some repairing of the bad places, would amply repay all concerned, and a regular system of drainage and maintenance was established by the general contractor, who thereafter kept the roads in condition. The maintenance consisted in keeping the drainage open, filling up chuck holes with gravel, and, in places, building stretches of plank road. After this was done the trucks were operated over the dirt roads with a time efficiency of 90 per cent.

The operation of this fleet has established new records. While it had always been assumed that over ordinary roads for hauls averaging ½ mile teams would be more economical, it was found that the trucks, in conjunction with the mechanical loading apparatus, effected a saving of from 25 to 30 per cent. The speed of the trucks was one of the main factors. In one instance a truck handled 60 loads of material in a 10-hour day, while the average number of loads of stone and sand per truck has been in excess of 30 per day. The number of railway cars unloaded per 10-hour day has been about three hundred. It is estimated that one truck will do as much as four teams, and in one case a truck did as much as 10 teams.

With reasonably good earth roads the motor truck will handle material with maximum efficiency and speed. This, however, can only be done where every mechanical means is used to facilitate the loading and unloading of trucks. The transportation charges, which are such a large item on a job of this character, are greatly reduced, and the system assures the general contractor of prompt delivery and consequent freedom from delays.

Water Terminals Subject of Federal Report

New River and Harbor Act Requires Full Details on Ohio River and on Harbor Projects

IN THE rivers and harbors act just signed by the President, provision is made for the development of river and harbor terminals and transportation communications between water and rail. In the paragraph authorizing the continuance of work on the Ohio River the Secretary of War is requested to investigate and submit to Congress before December, 1918, a report showing the status of water terminals at cities and towns along the river between Pittsburgh and Cairo, whether owned by municipalities or some other public agency, and whether they are satisfactory as to location, construction and equipment. The report is also to furnish the names of cities and towns where an interchange of traffic exists between the water transportation lines and the railroads, a list of all the transportation lines on the Ohio, with a description of equipment, names of cities and towns where no adequate public terminals exist, together with a statement of prospective plans for such terminals, and finally any recommendation for the development of transportation on the river.

As a general clause in the act, the Chief of Engineers is required to indicate in his annual report the character of the terminal facilities existing in every harbor or waterway under maintenance or improvement by the United States. He must also state whether they are considered adequate for existing commerce. He must submit special reports on this subject as soon as possible, including among other things the following:

1. A brief description of such water terminals, including location and the suitability of such terminals to the existing traffic conditions, and whether such termi-

nals are publicly or privately owned, and the terms and conditions under which they may be subjected to public use.

2. Whether such water terminals are connected by a belt or spur line of railroad with all the railroads serving the same territory or municipality, and whether such connecting railroad is owned by the public and the conditions upon which the same may be used, and also whether there is an interchange of traffic between the water carriers and the railroad or railroads as to such traffic which is carried partly by rail and partly by water to its destination, and also whether improved and adequate highways have been constructed connecting such water terminal with the other lines of highways.

3. If no water terminals have been constructed by the municipality or other existing public agency there shall be included in his report an expression of opinion in general terms as to the necessity, number, and appropriate location of such a terminal or terminals.

4. An investigation of the general subject of water terminals, with descriptions and general plans of terminals of appropriate types and construction for the harbors and waterways of the United States suitable for various commercial purposes and adapted to the varying conditions of tides, floods, and other physical characteristics.

Piezometers and Current Meters Used to Test Wells

Flow Records Obtained and Leaky Casings Located as Part of Water Conservation Program at Honolulu

By R. D. Klise
Assistant Engineer, Division of Hydrography, Territory of Hawaii, Honolulu

CONSERVATION of artesian waters throughout Hawaii and particularly within the city of Honolulu is receiving careful attention from the territorial and municipal governments. Besides territorial investigation and legislation the city named is doing practical work to detect and control waste. This work includes tests of well flows and location of defective casings by means of the piezometer and the current meter, followed by repairs of the casings.

As the result of a thorough investigation and report by the water commission of the territory to the governor of Hawaii, the 1917 territorial legislature adopted as law "an act relating to the use of water from artesian wells." Though applicable to the use of water in any part of the territory, this law has particular significance to the use of water from the wells within the city limits of Honolulu, because it is from the artesian basins underlying the city that the water-works department obtains 80% of all water passing through the city mains, and there is no other source of supply to which we may turn when these artesian basins are exhausted.

What the New Law Provides

Briefly stated, the new law provides a more or less general definition of what constitutes waste of artesian water for irrigation purposes, and a specific definition of underground waste. It prohibits the use of artesian water solely for the purpose of driving machinery, obliges people sinking new wells to submit an accurate log of the boring to the Government, and compels all well owners to see that their wells are properly capped and cased. The violation of any of the provisions of this law constitutes a misdemeanor, and for each offense the guilty party may be fined not more than $50.

The act proposed by the commission in its report to the governor also recommended that the owners of private wells should be allowed to use them for garden and irrigation purposes only during the same hours as is prescribed by the water-works department for the people who obtain water for like purposes from the city mains (4 hours per day). The commission took the

CURRENT METERS ARE USED TO LOCATE DEFECTS IN ARTESIAN WELL CASINGS

stand that its report amply proved that in Honolulu all the wells of the various districts are drawing from the same artesian basins, and that these basins are fast being depleted. The artesian head is now 30 ft. above mean sea level, whereas originally it was approximately 42 feet.

143 Artesian Wells in City

There are 143 artesian wells within the city limits of Honolulu. Of this number 125 are owned privately, four belong to the territory and the remaining 14 are owned and operated by the water-works department. These wells vary in size from 4 to 12 in. in diameter. Nearly all wells bored in the past 25 years have been 10

and 12 in. in diameter. The average diameter for all wells bored in Honolulu is approximately 9 inches.

To obtain a continuous record of the artesian head in each basin, a number of wells known to be in good condition are equipped with piezometer tubes so that the height to which the water rises may be quickly and accurately ascertained. The head on wells so equipped is read at least once a month, and on two of these wells daily records are kept by the engineers in charge of the industrial plants operating the wells.

The piezometers consist of short sections of ½-in. galvanized-iron pipe terminating in a sleeve fitted with a plug. A small glass tube that will fit into this sleeve is carried by the observer, who goes from well to well and measures the height of water above an established bench mark conveniently located for that purpose. The wells in Honolulu have been tied in by accurate levels, and it has been found that for all the wells in any particular basin the artesian head is the same. When the head on any particular well shows as much as 2 or 3 ft. below the standard head for that basin the presumption is that the casing has failed, and if possible the well is tested by a current meter.

Current-Meter Test

This test is simply an effort to determine velocity, and if successful will show not only the amount of flow but the approximate locality of the break in the casing. In the case of flowing wells it is first necessary to close all valves and carry the casing up to such an elevation that the water will not overflow. Any type of current meter with suitable telephone connections may then be utilized for the velocity measurement by lowering it into the well and "listening in" on the telephone. The small-size Price current meter makes a very good instrument for use on wells above 8 in. in diameter, and a smaller type of the same instrument could undoubtedly be turned out that could be used inside of casings of 6 in., or even 4 in. diameter. It is necessary, of course, to protect the cups of the meter from the sides of the casing and on the bottom.

On the meter originally equipped for this purpose the writer has used three additional yokes made of No. 6 galvanized-iron wire. These wire yokes are riveted to small collars bent to fit evenly around the upper and lower arms of the regular meter yoke, to which the collars are securely fixed by means of small bolts. The meter is raised and lowered with a plunger rod made of ⅜-in. galvanized-iron pipe in 10-ft. sections. The sections are joined together as the meter is lowered into the well. Three men and the observer can readily handle 400 ft. of this pipe, and by using tee connections which permit the insertion of a short nipple for the purpose of hanging the pipe over the top of the casing while adding an additional section, as much as 500 or 600 ft. can be handled without any great difficulty. A rigid plunger rod enables the observer to make slight changes in the position of his meter, prevents surging of the instrument at high velocities and gives reasonable assurance that the instrument can be safely recovered.

Telephone connection with the meter is obtained through a double line of No. 18 insulated copper wire having a length of 1000 ft. and carefully reeled on a 14-in. spool conveniently mounted for operating. To insure good contact the cable is first firmly secured to the section of the plunger rod connecting directly to the meter. The ends of the two wires are then soldered to the binding posts and well taped. The other ends of the cable connect with a small plug embedded in the side of the spool. The observer makes and breaks his connection through this plug. As the meter is lowered into the well the cable is temporarily secured to the plunger rod at intervals of 20 or 30 ft. in order to avoid the chance of snagging the cable.

Results of Tests

All tests made to date on wells whose head indicated a defective casing have been successful, the most startling record being on a 10-in. well, where a velocity of 5.6 ft. per sec. was recorded at a depth of 200 feet.

In some instances old defective wells have been covered up and it is not now an easy matter to find them, owing to the erection of buildings and improvements. To guard against this in the future maps and photographs have been prepared showing the location of all existing wells.

While the provisions of the existing law relative to waste are excellent and can be made effective on most wells, the law as it stands cannot be a guarantee against the still further depletion of the artesian basins. To make such a guarantee possible the city government must have complete control over all wells and be able to prevent additional borings.

Honolulu cannot escape the fact that 80% of her entire domestic supply comes from artesian wells, and that while her population is steadily increasing (at present approximately 70,000) her water-supply is diminishing.

Resurfacing Reduced by Patrol System on Boulevards

Crews Work Continuously in Kansas City, Making All Repairs with Stone and Hot Asphalt—Dust Laid by Power Sprayer

By Ralph R. Benedict

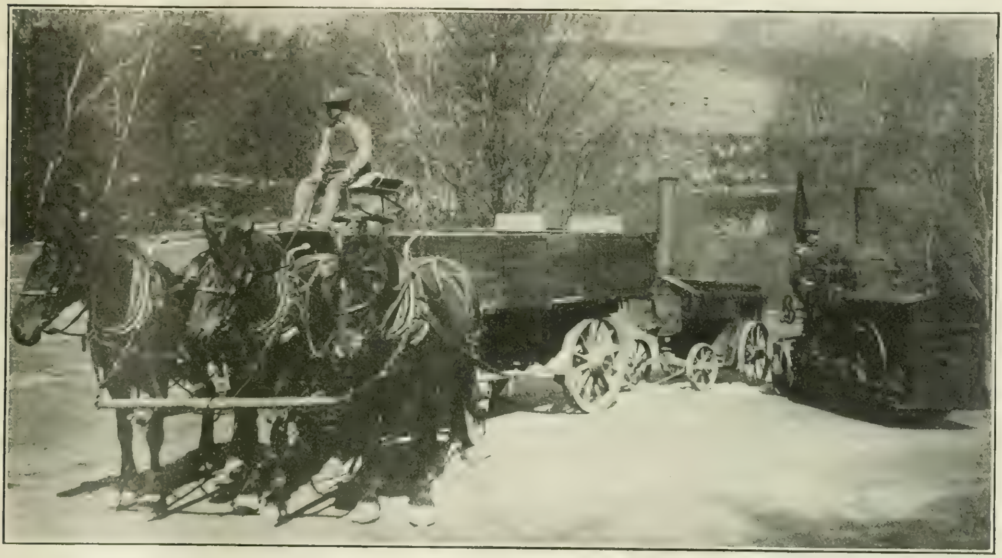
Assistant Superintendent, Board of Park Commissioners, Kansas City, Mo.

The use of the patrol system for making repairs on boulevards has practically eliminated resurfacing charges in Kansas City, Mo. The crews work continuously and repair small holes as soon as they are formed, and thus prevent excessive raveling. Stone and hot asphalt

FOUR-MAN PATROL CREWS KEEP KANSAS CITY BOULEVARDS IN GOOD CONDITION

are the materials used, and this system of maintenance, coupled with an oil treatment to keep down the dust, has been very satisfactory. The oil is applied by means of a special power spraying device built by the park board.

The park and boulevard system was initiated in 1895 and the first paving was finished in 1897. The early pavements were so well built that they have never been resurfaced. They are mainly of a soft native limestone, built in two courses with a total thickness of 12 in. Water-bound macadam was used at first and bituminous macadam in later years. All thoroughfares under control of the park board are kept in good condition by repair crews, each consisting of four men with a three-horse supply wagon, a 3-ton tandem roller and a small portable melting kettle.



OUTFIT FOR BOULEVARD CREW CONSISTS OF SUPPLY WAGON, HEATING KETTLE AND ROLLER

The wagon box of the supply wagon is mounted on a low-wheel running gear and is divided into three compartments, which hold one ton of stone, 2¼ tons of grit and three barrels or drums of asphaltic cement. The melting kettle, with 150 gal. of hot asphaltic cement, is mounted on four wheels and trails behind the supply wagon. These crews and outfits make the rounds of the boulevards and park roads, repairing every break in the road surface, however small, and filling low places.

No preliminary work of picking or spiking is necessary. The repairing is done by simply brooming all loose material or moisture from the depressions or breaks and adding either 1-in. rock or small grit, depending on the size of the break. Hot asphaltic cement is poured over this in the proportion of about 1½ gal. per square yard, and then grit is spread over it and rolled. This method is used on water-bound and bituminous macadam and also on sheet asphalt.

Cuts in the roadways, made by the public service corporation and the plumbers, are patched by the repair crews, all excavations in the boulevards being controlled by permits issued through the board of park commissioners. When these excavations are ready for backfilling, the office must be notified at least four hours in advance, in order that an inspector may be present to see that the work is properly done. The filling is tamped back dry and in such small layers that settlement is prevented. This care of the backfilling is considered a very important detail in the proper maintenance of boulevard surfaces.

Road oil is applied early in June to all boulevards which have been repaired or which show signs of wear. This not only improves the appearance of the pavement but removes all trace of dust and waterproofs the surface. A residuum oil of 19° Baumé, from the mid-continent oil field, is used for this purpose. It has no cementing value and is used strictly as a dust layer.

The oil is applied by a power sprayer built by the park department and consisting of a 60-gal. steel tank mounted on the running gear of a former water sprinkler. The tank carries a small rotary pump, a compression regulating valve and a pressure gage. The pump is on the back of the tank, and is geared to a rear wheel by means of sprocket chains. It receives the oil as it flows from the tank and produces the necessary pressure at the three spray nozzles. Each nozzle consists of a very small slotted orifice in a plug screwed into an elbow attached to the discharge or distributor pipes. The pressure can be regulated by means of the valve operated by a man riding at the rear of the tank. It can be varied from zero to 30 lb., the former allowing the oil to flood the road, while the latter makes a fine mist and barely covers the surface. The operator can observe the condition of the pavement and apply as much or as little oil as is needed. As a safety precaution, half of a roadway is oiled at a time, and limestone screenings are cast over the fresh oil in such

quantities as to absorb any excess oil remaining on the surface.

Before the introduction of the patrol system of maintenance the condition of the surfaces of some of the boulevards was such that a certain number had to be resurfaced each year. Although traffic has doubled during the three years in which the system has been in force, not a yard of resurfacing has been necessary, and the cost of maintenance has been nominal. Last year 65 miles of boulevard was repaired at a cost of 1.2c. per square yard and oiled for 0.5c. per square yard, making a total cost of 1.7c. per square yard.

Under the provisions of the city charter Kansas City is divided into eight park districts, all under the board of park commissioners. Money for the maintenance of boulevards, park driveways, etc., under control of the board is raised by a levy on the land values of real estate in each district. George E. Kessler is landscape architect; W. H. Dunn is superintendent and the writer is assistant superintendent.

Flood Damage Is Checked by Storage Reservoirs

Irrigation Works Prevent Peak Discharge of Flood in Washington—Prompt Action Saves Canal and Lands

STORAGE reservoirs on the Yakima River, Washington, equalized the flow during the severe floods of last winter and thus reduced the damage. This is shown in the June number of the *Reclamation Record* by R. K. Tiffany, project manager of the Sunnyside and Tieton irrigation units of the United States Reclamation Service. Flood conditions occur in spring and fall, with maximum records of 30,000 and 60,000 sec.-feet respectively. Storage reservoirs for irrigation supply are planned, having an aggregate capacity of over 1,000,000 acre-feet, and those already completed have a capacity of 421,000 acre-feet, as shown by the accompanying table. Of these, Lake Clealum has a temporary crib dam while the others have permanent earth dams. The following is an abstract of Mr. Tiffany's paper:

The fall flood of 1917 came later than usual, beginning Dec. 14, after several days of heavy rain and warm weather following a fall of wet snow. A flood stage of 38,500 sec.-ft. was reached at the Sunnyside diversion dam on Dec. 19. Some protective work was done along the canal bank immediately below the dam, as the flood was beginning to cut the bank. Cooler weather checked the discharge for several days, but the river again began to rise on Dec. 27, and reports from the headwaters indicated that a flood considerably higher than the previous one must be expected.

Danger to the project works was threatened for only about ¼ mile below the Sunnyside intake, where it was feared that the flood might overtop the bank and follow down the canal, causing breaks which would damage the canal, farm lands, railroad lands and the little towns of Donald and Buena. It was decided that everything possible must be done to prevent this.

Calls were sent out from the Sunnyside office over all telephone lines at about 4 a.m., Dec. 30. The fire bell was rung in Sunnyside, and when the citizens turned out they were rushed to the headworks in automobiles. By 5 a.m. men and teams began to arrive, and by 9 o'clock about 200 men and 20 teams were on the job. With this force, during the next 12 hours, some 7000 sacks were filled with gravel and placed for protection of the river side of the canal bank and for raising the bank 12 to 18 in. for about ¼ mile. The teams were used to throw a dam across the canal below this protective work, so that if the water overtopped the bank it would be prevented from following down the canal.

Telephone reports were received from gages on the upper river. During the night of Dec. 30, some 30 or 40 men guarded this stretch of canal bank, filling new sacks to strengthen weak places or to replace those that were undermined and washed into the river. Waves were constantly splashing over the top of the sack dam and softening the canal bank, which was already weakened by the taking of material for filling the sacks. By noon the flood began to subside and the danger was past.

More than 100 automobiles brought farmers and business men, as well as all Government employees, from distances of 12 to 50 miles. It was necessary to establish a commissary service by means of trucks running from Sunnyside, 30 miles distant, the nearest source of supply. Before this was running smoothly, the local Red Cross auxiliary furnished an emergency luncheon to the first contingent of about 50 men.

Records show that water was stored during the peak of the flood at the different reservoirs in the amounts indicated in the table. The discharge compares with

INFLUENCE OF STORAGE RESERVOIRS ON FLOOD RUN-OFF IN THE YAKIMA RIVER

Reservoirs	Storage Capacity Acre-Feet	Max. Run-Off Stored During Flood Peaks: 1st Flood Dec. 15 to 20 Sec.-Feet	Max. Run-Off Stored During Flood Peaks: 2nd Flood Dec. 28 to Jan. 1 Sec.-Feet
Kachess	25,000	7,400	5,520
Keechelus	210,000	7,020	5,580
Clealum	152,000	15,000	7,700
Bumping	341,000	6,900	
Total	421,000	36,320	18,800
Flood discharge at Union Gap		38,500	50,000
Maximum flood (without storage)		74,820	68,800

the previous maximum flood discharge at Union Gap of 63,300 sec.-ft. in November, 1906. In that flood only two wagon bridges remained in place across the Yakima River between Ellensburg and its mouth, a distance of 150 miles.

Without the regulation provided by the Government storage reservoirs, the floods of December, 1917, would have exceeded the great flood of 1906 by nearly 25 per cent. Storage reduced the 1917 flood stage by at least 4 ft. at Clealum and 2 ft. at Yakima and in the lower valley, where an additional 2 ft. would have flooded the country for a distance of ½ mile to 2 miles back from the river.

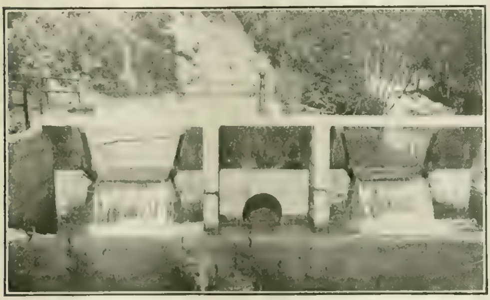
Upon the completion of the Tieton reservoir, with a capacity of 180,000 acre-feet and the Clealum reservoir, 501,000 acre-feet, the fall floods will be reduced by storage to a maximum of about 30,000 acre-feet, or about the equivalent of the maximum spring floods. This amount of water can be carried practically within the river banks with little damage to adjacent property.

Protect Water-Supply Creek from Pollution and Ice

Hydro-Chronographs in Concrete Houses Measure Portions Diverted to Different High Level Districts

WATER supplied to high level districts of Salt Lake City is delivered by gravity through several cast-iron pipe lines leading out of pools in City Creek made by low Cippoletti weired dams. The stream is small and has a steep grade, and originally the flow was much hindered by rocks, débris and willows, which facilitated the formation of slush and anchor ice in winter. Removal of the obstructions has been carried on consistently for the past three years, about $2500 being expended each year on the 15-mile section covered.

To safeguard the purity of the water, derived mostly from springs, the flow of which is regulated by the Pleasant Valley 5,000,000-gal. reservoir, two men on foot and one mounted man patrol the creek for 15 miles upstream from the city. A city ordinance gives the department this authority. Picnic parties and incidental travel into the valley are induced by a well-kept drive maintained by the park department. No one is allowed, however, to camp over night in the cañon. Outhouses with pails, cared for by the patrols, are maintained at intervals of not more than one mile. Not the least of the duties of the patrolmen is a strict lookout for forest fires and recruiting of a force to fight them.



THESE DOUBLE WEIRS ASSIST IN KEEPING HEAD HIGH OVER INTAKE

At six of the seven Cippoletti weirs there are hydro-chronograph continuous recorders in concrete booths erected alongside the pools. For such small amounts the water is measured many times, for there is a constant influx from the side hills and it is desirable to know quite closely the amount to feed in from the Pleasant Valley reservoir so that none will be wasted below the lowest intake.

WHEN SLOPES ABOVE PLEASANT VALLEY GET DRY FIRE RISK IS IMMINENT

Entrances into the heads of the pipe lines are screened, usually by small rectangular frames with ⅛-in. screens set at an angle of 45 deg. with the inlet so as to bypass as much of the débris as possible. Below each inlet there is usually a second pool or a surge chamber maintaining a constant head on the pipe line and overflow back into the creek. Weirs above and below this inlet give by difference the amount of water let into the conduit. A weir and chronograph outfit consisting of two weirs and two hydro-recorders cost at the time $275 each. By the use of these weirs the gain or loss in the various sections of the stream between the several intakes can be accurately measured at all seasons.

WIDE WEIR AND HYDRO RECORDER IN CONCRETE HOUSE MEASURE FLOW IN RIPRAPPED CREEK

Ice fighting each winter costs about $2500. It consists of removing ice jams and débris obstructions brought down during high water. Both frazil ice and drifting fine snow make a mush which easily solidifies once the velocity is reduced in the service pipes. This condition usually obtains for five or six weeks. Cobbles cleared from the bed are used to riprap the sides of the stream.

The maintenance of the water department, formerly under the charge of Charles F. Barrett, superintendent, has recently been delegated as an economy measure to the city engineer, Sylvester Q. Cannon.

Receipts From National Forests Increase

National forests brought in $3,574,000 revenue during the year ended June 30, which was about $120,000 more than in the previous year. The cost of operation was $4,000,000, not including expenditures, for which Congress provided $700,000, to meet serious fires. Water-power permits brought in slightly less than $100,000, a falling off compared with the previous year attributed to uncertainties as to pending legislation. Timber sales totaled more than $1,500,000 and grazing permits more than $1,700,000. Turpentine privileges in the Florida forest produced a little more than $8000.

Factories Should Be Diffused Through Small Towns

Railroads, by Equalizing Rates, Must Play Large Part in Reconstruction and Readjustment Plan After the War

By C. C. McChord

Member of Interstate Commerce Commission, and of Railroad Wage Commission Washington

THOUGHTFUL men are looking forward to a reorganization of industrial, social and economic conditions in this country and throughout the world when a treaty of peace has been signed that shall bring the war to an end. Vast armies and navies are then to be demobilized and the soldiers and sailors of which they are comprised returned as quickly as possible to peaceful pursuits. The reabsorption into productive industries of four million men or more drilled in the arts of war must in some way be accomplished. At the same time millions of employees in great munition plants and other industries, engaged chiefly in producing the necessities of war, will have to be diverted to the production of the things needed in times of peace. The problem is how this may be done in a way that shall be reasonably satisfactory to the workers of the country, and at the same time shall not lead to an interim of stagnation of production and business. The transition must not be left to chance. Comprehensive plans of reconstruction should be formulated at once.

Workmen who have had opportunity to enjoy life as the result of adequate pay are not going to consent, if they can avoid it, to any reduction in their wage scale unless there are compensating benefits. It is equally certain that the era of extremely high prices for the necessities of life will not continue during times of peace. The great class of nonproducers represented by clerks in offices and stores, salaried men in every calling, employees of public utilities and the like, cannot long continue to pay ever-increasing living costs unless they too receive further material increases in rates of pay.

Wider Diffusion of Factories

What is needed in this country is a wider diffusion of manufacturing industries and the local supply of the necessaries of life. There are many considerations that dictate a relocation of our manufacturing industries. It costs more to do business in a city than in the country. Land values and costs of construction of plants, taxes, etc., constitute charges that must be met from earnings. It also costs more to live in a city than in the country. A lower wage payment in the country than in the city would enable the workman to secure more comforts of life, to clothe his family better, and educate them more adequately. If the factory is located near the raw product there is saving in transportation costs which will be reflected in net earnings.

If wage scales are to be readjusted downward to meet conditions in times of peace, the wider diffusion of factories presents an alluring way out. What the workman desires, and what he has the right to demand, is opportunity to live in comfort. Reduction in the rate of his daily wage means, as he now sees it, lessened opportunity to secure to himself and his family those necessities which go to make comfort in daily life. In almost any country town of 1500 or more population in the Middle West or the South there is opportunity to live better and enjoy more of the real comforts of life, at materially lower wages than would secure even an approach to the same state of livelihood in any congested manufacturing center. In the country there are pure air and sunlight. The surroundings are clean, sanitary and moral. In such an atmosphere a workman can easily rear a family of sturdy boys and girls, and live a life of peace and happiness impossible for him to live in the crowded and unwholesome conditions of congested centers. In the country he is afforded opportunity to buy products of the soil first hand for his table at reasonable prices, and the admirable schools and religious institutions now in existence everywhere insure to his children every chance to lay the foundation of good citizenship.

To Make the Small-Town Factory Pay

There is hardly a town of 1000 population or more in the Middle West that from 1875 to 1895 did not endeavor to obtain, and succeed in obtaining, manufacturing industries. Many of these factories proved to be failures. Not all were properly located, but most of them should have survived, and would have done so but for influences that made success impossible. Among the chief of these was the fact that the railroads favored certain manufacturing centers in the way of facilities and rates. Preferment to long hauls in large lots, the granting of rebates to large shippers, the levying of excessive rates against certain localities to make up for the meagerness of returns where keener competition forced the rates down, the killing off by the railroads of inland water traffic—all these conditions rendered it impossible for the factory in the small town to compete with that in the larger and more favored city. Hence it came about that the large part of our manufacturing is done in the cities.

The railroads, therefore, must play an important part in the readjustment that must be made in our industrial and economic conditions. Thoughtful study should be given to the equalization of rates for freight transportation. Transportation by boat on our rivers and coast lines should be encouraged to relieve rail carriers at congested cities and ports. Rates should be made and facilities provided so that each port of the United States shall receive its share of traffic under the most economical transportation conditions. The opportunity to do a manufacturing business at a profit should be afforded at any point in the country.

Maintains High-Speed Ship Riveting for Five Days

Two riveting gangs at the shipyard of the Groton Iron Works, Groton, Conn., recently made five-day averages of 1202 and 1138 rivets per day, according to the *Emergency Fleet News* of July 25. The work was of difficult character, being on oil-tight outer bottom work, ⅞-in. pan-head countersunk-point rivets. Each gang consisted of riveter, holder-on, passer and heater. Working nine hours per day, one gang made daily records varying from 1185 to 1241 rivets, while the other drove from 1058 to 1181 rivets per day. Not one of the rivets was cut out.

Ton-Mile Charge to Maintain Highways Suggested

As They Are Public Utilities, Funds for Their Up-Keep Might Be Raised as They Are for Other Public Utilities

BY J. STROTHER MILLER, JR.
Barber Asphalt Paving Co., Maurer, N. J.

TON-MILE rates are used extensively as a basis of revenue by public service corporations, and there is no reason why the public highways cannot be maintained by the same system. The public highway is as much a public utility as the railroad. The railroad is built by private capital for private gain, and those who utilize its service pay in proportion to the amount they use. The highway is built by the state for public use, and by the same logic each individual should pay in proportion to his use of it.

Before the advent of motor vehicles, county highway traffic consisted mostly of local teams moving within a very restricted area; those passing through on long journeys were few and far between. Later came the motor vehicle, at first a novelty, used only as a pleasure car, but with a more extended radius of travel. Then the motor truck appeared, at first confined to a rather restricted district. Now, under the stress of war, we see regular highway freight services established between large cities a great distance apart, such as that between Akron, Ohio, and Boston.

Naturally, while the highway was a matter solely concerning the local community, local taxpayers felt an obligation and interest therein, and willingly paid their road tax. When it became an intercounty necessity, the state assisted financially. And now the evolution has continued until, on certain highways, whether interstate or not, we see Federal aid extended.

In the early stages private corporations operating toll roads endeavored to improve the situation, and those using the better highways most had to pay proportionately. As the radius of travel became longer, the toll roads were largely eliminated by public demand for free routes. All states now require a fee from every owner of a motor vehicle. Some states have a graduated fee based upon horsepower or capacity. These fees are generally used to cover the cost of maintaining the licensing department, the major portion of the balance being assigned to the highway department for maintenance and repair. Such a method of graduated fees, with possibly a limitation as to the size of trucks, is a step in the right direction, but does not take into account a most important variable in the problem.

One owner uses a passenger car for combined business and pleasure. His car is of average weight, pneumatic tired, and his average trip is to and from business, with an occasional pleasure trip of greater length. Another owner uses a delivery truck with hard tires for local deliveries, running loaded only in one direction. Still another truck passes over the same road twice a day, heavily loaded in both directions. Which car should pay the most toward the maintenance of that road?

As stated above, a railroad is a public utility owned and operated by a private corporation under state and Federal regulation. If an individual wishes to use the right-of-way of a railroad, he does not pay an annual fee dependent upon the supposed loaded capacity of his private car, but, rather, he pays a mileage rate, which rate no doubt includes the cost of power, a proportionate share of the cost of maintenance, amortization, labor, and in addition thereto a profit to the corporation. Nor do the residents or property owners along that right-of-way pay a railroad tax.

A highway is also a public utility. Why should not users thereof pay a mileage rate? Here the state is the owner; residents or property owners along the right-of-way receive certain benefits even though they do not own vehicles, and these benefits are justly assessed as a road tax; but the vehicle owner, using that road constantly, should pay a proportionately larger share than one using it intermittently. This mileage charge, a ton-mile rate if desired, should be the chief means of paying maintenance costs. Weight of vehicles per inch width of tire should be a factor in the rate, and single loads in excess of a certain quantity could either be prohibited or charged a mileage rate so excessive as to eliminate them.

The law enacted by the legislature of Maryland which took effect July 1, 1916, is in the direction suggested, but covers a definite daily service between fixed points over fixed routes. If this could be extended to cover all users of the highway on a graduated mileage charge, it would, in my opinion, tend to solve the difficult problem with which we are now struggling.

Some may object to this proposal as a reversion to conditions existing when we had toll roads. This is not the case. If state motor vehicle fees are not maintaining roads as they should be maintained, then these fees should be increased. This has been done in many states. A system of general state fees, while differentiating between various motor vehicles, makes no distinction between the constant and intermittent user. This is certainly more unjust than a graduated ton-mile rate, and if we are satisfied with graduated state fees, we should not object to a modification thereof whereby the cost of maintenance is more equitably distributed among the users of the highways.

Davenport's Garbage Is Utilized

UNDER a 10-year contract, awarded June 7, for the collection, removal and disposal of garbage and dead animals, the City of Davenport, Iowa, is to pay $12,500 annually until January, 1920, after which the payment is to be 20c. per capita on the basis of the 1920 census. An annual license fee of $50 per wagon is to be paid by the contracting company, which also is required to give a bond of $10,000, to be renewed annually. Provision is made for cancellation of the contract by the city after two years if the service should be unsatisfactory. The contract was awarded to the Tri-City Disposal Co., organized by J. H. Kelly, of Davenport.

Garbage is being fed to hogs, but the contract does not specify the method of disposal. It does provide, however, that after three years the city has the right to require the construction of a reduction plant. It also authorizes the city to purchase this plant at 75% of the appraised valuation after it has been in opera-

tion for five years. The contractor has purchased the city's wagons, horses and other equipment used in this service. The contract time is to date from June 1.

Collections are to be made daily from hospitals, restaurants, hotels, fish stores, etc. Elsewhere they will be made twice a week during the May-October period and once a week during the November-April period. Two watertight cans must be used by householders, one for garbage and the other for general refuse. The work is to be done under the direction of the Board of Health. Thomas P. Kennedy is health officer.

Collection of garbage has been made hitherto by the city, and the material deposited as filling for made ground behind the new river-front wall. Layers of garbage were covered with clean sand, as described in *Engineering News-Record* of June 7, 1917, p. 482. During the negotiations for the present contract it was proposed that the company should furnish sand sufficient to make up for the loss of garbage as fill. Instead of this, the company reduced its bid \$600, as the estimated cost of 1600 cu.yd. of sand, equivalent to 8000 cu.yd. of garbage. The annual quantity of the city's garbage is about 8500 tons.

Opposition to the contract was made on the ground that the matter had not received sufficient investigation and that other cities received pay for their garbage instead of paying for its removal. The contract seems to have been handled entirely between the city council and the company, without consulting an engineer. The contract was first awarded in April, but at the election a short time afterward an entirely new city council was elected. The matter was taken up by the new council and the contract was awarded again after certain changes had been made.

The company has similar contracts with the neighboring City of Moline, Ill., and the United States Arsenal at Rock Island, Ill., while it is negotiating also with the city of Rock Island, Ill. These cities are close together. The Moline contract dates from July 1. About 2000 hogs are now being fed, but the number will be increased to 3000, as corn and tankage are fed in addition to garbage. Hog ranches are just outside the city limits, or about three miles from the centers of the cities.

New Zealand Engineer on Hydraulics

Short papers on hydraulics have been reprinted for private circulation by E. Parry, Public Works Department, Wellington, New Zealand. The first one, which is only some two pages in length, is on "Surface Friction of Fluids" (from the *New Zealand Journal of Science and Technology*, May, 1918). It calls attention to a "theory of fluid friction applicable to turbulent flow and sufficient for the purpose of a working hypothesis" published as long ago as 1883 by Reynolds in the "Philosophical Transactions of the Royal Society," Vol. 176, p. 935. The second paper, on "The Resistance to the Flow of Water Through Pipes" (from "Transactions" of the New Zealand Institute, Vol. 50, pp. 45-55, 1917) is a continuation of a discussion of the same general subject by Mr. Parry published in the same periodical (Vol. 48, pp. 481-89, 1916). Mr. Parry calls attention to an important correlation, basedon Reynolds' experiments, between fluid friction.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Use of Average and Medium in Rainfall Statistics

Sir—Harry M. Roeser, in a letter to *Engineering News-Record* of May 9, p. 925, objects to the use of the median in rainfall statistics. It should be first noted that the writer, in his letter published Mar. 28, p. 628, did not advocate the median "rather than" but "as well as the arithemetic mean. It should also be noted from the trend of the original letter that "prediction" was confined to the determination of a most probable average annual rainfall, or precipitation, as perhaps it should more properly be called.

In spite of Mr. Roeser's objection, the fact remains that eminent statisticians differ in their opinion as to the best method of averaging various statistics, rainfall along with the rest.

The desirable properties for an average to possess are as follows ("An Introduction to the Theory of Statistics," by G. Udny Yule, 1912):

"(1) An average should be rigidly defined, and not left to the estimation of the observer; (2) it should be based upon all the observations made; (3) it should possess some simple and obvious properties to render its general nature readily comprehensible, and should not be of too abstract a mathematical character; (4) it should be possible to calculate it with reasonable ease and rapidity; (5) an average should be as little affected as may be possible by what is termed 'fluctuations of sampling'; (6) the measure chosen shall lend itself readily to algebraic treatment.

"There are three forms of average in common use: (1) the *arithmetic mean;* (2) the *median*, and (3) the *mode*, the first named being by far the most widely used in general statistical work. To these may be added (4) the *geometric mean* and (5) the *harmonic mean*, more rarely used, but of service in special cases."

The *arithmetic mean* of a series of values is the quotient of the sum of the values by their number. The word *average* or *mean* is very generally used to denote this particular form of average.

The *median* may be defined as the middlemost or central value of the variable when the values are ranged in order of magnitude; or as the value such that greater and smaller values occur with equal frequency; or as that value than which there are as many occurrences greater as there are less than it.

The *mode* is the value of the variable corresponding to the maximum of the ideal frequency-curve which gives the closest possible fit to the actual distribution. Another way of defining the mode is as the position of greatest density or that variable which occurs the greatest number of times.

The *geometric mean* of a series of values is defined as the product of the value to the $1/n$th power, or the log of the geometric means of the series of values is the

arithmetic mean of their logarithms, $\log G = 1/N\Sigma(\log X)$ It is always less than their arithmetic mean.

The *harmonic mean* of a series of quantities is the reciprocal of the arithmetic mean of their reciprocals, or $1/H = 1/N\Sigma(1/X)$.

For broad-scale predictions, the use of probability paper has been advocated (originally by Allen Hazen. see *Transactions* of Amer. Soc. C. E., Vol. 77, p. 1539 (1915); *Eng. News*, of Jan. 6, 1916, p. 4; and *Journal of Electricity*, Vol. 38, p. 338).

Gauss' law of distribution, referred to by Mr. Roeser, is an old law, used as the basis for the theory of least squares, and is the basic law in the study of probability of error as well as of distribution. The question of probability of error in the records is a very different one from that of the probable cyclic variation of rainfall. If rainfall occurred in uniform cycles, the third or the fifth method of averaging as mentioned above, and not the first, would be the logical one to apply. Nevertheless, the two types of variation must be considered together in rainfall statistics.

Unfortunately, the distribution of rainfall, while undoubtedly following fixed laws of nature, is affected by so many secondary contributory causes and laws that it follows no uniform curve of variation. The causes for the variation in rainfall are so complex and numerous that to date the human mind has been unable to grasp them in their entirety and reduce them to mathematical formulas.

Prof. L. H. Moore, in "Economic Cycles, Their Law and Cause," has referred to Brückner's cycle, which has been studied in a report available to the writer but not as yet published (soon to be presented in Stone & Webster's *Public Service Journal*).

In studying rainfall statistics we must consider the *use* to which the results are to be put. Do we wish to arrive at a rigid mathematical average or a most probable average? In some kinds of hydraulic investigations, the former is preferable and in others the latter. In this connection, note the desirable properties of an average, quoted above.

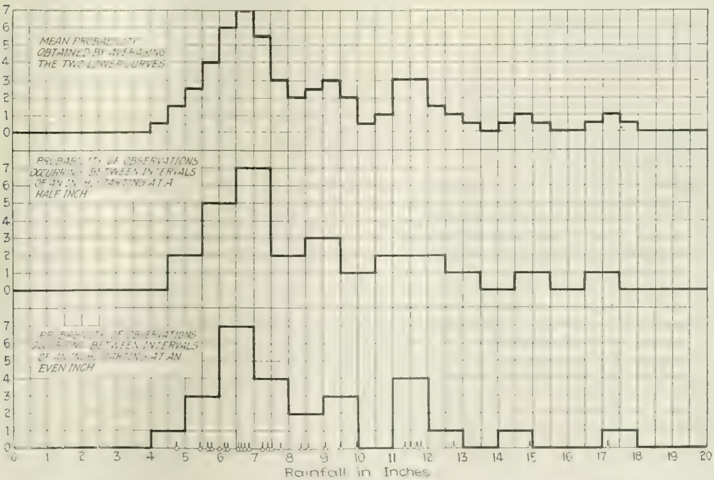
In view of the many uncertainties involved in the study of rainfall and the making of broad predictions therefrom, the question is, what method of averaging can be used to the best advantage. The writer's conclusion, not necessarily a settled one, is that both the *arithmetic mean* and the *median* are useful, the latter especially so when studied by the use of probability paper.

This question was raised with a definite object in view. The subject has been presented, among other questions, for discussion by the Boston Society of Civil Engineers' committee on New England run-off. As a member of this committee, the writer thought that if a few good discussions of the question could be brought out through the columns of your periodical, which reaches such an extensive number of engineers, a direct benefit would accrue to this committee. He is, therefore, grateful for Mr. Roeser's valued discussion, and hopes others may add to it.

Boston. DANA M. WOOD.

Sir—Referring to the discussion of the most probable value of rainfall by Dana M. Wood, *Engineering News-Record*, Mar. 28, p. 628, and by Harry M. Roeser, the issue of May 9, p. 925, the accompanying example is given in which neither the arithmetic mean nor the median appears to be the most probable value. The tables and diagram show the observed rainfall data at Reno, Nev., for 27 seasons, from July, 1888, to June, 1915.

The number of observations falling between intervals of an inch are tabulated and plotted (1) starting with an even inch; (2) starting with the half-inch. The upper of the two curves in the diagram is obtained by taking the mean of the two lower curves.



RAINFALL AT RENO, NEV., FOR SEASONAL YEARS JULY TO JUNE FOR PERIOD JULY, 1888, TO JUNE, 1915

Arithmetic mean, 8.62 in. Median value, 7.5 in. Most probable, 6.75 in

The arithmetic mean of the 27 seasons is 8.62 in., in., and the most probable value, as judged by the value at which the observations occur most frequently, is 6.75 inches.

The example given is typical of stations throughout the semiarid and arid portions of the country, while the method of procedure taken in finding the most probable value is in accordance with the principles of probability, as set forth in the standard books on the subject.

The writer has given some attention to the principles of probability as applied to rainfall and run-off measure-

OBSERVED PRECIPITATION AT RENO, NEV., FOR SEASONAL YEARS, JULY TO JUNE, FROM JULY, 1888, TO JUNE, 1915

1888-89	7.23	1900-1901	11.35	1912-13	6.22
1889-90	17.16	1901-02	6.71	1913-14	14.93
1890-91	11.49	1902-03	7.49	1914-15	5.44
1891-92..........	6.00	1903-04..........	8.54		
1892-93	11.77	1904-05	7.40	Total	27) 232.82
1893-94..........	5.64	1905-06..........	7.76		
1894-95	6.85	1906-07	11.70	Mean-27 yr	8.62
1895-96..........	8.35	1907-08..........	6.63		
1896-97	9.95	1908-09..........	9.50	Median*	7.50
1897-98..........	6.55	1909-10..........	6.16		
1898-99..........	5.76	1910-11..........	12.73	* (Obtained from diagram.)	
1899-1900..........	9.05	1911-12..........	4.76		

Number of Observations Occurring Between Intervals of an Inch (1) Starting with an even Inch (2) Starting with a Half-Inch

Interval	No. of Observations	Interval	No. of Observations	Interval	No. of Observations
3-4	0	14-15	1	9.5-10.5	1
4-5	1	15-16	0	10.5-11.5	2
5-6	3	16-17	0	11.5-12.5	2
6-7	7	17-18	1	12.5-13.5	1
7-8	4	18-19	0	13.5-14.5	0
8-9	2	3.5-4.5	0	14.5-15.5	1
9-10	3	4.5-5.5	2	15.5-16.5	0
10-11	0	5.5-6.5	5	16.5-17.5	1
11-12	4	6.5-7.5	7	17.5-18.5	0
12-13	1	7.5-8.5	2	18.5-19.5	0
13-14	0	8.5-9.5	3		

ments, and feels that the subject should receive more attention from engineers than is apparent from discussions on the subject. L. STANDISH HALL.

San Francisco.

Proposed Solution of Highway Transportation Problem

Sir—Your editorial of recent date relative to the New York *Evening Mail's* solution of the highway transportation problem again draws attention to the all-important need of proper regulation of the load and speed of motor trucks and the corresponding standardization of highway construction.

Truck manufacturers, transportation companies, and highway engineers and officials must meet on common ground and formulate plans which will bring these interests into closer harmony. Unity of effort and definiteness of direction seem, just now, to be missing factors. The designers of trucks are striving to give the users a product which will render the most economical service (this not necessarily meaning the biggest possible load), therefore they naturally look upon the opinion of the owners of trucks as a "barometer" indicating wherein changes in size, capacity, etc., are needed.

These trucks must travel over paved roadways, and if the roads will not sustain the various stresses created by the moving vehicles, then the companies operating the trucks, the manufacturers who built and sold the trucks and the taxpayers whose money paid for the roads are all losers. The engineers who built the pavements will also be subjected to severe criticism for having failed to provide structures equal to the task for which they were intended.

However, pavements which will meet traffic requirements cannot be designed until engineers know what loads must be carried, at what speeds trucks will travel, and what the tire widths for any given capacity will be; this list neglects mention of many other constantly changing factors of design and operation. It therefore becomes certain that no one of these interests can accomplish much alone. The "equation" must be cleared of its "fractions" by reducing to a "common denominator," and this must be done before any scheme for handling highway transportation will produce results in any way proportionate to the labor and capital invested.

Almost none of the really vital problems of highway construction have been solved. However, engineers are giving these matters most serious thought, as may be noted from the increasing amount of attention and publicity given to drainage, frost action, foundations, wearing surfaces, maintenance, length of service, costs, etc. A vast amount of actual data (facts rather than somebody's ideas) is sorely needed. Much of this information requires time for its collection, but we are gradually accumulating it, and given some sort of known load and speed factors (something which will not change before paving plans for a given job can be completed), an early and effective solution of the paving problem will result.

On first thought, it would seem that a great many difficulties, unlike those presented by the use of streets and highways for rail transportation, conduits and other public utility purposes, would offer obstructions to a scheme subsidizing highways for motor transportation. Any company launching such a project would want more or less to say about the kind of pavement, the location of the road, etc. If a right-of-way for this purpose were actually purchased from the people, the new owners would naturally want to exclude other traffic, for economic reasons. If permission to use certain streets and roads were obtained, the very fact that such are public property would establish the right for general traffic, which might or might not inconvenience the forwarding company. Also, such an arrangement would make very difficult the matter of tax apportionment, to cover first cost and maintenance.

It is doubtful that any plan contemplating procurement of absolute right-of-way could at this time be shown to warrant the enormous initial expenditure necessary therefor. It is also doubtful that any legal way could be found whereby such a company could secure limited right to use the certain streets and highways which would form a connected whole, thus affording a reasonably direct and uninterrupted route.

Unless right-of-way were purchased for the sole purpose of providing paved routes for these private concerns, it would seem that the people who own the roads should continue to pave and maintain them, and that those who use them should foot the bills through some fair scheme of taxation.

However, since nothing is impossible, the idea advanced by the *Evening Mail* might solve its own problems during the process of development. But, as you state, there are other questions which must be answered before any great amount of time need be spent in weighing the possibility of centralizing control of motor traffic. H. W. SKIDMORE,

Construction Engineer, Department of Public Works.

Oak Park, Ill.

Force Account Paving Saves Money at St. Paul

Paving by force account has saved the city of St. Paul, Minn., $73,000 in the past four years, according to Oscar Claussen, city engineer. The Department of Public Works has completed 32 paving jobs, in competition with the contractor's lowest bid price, and in every case a saving has been accomplished. The total saving given above is exclusive of depreciation charges

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Proper Quality of Construction Supplies Important

POOR supplies can cause a lot of trouble on construction work. Coal was hard to get last winter and was often found to be of the unburnable variety when received. These facts were being discussed resentfully by the job blocksmith in whose shop the editor was warming himself after a frost-biting hour on the work. Poor coal had upset the blacksmith's temper. This was bad. Still worse, the coal was upsetting the temper of his steel. Less footage of hole per sharpening was being drilled.

Out on the job the boilers were giving trouble. One veteran steamer whose insides had been riddled by years of hard living was refusing to digest its poor provender.

Good coal was beyond the reach of the contractor in the circumstances mentioned; but contractors too often let the same trouble arise when the coal supply is normal. Generally, this is carelessness or oversight. Just the same, such inattention disarranges things and costs hard money. Buying first-class supplies, under specification if necessary, is just as important as buying good construction materials and the right construction plant. C. S. H.

Other Articles in This Issue of Interest to Contractors:

Have You Read "Berlin or Bust?" (Page 421)

Wooden Shoes Used on Concrete Mixing Boards

BY ALBERT A. NORTHRUP
Hog Island, Pa.

THE well-known tendency of cement to destroy shoes was overcome on the work in South America, described on page 401 by the use of shoes with heavy wooden soles.

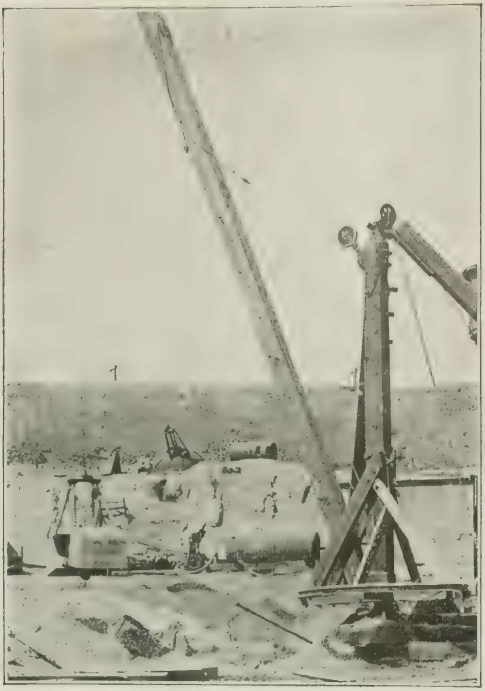
Concrete was being mixed by hand and the laborers could not be kept on the job because the cloth slippers with rope soles usually worn by them soon became saturated with cement-impregnated water. The difficulty was overcome by furnishing them with wooden-soled shoes with leather tops.

Tagline Rig Gives Direct Pull and Eliminates Fouling

FOULING of the tagline with the mast and boom, and with the falls when the bucket is in low position, is prevented by the new arrangement shown in the illustration. This rigging is said to be very convenient when excavation is made from narrow spaces, as between trench sheeting, and for digging below the level of the derrick.

In the particular layout shown in the photograph, a cylinder of concrete was used for the tagline weight. The tagline is attached to the clam bucket at one end, while the other is fastened to the becket end of the boom fall. It is rove through three blocks, one at the

WOOD-SOLED SHOES FOR LABORERS PROVED GOOD INVESTMENT ON SOUTH AMERICAN JOB



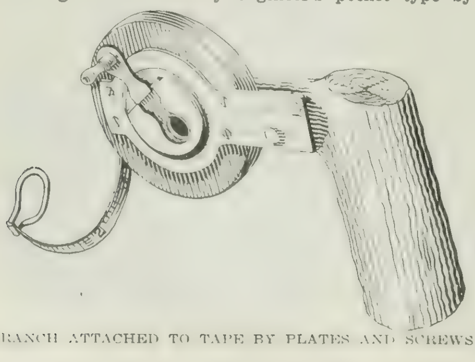
TAGLINE RIGGED TO BOOM TO LOAD WAGONS AND EXCAVATE MATERIAL FROM NARROW PITS

foot of the boom, one near the middle of the boom and one at the weight. This gives a more direct pull upon the bucket, which allows for excavation in a lower position without twisting of the bucket falls with the tagline. It also prevents the fouling of the tagline with the mast and boom as the boom is swung into position. With properly placed wagons, it is unnecessary to turn the bucket to dumping position by hand.

Branch Makes Pistol-Grip Handle for Tape

By A. J. Cahen
Brooklyn, N. Y.

A PISTOL-GRIP handle, made by cutting a piece from the limb of a tree just below a branch, and fastening to the ordinary engineer's pocket type by



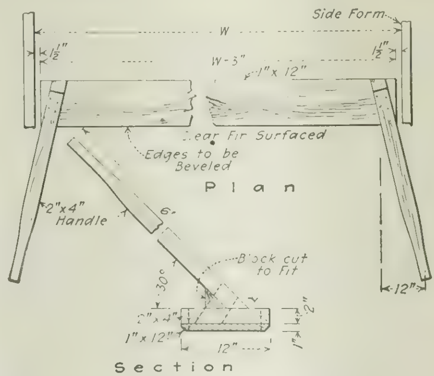
BRANCH ATTACHED TO TAPE BY PLATES AND SCREWS

means of fitted plates passing from the tape to the small projection of the branch, which is left on, is shown in the illustration. The addition of this handle makes it much more convenient to hold the tape when unwinding or winding up, especially when the hands are cold.

A branch about ¾ in. in diameter is the best size to use. The strips of sheet metal can be fitted to the metal fittings of the tape in any machine shop, and may be of any thickness which will not interfere with the winding handle. The strips are attached to the case by small screws which pass through the rim of the case in locations which will not interfere with the type on the inside. Rivets or screws, as desired, may be used to fasten the strips to the handle.

Device for Finishing Concrete Pavements Said To Save Labor

THE home-made finisher shown in the illustration is reported to finish the surfaces of concrete pavements with less labor and quicker than the canvas belt, according to J. C. Hills, county engineer, Bellingham, Wash., who states in a recent issue of the *Concrete Highway Magazine* that he has surfaced a considerable



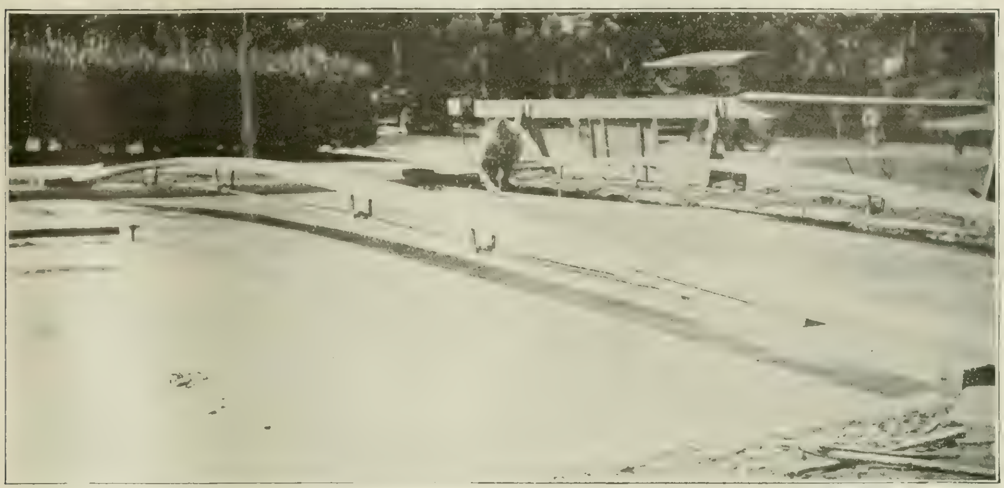
INEXPENSIVE CONCRETE FINISHER REPLACES CANVAS BELT METHOD

area of pavement with this tool, with perfectly satisfactory results. It was designed to work in conjunction with the concrete roller.

When the concrete has been spread and rolled the finisher is passed over the slab two or more times, and a perfectly even surface with the degree of grittiness required to prevent skidding is produced. For the best results the concrete should be mixed fairly dry, containing just enough moisture to produce a workable mix. The roller forces the coarser aggregate down, and the plank smooths out the ridges and irregularities.

Lengthens Scant Finishing Bridge

LENGTHENING of a concrete pavement finishing bridge which was too short was accomplished on a recent contract as shown in the illustration. Where a contractor is working on several different streets, it



CONCRETE PAVEMENT FINISHING BRIDGE LENGTHENED BY BOLTING PLANK AT THE ENDS

often happens that the finishing bridge made for one street will not serve upon the others, on account of their different widths. In the case illustrated the contractor overcame the difficulty by bolting a heavy plank to each end and making up for the extra deflection by blocking up at curbs. A man working upon a similarly lengthened bridge is seen in the background.

Use Pipe Ram to Tamp Trenches in South America

By Albert A. Northrup
Hog Island, Pa.

THOUGH far from home the forces of the Ulen Contracting Company in Uruguay still knew how to make an effective ram for tamping the backfill in trenches, as is shown by the photograph. The ram was made by cutting off about 40 in. of the bell end of an 8-in. cast-iron pipe, drilling two holes at right angles through both sides of the pipe at the upper end, through which were run two short lengths of wrought pipe for handles, and filling the cast pipe with concrete.

RAM MADE OF PIPE LENGTH FILLED WITH CONCRETE

The four men manipulating the tamper are typical specimens of the labor in Uruguay, except the one on the right who is marked by his boots as a "caballero," or gentleman, in reduced circumstances. The class which owns and wears top boots in Uruguay is not popularly supposed to work with the hands if it can be avoided.

The work, which is described on page 401, was carried out under the direction of H. C. Ulen, president of the contracting firm, and Thomas Shepperd, vice president and general manager. Stone & Webster and the American International Corporation, associated with the Ulen Contracting Company in the work, were represented by the writer.

Women Replacing Men in British Industry

According to recent reports, the number of women directly replacing men in Great Britain in April, 1917, was estimated at 1,256,000, of whom more than three-fourths were found in industrial and commercial occupations and in government employ. In January, 1918, according to the *British Labor Gazette* of June, 1918, this number had increased to 1,442,000. The degree to which women replace men varies widely in different industries. In government establishments, not including controlled establishments engaged in munitions work, they formed 36% of the total employees; in banking and finance, 24.6%; in commercial occupations, 16.9%; in engineering firms, 7.14%; and in all metal trades 6%. These figures refer only to the women directly replacing men. Many others are engaged in work in which they replace only partially, or indirectly, men who have been withdrawn for war service or for work in other industries.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

The University of Uncle Sam

All Colleges to Be Converted Into Military Training Posts—Expected to Turn Out 310,000 Officers and Technicians by Next July

(Washington Correspondence)

"The University of Uncle Sam," so Frederick P. Keppel, assistant secretary of war, has aptly termed the greatest educational effort that this country—or probably any other—has ever made. The student output, half a million; the educational plant, 500 institutions; the purpose, to give Uncle Sam the most intelligent army that history has known.

Best of all, the announcement can be made with full confidence of success, for already there are 47,000 men in the schools and they are being turned out at the rate of 23,000 a month.

The training plan referred to has already been described in *Engineering News-Record.* It consists of two parts —the training of technicians, and of young men in college. Plans for the latter division, known as the Students' Army Training Corps, were in hand before it was decided to lower the draft age to 18. Military training was to go hand in hand with the usual courses.

In two weeks' time, all plans have gone by the board. The certain lowering of the draft age has done it. Standard college courses are wiped out, and no college will operate this year except as a military training school. The plans announced for Brown and Lehigh and Rutgers, discussed in this journal last week, are laid by for the period of the war at least.

Dr. C. R. Mann, who studied engineering education for the national societies and the Carnegie Foundation, and who is now on the advisory board working with the army committee on these matters, put the new plan before the Senate Committee on Military Affairs last week. Men prepared for college will register as usual, and will as soon as all arrangements are completed, be inducted into the army as privates, with a private's pay and subsistence. In other words, they will be under full military jurisdiction. Boys of 20 will stay in school three months; those of 19, six months; those of 18, one year. In all cases men who clearly show that they may make good army officers or technical experts may be detailed to take further instruction. It is expected that at least 125,000 men will be enrolled under this part of the plan, and to date 320 schools of collegiate rank have been accepted as training posts.

The other division is that already in successful operation—the training detachments for mechanicians. These now become part of the Students' Army Training Corps. In addition to the 90,000 men who will have been turned out by Oct. 1, the quota for the period from Oct. 1 to July 1 is 220,000. Already 147 schools are engaged in this work, and 120 of them have been accepted for the winter courses. The University of Texas will be able to take care of no less than 5000 of these men at one time.

Democracy and merit will dominate Uncle Sam's khaki university. All the students being soldiers on pay and subsistence, the length of dad's pocketbook is not a factor in the matter of entrance. The necessary qualifications are willingness and ability. Men who after entering a training detachment show ability to carry college work will be transferred thereto, and in general, the only qualification for any part of the work is ability to carry it.

While the men are taking their school work the usual drill instruction is carried out. Experience with the technician detachments shows that in military proficiency the boys are not behind those who spend an equal time in the cantonments.

The plan has been worked out admirably and in conformity with military needs. It neglects the civilian demand for engineers and should that shortage become more acute, it may be necessary for the Government to take steps for the maintenance of the necessary municipal sanitary enterprises.

But for war needs, the scheme has been excellently prepared. Aside from its military results, there will be a tremendous psychological benefit from placing these centers of patriotism and military endeavor in hundreds of cities, where soldiers before were merely men on leave. The moral effect is likely to be no less important than the military.

The officers composing the War Department's committee on education and special training and its able civilian co-workers deserve congratulations.

Women Street Cleaners Proposed

The Civil Service Commission of New York City has announced that as a means of filling the rapidly-increasing number of vacancies due to war conditions women will be employed as street sweepers in the outlying districts of the city.

Muscle Shoals Dam Work Suspended

Work on the dam for the hydro-electric project at Muscle Shoals, Ala., has been ordered temporarily suspended by the War Department on representation from the War Industries Board that labor and materials used there are needed to meet immediate war demands. This dam is intended to develop power to be used eventually at the Government nitrate plant at Sheffield, Ala., near by. For the present, however, the Sheffield plant is to be operated by steam power and by electricity brought from other hydro-electric plants. It was not expected that the Muscle Shoals project would be completed for several years. Preliminary work on the dam was first in charge of Col. Hugh L. Cooper, and after Colonel Cooper returned to construction work in France it was put in charge of Major D. A. Watt, who was the Government engineer officer on the Troy dam on the Hudson River.

More Engineer Officers Made Generals

In the list of new generals sent to the Senate by the President on Aug. 22 are the names of three officers in the Corps of Engineers. To be brigadier generals in the army of the United States, for the duration of the war, are Col. Henry C. Newcomer and Col. Harley B. Ferguson; to be brigadier general, United States Army (permanent promotion) is Col. Amos A. Fries.

Col. Guy E. Tripp, late of the Westinghouse companies, is also promoted to brigadier general in the ordnance department.

Federal Bill to Enlarge Central Power Plants

A bill appropriating $200,000,000 to enlarge central power stations wherever war industries may require was introduced in the House of Representatives Aug. 19 by the Hon. T. W. Sims, chairman of the Interstate Commerce Committee, and was urged by Secretary Baker before that committee Aug. 23. The bill gives broad authority to the President to make contracts with the owners of any existing power plant for its enlargement, or to take it over as a whole, or to construct new plants. While the bill is primarily intended to finance enlargements of steam power plants it gives full authority over hydroelectric plants as well, except that structures affecting navigation require previous approval by the Chief of Engineers.

In explaining the necessity for the

(Concluded on p. 423)

"Berlin or Bust"

To my fellow engineers who have been left behind:

Somewhere in America
August 10, 1918

This is my office.

I am the high mogul here.

It's true it is not a fancy office building, and the furnishings are all home-made. There is not a square inch of mahogany or oak in the whole layout.

The flies are something fierce. I have screens on four small openings but one large opening is innocent of protection. Such is the consistency of an engineer.

My next-door neighbor on one side is a 30 x 30-ft. storehouse, piled 12 ft. high with cement in its unused state. The voids are filled with a miscellaneous and villainous assortment of tools for various uses.

My neighbor on the other side is a 16 x 20-ft. tent filled with the same commodity.

On another side is a trunk-line railway.

From my desk I look through the window and very, very often I see a long train of khaki-clothed boys. Sometimes they are headed toward Berlin. Other times away from Berlin. Then they are bound to some training camp for the preparatory course.

But no matter which direction they are traveling, they are all going to the same place eventually. The slogan is always the same,

"Berlin or Bust"

Owing to circumstances beyond my control I am not with them—except in purpose.

I am honored by the position in this fly-specked, mosquito-bitten office. My consolation is the hope that I am doing something that should be done.

From this office, thousands of dollars are being spent for war work. The slogan of the force, like that of the boys, is "Berlin or Bust."

Sometimes we become dissatisfied. We shout for more money. Living expenses appear to be tied to the tail of an airplane.

But we are buying Liberty Bonds and W.S.S. We have had to cut down our expenses all along the line to do it. The theater knows us no more and we have abandoned the use of clothing to the limit of the law.

But our slogan is always the same

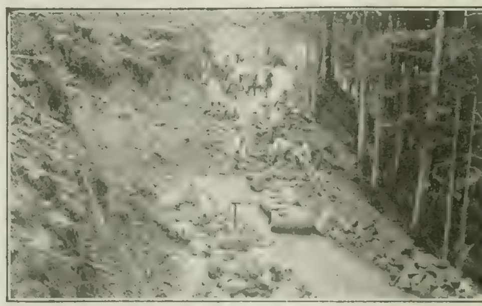
"Berlin or Bust"

Lafayette, we are here!

Pershing, we are with you!

A CHIEF ENGINEER
AND HIS STAFF

Engineering Activities at the Western Front



1 AND 2. BUILDING TWO TYPES OF BRIDGES AT ONE POINT

3. PREPARING THE SUBGRADE FOR A ROAD

4. CARRYING A DRAINAGE CULVERT UNDER THE SUBGRADE

5. GRAVEL PIT IS WORKED WITH BELT CONVEYORS

6. CAMOUFLAGE CONCEALS THIS PILEDRIVING OPERATION

WHEELING A TRUSS BRIDGE INTO PLACE

Bill to Enlarge Power Plants

(Concluded from p. 420)

bill, Secretary Baker said that power companies were reluctant to undertake large extensions of their plants, since the investment necessary at the present time is nearly double what it would be under ordinary conditions. It is contended that the excess of cost due to war conditions should be borne by the Government. It is stated that in both shipbuilding work and munitions manufacture a large increase in power is urgently needed and can be most economically obtained by development at central power plants.

New England Water Men Will Hold Win-the-War Meeting

The proposed help-win-the-war meeting of the New England Water-Works Association, announced by C. E. Davis, president, in a letter published in *Engineering News-Record* of Aug. 15, p. 329, will be held at the association headquarters, Tremont Temple, Boston, Sept. 11-12. The usual exhibits, excursions and entertainment features will be eliminated. Besides an experience meeting on labor troubles there will be discussions on fuel conservation, boiler-room practice and its adaptation to changing fuel conditions, the expediency of raising water rates to offset increasing costs of water service, and practical means for detecting leaks in underground pipes. The committee on frozen service pipes, appointed to gather data on experiences during the extreme cold weather of last winter, will submit its report. Willard Kent, Narragansett Pier, R. I., is secretary and S. E. Killam, 1 Ashburton Place, Boston, has charge of arrangements.

New York Meetings Committee of American Society Appointed

C. M. Holland, chairman, and J. B. French, A. W. Tidd, J. O. Eckersley, E. N. Layfield, E. B. Besselievre and Charles Gilman have been appointed the members of the New York meetings committee of the American Society of Civil Engineers, the creation of which was voted by the board of direction some time ago. The resolution creating the committee stipulated that at the second meeting of each month "the program of papers, addresses or discussions shall be placed in the hands of a committee of seven resident members to be appointed by the executive committee . . . this committee to be charged with the sole responsibility for the conduct of these meetings."

Regular business meetings, and the presentation for discussion of professional papers, are to be continued at the first meeting of each month. The first meeting of the coming season, however, that of Sept. 4, will be of the informal nature, the speaker being the military expert of a newspaper; and it is understood that there are likely to be few formal papers discussed or published during the coming year.

Highways Council Announces New War Policy

Governing Features and Procedure To Obtain Permission for Road Work Outlined

The character of the highway work which will be considered, the order of importance of the various types, and definitions of what constitute highways of military and of National economic value, are outlined in a new policy announced by the United States Highways Council to go into effect Sept. 10. A detailed method of procedure to be followed in applying for permission is established, and the necessary forms to be filled out are presented and explained. All applications must go through the various state highway departments as heretofore. The council hopes that all highway officials will coöperate in cutting down road work to the most essential needs, and requests that its recommendations and forms of application be carefully followed.

The character of work affected by this announcement is all proposed highway, street, culvert, and bridge construction, reconstruction and maintenance involving: (a) Issuance of bonds; (b) use of rail or water transportation; (c) use of coal or oil as fuel; (d) use of cement, brick, asphalt, oil, tar, crushed stone or steel (also sand and gravel where shortage exists) as highway material. No manufacturer will furnish any road-building material until the project has first been approved by the United States Highways Council.

In passing upon applications for projects, the council will give first consideration to maintenance, with a view to conserving all highways already completed. Reconstruction will be favorably considered only where it is clearly established that maintenance is no longer possible except at prohibitive cost. New construction will be considered in the following relative order of importance: (1) Highways and streets of military value; (2) highways and streets of National economic value; (3) unfinished contracts incurred prior to April 5, 1918, where a bond issue is involved, and which may not be disturbed without serious consequences; (4) streets and highways which, although not of National economic importance, are of extreme local importance, or the construction of which has progressed to such a point as to cause serious hardship, if completion is postponed.

Definitions

Defining highways of military and of National economic value, the announcement reads as follows:

"A highway of military value is one used regularly for the transportation of military supplies in considerable quantity; for the movement as an established practice of army truck trains; or a road which is essential to the efficient operation of a military cantonment, post, or plant.

"A highway of National economic value is one which serves or will serve, if properly improved, directly to promote the welfare of the nation, and not merely the local welfare.

"As examples, it may be stated that in this class would be placed (1) highways which, although not directly used for military purposes, yet serve to help win the war by greatly facilitating the output or movement of war munitions and supplies; (2) highways which can clearly be shown to relieve congestion of railroad lines in a territory which is actually in need of such relief; (3) highways which give access to or promote the output of natural products needed by the nation to a marked degree; (4) highways which further housing operations undertaken by the Federal Government, or by other agencies with the approval of the Federal Government, will justify at times this designation."

Coöperative Development of Program

In coöperation with the Office of Public Roads of the Department of Agriculture, and the state highway departments of the several states, the council will shortly begin the preparation of a program of road and street construction, reconstruction and maintenance, throughout the United States, for the working season of 1919. The purpose of this program is to obtain, approximately, the character and amount of street and highway work deemed essential, together with an approximation of the amount and character of financing required, the amount and character of the various materials entering into the work, the extent to which rail and water transportation will be involved and the probable demand upon the labor supply. The program in each state will be prepared by the state highway department, and will cover all state, county, township and municipal highway and street work.

State highway departments are requested to give most careful consideration to each application on its merits, in the light of the policy announced by the council, and to exercise the power of disapproval freely. Only projects approved by the state highway departments will be considered, unless the department itself is in doubt and wishes a decision in the nature of a precedent. For the purpose of expediting this program, certain forms have been prepared as follows: Form HC-3 is an application to the United States Highways Council for approval of a project, and is to be signed by public officials and filed with the state highway department, which, upon approval, will present it to the United States Highways Council; Forms F-1 and F-2, heretofore used for applications for bituminous materials, have been superseded by Form HC-3, but may be used, if desired, where only bituminous materials are required; Form HC-4 is a schedule for use in submitting the program of proposed highway and street work for the working season of 1919. This schedule is made up for the various political divi-

sions, with a separate schedule for construction, reconstruction, and maintenance.

It is hoped that the selective consideration of new highway and street construction by the township, county and municipal officials and the state highway departments will so materially eliminate the less essential projects as to make it possible for the council to render active aid on approved projects. The aid contemplated will be in the form of such action by other Government agencies involved as will remove obstacles to speedy completion.

The council again urges that new highway and street construction be confined to the most essential needs. If this be done, there will be a far greater probability that work thus selected can be promptly and effectively carried through to completion, than if an amount far in excess of the available facilities were to be undertaken.

New Contracts Let for Camp Garbage and Manure

Separate Bids Received for Bread, Meat, Bones, Other Garbage Manure and Carcasses

Contracts for the disposal of garbage at 34 army camps and for the disposal of manure at 21 camps have recently been awarded by the Conservation and Reclamation Division of the Quartermaster's Department, U. S. A., as shown by the accompanying table. The garbage bids were divided into a half dozen elements. A seventh column gives the estimated total yield per ton of garbage. These figures range from $2.41 per ton at Camp Greene, N. C., to $22.176 at Camp Fremont, Calif., and show an average of $9.38 a ton. At a majority of the camps the military authorities deliver the garbage to the contractor.

A partial list of camp garbage contractors for the year ended June 30, 1918, was published in *Engineering News-Record* of Oct. 18, 1917, p. 731. Quantities of garbage and other wastes collected at a considerable number of camps in 1918 were printed in *Engineering News-Record* of July 4, 1918.

CONTRACT AWARDS FOR DISPOSAL OF GARBAGE AND MANURE AT U. S. ARMY CAMPS

		Garbage								Manure					
		Per 100 Pounds													
Camp	Garbage Contractor	a Breads	b Meats, Fats, Greas	Trap	c Bones	d Other Garbage	Dead Animals, Each	Estimated Yield per Ton	Contract Expires	Manure Contractor	Price per Animal per Month	Price per Ton	F.O.B. Cars	Delivered at Siding	Contract Expires
Beauregard, La.	Hart Brothers (a&d), Steinburg & Co. (b&c)	0 60	$3 00		$1 00	$0 40		$11 76	6/30/19						. . .
Cody, N. M.	Geo. Turvey, Sr.	2 00	2 00		50	.25		8.86	6/30/19						. . . .
Custer, Mich.	United Disposal & Recovery Co.	1 00	2 75	.50	60	.04	$2 50	6.654	s 6/30/20	Michigan Agricultural College	$6.00 per ar		X		No contr'ct
Devens, Mass.	Ayer Contracting Co.	20	8 00		1.00	05	2 50	15 07	s 6/30/19	U. S. Cons. Co.	33 camp 27 remount			X	s 6/30/19
Dix, N. J.	General Mfg. Co.	4 33	4 96		.95	.05¼	1 50 3 00	11.98	s 6/30/19	John E. Meehan & Son	$0 38		...	X	s 6/30/19
Dodge, Iowa	United Disposal & Recovery Co.	1 00	3 00	50	70	05	3 00	7 41	s 6/30/19						
Doniphan, Okla.	N. A. Robertson	2 05	4 02		52	.08	2 10	9.784	s 6/30/19						
Fremont, Calif.	Pacific Hog Co.	2 65	7 00	6 50	1 70	.41		22 176	s 6/30/19	John W. Moffitt	.15			X	s 6/30/19
Funston, Kan.	Nat'l Pro. Sal. Co.	1 50	2 50	8 00	.50	18¾	2 00	9.11	s 6/30/20						
Gordon, Ga.	Henry Knight & Son	1 50	3 25		.90	12	2 00	9.40	s 6/30/19	U. S. Cons. Co.	26			X	s 6/30/19
Grant, Ill.	United Disposal & Recovery Co.	1 00	4 50		80	.05	3 00	10 15	s 6/30/20						
Greene, N. C.	Wm. J. Cocke	25	20		22	.10¼		2 41	s 6/30/19	T. Croft Woodruff	15			X	s 6/30/19
Hancock, Ga.	Henry Knight & Son	1 00	3 25	1 00	1 00	12	2.00	9 44	s 6/30/19	Buffkin & Garvin	40			X	s 6/30/19
Humphreys, Va.	Callender, Conrad & Lawler					.01¼			s 6/30/19	Miss I. M. Sharpe	75			X	s 12/31/18
Jackson, S. C.	Henry Knight & Son	1 50	3 25		90	.10	2 00	8 97	s 6/30/19	Powell Fuel Co.	.12½			X	s 6/30/19
Johnston, Fla.	Henry Knight & Son	1 50	3 25		90	.11	2.00	9.17	s 6/20/19	Buffkin & Garvin		1 60		X	s 6/30/19
Kearny, Calif.	I. M. Sayre	One cent per man per month.							s 1919—Old contract renewed	Southern Calif. Fertilizer Co.	.15			X	s 6/30/19
Lee, Va.	Nat'l Cont. Co.	5 00	2 00		75	.02½		6 05	s Cancellation clause	F. B. [illegible]	21			X	s 6/30/19
Lewis, Wash.	Camp By-Products Co. Camp By-Products Co.	50 65	50 65		.60 78	.15 .30	1 00	5.69	s 6/30/19	Camp By-Products Co.	13		X		s 6/30/19
Logan, Tex.	Joffney Royalty Co.	40	40			30		6 20	s 6/30/19						....
McArthur, Tex.	Charles K. Durham	7 75	per kitchen		per month				Old contract renewed						. .
McClellan, Ala.	Rhea & Rhea	17	17		.17½	17	1.25 2 50	3 50	s 6/30/19	Wm. W. Mendenhall	05			X	s 6/30/20
Meade, Md.	General Mfg. Co.	4 33	5 01		.95	05	3 00 1.00	12 04	s 6/30/19	John E. Meehan & Son	08			X	s 6/30/19
Merritt, N. J.	Products Mfg. Co.	25	1 00		90	.05¼	1.50	9 38	s 6/30/19						
Newport News, Va.	Nat'l Contracting Co.	3 00	2 00		.75	.02½	1 00	5 655	s 6/30/19	Virginia Reclamation Corporation		.60	X		s 6/30/19
Pike, Ark.	Guy W. Caron	2 00	4 50	2 00	.75	06	1 50	10 40	s 6/30/19						
Sevier, S. C.	Greenville - Carolina Trust Co.	50	50		50	.20		5 02	s 6/30/19	Powell Fuel Co.	.12½			X	s 6/30/19
Shelby, Miss.	R. L. Bradly	100 00	per month						Cancellation clause	R. L. Bradly	12			X	s 6/30/19
Sheridan, Ala.	U. S. Cons. Co.	1 00	4 50		1 50	06	3 00	11 39	s 6/30/19	U. S. Cons. Co.	10			X	s 6/30/19
Sherman, Ohio	Henry Knight & Sons	1 50	3 25		1.10	.13	2 50	9 86	s 6/30/19	Sold to farmers and Swift Co.				X	.
Taylor, Ky.	Price Vogt Stock	1 50	3 50		1.05	.16		10 76	s 6/30/19						.
Travis, Tex.	W. C. McCord Feeding Co.	1 20	2 25		.75	41		12.13	s 6/30/19						
Wadsworth, S. C.										Powell Fuel Co.	.20½			X	s 6/30/19
Wheeler, Ga.	U. S. Cons. Co.	1 00	4 50		1 50	06	..	11 39	s 6/30/20	U. S. Cons. Co.	22			X	s 6/30/20
Upton, N. Y.	Products Mfg. Co.	.25	4 00		.90	.05¼	1.50 3 00	11 05	1920	Wm. L. Peck	.21			X	s 6/30/20
Average		1 46	3 13		83	135	2.10	9 38			26	50			...

s Standard form of contract

Army Death Rate Low

Combined reports for the American armies at home and abroad showed a death rate from disease of 1.9 per 1000 per annum for the week ended July 26, based on a total of 2,500,000 men. For the past two months the rate was 2.8. The rate for men of military age in civil life is 6.7. Records for earlier wars, according to the office of the surgeon-general, were: Mexican, 100; Civil, 40 in 1862 and 60 in 1863; Spanish-American, 25; Russo-Japanese (for Japanese troops?), 20. (It should be noted that the civil rate and the earlier war rates cited are for long periods.—Editor.)

Floods Damage Arizona Canal

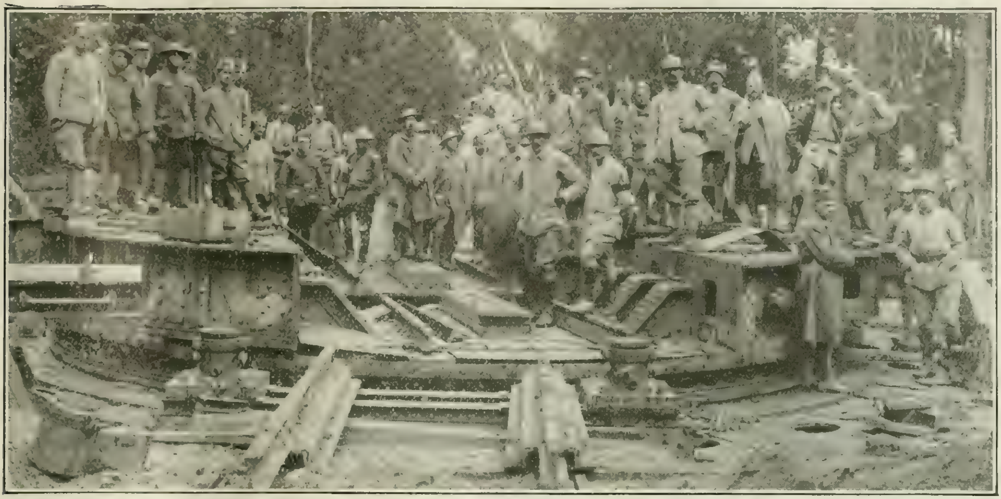
Recent floods have caused 15 breaks in the Arizona Canal, ranging from 200 to 1500 ft. in length, the worst of these being at Scottsdale. The total estimated damage to the canal system and railroads is $500,000.

Progress on Proposed Connection with Laguna Dam

The board of directors of the Imperial Irrigation District have signed the Government contract submitted by Secretary Lane covering the terms under which connection with the Laguna dam is to be made. This action must be ratified by popular vote.

It is reported that the contract is not satisfactory to the people of Imperial Valley and that the approval of the board was given to it only in order that the voters of the valley might have a chance to express their opinion.

First Photographs of Emplacement for New 75-Mile Gun, Captured by U. S. Troops in Recent Sweep Above Marne



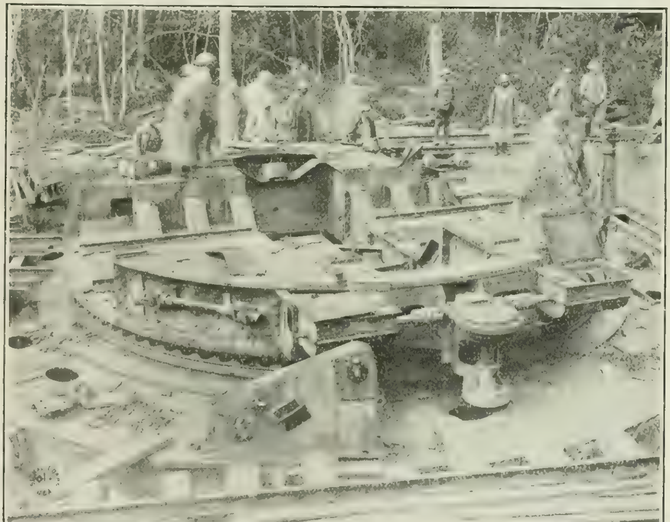
Capital Issues Committee Will Co-operate

The United States Highways Council has been assured that the Capital Issues Committee desires to coöperate with it in selecting road construction projects. This is the outcome of the controversy outlined in *Engineering News-Record* of Aug. 15, p. 352. In conference with representatives of the Highways Council, the Capital Issues Committee agreed to transmit verbatim the minute passed by the council, which stated that it would be advantageous, if the Capital Issues Committee would depend upon the Council for recommendation as to military and technical phases of proposed highway improvement, and leave to the subcommittee of the Capital Issues Committee only the financial aspects of the proposed bond issues.

Those interested in highway problems are hopeful that better conditions will result from such coöperation.

New Jersey Convicts Will Work on State Highways

Convicts in New Jersey are to be put to work under a comprehensive program recently outlined by Governor Edge. State-prison convicts assigned to outside work will be sent this fall to clear and drain land and do other work at a state farm and, if a quarry can be leased, to produce trap rock for highways. Next spring inmates of the state prison and of the state reformatory will be put on state highway work. Work in a state nursery under the Conservation Commission is proposed. Prisoners kept within institutions will do a variety of work. The plan involves social and industrial reclamation as well as labor utilization.



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TURNTABLE MOUNT FROM WHICH GERMANS INTENDED TO BOMBARD PARIS WITH ANOTHER "GROSSE BERTHA," PHOTOGRAPHED BY OUR SIGNAL CORPS

Will Study Effect of Powder Plant on Nashville Water

The effect of chemical wastes from the Old Hickory powder plant on the water-supply of Nashville, Tenn., which was reported on some time ago by Prof. Earl B. Phelps of the United States Public Health Service, will be further investigated by Dr. W. H. Hollinshead of Vanderbilt University, Professor Phelps and Prof. George C. Whipple, Harvard University.

Sand, Gravel and Stone Placed on Nonessential List

Sand, gravel and stone have been placed by the Railroad Administration upon the list of nonessentials, except where shipments are for war industries purposes. This ruling was made Aug. 20, and hereafter open-top cars will not be available for transportation of such commodities, it is stated.

The reason assigned for this order was that the war industries, army,

navy and merchant marine have such large coal requirements that open-top equipment cannot be used for other commercial traffic. Such curtailment rules will, it is thought, tie up every sort of building activity, but officials are said to believe that this is the only method of staving off a winter shortage of coal cars. It is hoped that the maximum production of the mines can be handled during the winter.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

NEW ENGLAND WATER-WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 11-12, Boston.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The Detroit Engineering Society will hold its opening meeting of the season Sept. 6 in the auditorium of the Detroit Board of Commerce. H. H. Esselstyn, past president of the society and now commissioner of public works of Detroit, will address the meeting on "The Hog Island Shipyard." On Aug. 26 the society attended a meeting called by the advisory board on fuel conservation, United States Fuel Administration, at which the general subject of coal conservation as applied to industries was discussed.

The Smoke Prevention Association made a trip of inspection by automobile to the Pequannock watershed on the afternoon of Aug. 21, as guests of the local committee of Newark, N. J., where the association is holding its annual convention, as mentioned in *Engineering News-Record* of Aug. 15, p. 338. In the morning of the same day William A. Pittsford of Kewanee, Ill., addressed the meeting on "Burning Bituminous Coal Smokelessly." Other papers which have been read before the convention are: "Burning a Million Tons of Coal a Year," by Frank W. Casler, general superintendent of production of the Public Service Corporation of New Jersey, in which was pointed out the economy from efficiency of equipment attained through the operation of 16 generating stations as a single unit; and "Smokeless Operation with Chain-Grate Stokers," by Thomas Marsh, chief engineer of the Green Engineering Co., Chicago.

Personal Notes

EDWARD STUART, who was sanitary engineer for the American Red Cross in the Balkans, 1915-17, and recently a member of the Red Cross Relief Commission to Guatemala, has been commissioned as captain in the Sanitary Corps, and will handle sanitary problems at the Macedonian front.

ROBERT W. GAY, for the past eight years professor of civil engineering at the Mississippi Agricultural and Mechanical College, has resigned to become office engineer for the Morgan Engineering Co., Memphis. For ten years previous to his service as professor of civil engineering he was engaged in municipal, hydroelectric development and other engineering work.

R. A. ROSS, consulting engineer, Montreal, has been appointed by the Canadian government as chairman of the Lignite Utilization Board, which will have charge of the plant to be established in Saskatchewan for briqueting lignite for domestic fuel. As a member of the Canadian Advisory Council for Scientific and Industrial Research, Mr. Ross has given considerable attention to the use of Western lignites.

CHARLES E. WELLS, division engineer, Board of Water Supply, New York City, has become supervising engineer for the division of shipyard plants, Emergency Fleet Corporation, assigned to duty in charge of construction of the concrete shipbuilding plant at San Diego, Cal. Mr. Wells was supervising engineer at Camp Merritt, New Jersey, during its construction.

G. F. SCHLESINGER, for several years assistant professor of civil engineering at Ohio State University, has been appointed assistant chief examiner in charge of the examination division of the Civil Service Commission of Ohio. Professor Schlesinger was graduated from Ohio State University in civil engineering in 1907, and afterwards served five years with the Rock Island Lines as assistant engineer on the St. Louis division.

F. T. DARROW, engineer maintenance of way of the lines west of the Chicago, Burlington & Quincy R R., has been appointed assistant chief engineer of the lines west. The position of engineer maintenance of way has been abolished. Mr. Darrow, after his graduation from Allegheny College in 1897, began railroad work the same year with the Burlington system. In 1902 and 1903 he was resident engineer on the reconstruction of the Missouri River bridge at Plattsmouth, Neb. For a short time in 1905 he was manager of the International Contract Co., Seattle. Late in the same year he became engineer maintenance of way of the Nebraska district of the Burlington; shortly thereafter he was made principal assistant engineer, and in 1908 was made engineer maintenance of way of the western lines.

FRANK C. LINGENFELTER, principal assistant city civil engineer of Indianapolis, has been appointed city civil engineer, succeeding Henry W. Klausmann, whose death was noted in *Engineering News-Record* of last week, p. 381. Mr. Lingenfelter was graduated from Purdue University in 1894. He entered the office of the city civil engineer in 1907, and since that time has specialized in track elevation work. In March, 1918, he was appointed principal assistant city civil engineer. Before he entered the office of the city engineer he was in the contracting business and in the engineering department of the Big Four Railroad.

W. W. K. SPARROW, valuation engineer of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer for the corporation of the Chicago, Milwaukee & St. Paul Ry. Mr. Sparrow was born in Ireland in 1879. His first engineering work was with the Belfast & Northern Counties Ry., and for ten years he was in railroad work in South Africa. About 1908 he came to the United States, and for three years was engaged in steel and reinforced-concrete design with Waddell & Harrington, consulting engineers, Kansas City. Following that he was a year with Hans von Unwerth, consulting engineer, also in Kansas City. In September, 1913, he was made assistant chief engineer of the Missouri Public Service Commission. In March, 1916, he was appointed valuation engineer of the Chicago, Burlington & Quincy Railroad.

WILLIAM S. MOORE, state highway engineer of Indiana, has received a leave of absence from the Indiana State Highway Commission, to become associated with the Silvex Co., Bethlehem, Penn., as efficiency engineer. As stated in *Engineering News-Record* of May 15, p. 976, the work of the Indiana State Highway Commission was stopped by a court injunction regarding the validity of the state highway commission law.

JOHN W. ENNIG, chief engineer of A. Bolter's Sons, Chicago, manufacturers of structural steel, has become manager of the structural steel department of Wendnagel & Co., structural steel and wooden tank manufacturers, Chicago.

G. W. HARRIS, recently chief engineer of the Coast lines of the Atchison, Topeka & Santa Fé Ry., has been appointed chief engineer for the Santa Fé corporation. Mr. Harris entered the employ of the Santa Fé system in 1899,

and up to 1906 was successively chainman, rodman, transitman and assistant engineer. From 1906 to 1909 he was assistant engineer in charge of grade and line revision of the Pecos & Northern Texas Ry., and from 1909 to 1912 was chief engineer of construction. In April, 1912, he was made chief engineer of the Coast lines of the Santa Fé system.

LOUIS B. MANHEIMER, formerly assistant engineer in charge of the topographical bureau of Queens County, New York, with headquarters in Brooklyn, has been promoted from first lieutenant to captain in the Engineer Officers' Reserve Corps.

M. I. EVINGER, consulting sanitary engineer, Des Moines, Iowa, who was in charge of the department of sanitary engineering at Iowa State College, is now serving as a captain in the utilities branch of the Quartermaster Corps at Camp Dodge, Iowa, as officer in charge of water supply and sewerage.

HENRY B. MACHEN, borough engineer, Department of Water Supply, New York City, has been commissioned as major in the Ordnance Reserve Corps, and assigned to duty with the Production Division.

FINLAY L. MACFARLAND has been elected president of the Board of Water Commissioners of Denver, which was recently elected as the first Board of Water Commissioners of the city when it was voted to take over and operate the Denver Union Water Co., as noted in *Engineering News-Record* of Aug. 15, p. 336.

HENRY L. TATNALL has been appointed secretary and engineer of the Board of Park Commissioners of Wilmington, Del.

ALLAN F. OWEN, who has been associated with George C. Nimmons & Co., architects, Chicago, as engineer, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps, assigned to duty at Camp Humphreys, Virginia.

CAPT. W. GERALD HAWES, president of the John Wilfert Co. and the Hawes Foundry and Equipment Co., has been appointed to the chairmanship of the Brooklyn, N. Y., district of the United States Shipping Board.

ALLEN B. MCDANIEL, professor of civil engineering, Union College, Schenectady, N. Y., is now located in Washington, D. C., as expediting engineer for the camp and cantonment section of the Construction Division.

A. R. DUFRESNE, assistant chief engineer of the Canadian Department of Public Works, has resigned to become manager of the St. John Drydock & Shipbuilding Co., St. John, N. B.

F. L. THOMPSON, assistant chief engineer of the Illinois Central R.R., has been appointed chief engineer, succeeding A. S. Baldwin, whose appointment as vice president of the Illinois Central corporation was mentioned in these columns last week. Mr. Thompson was engineer of construction of the Illinois Central when promoted to assistant chief engineer four years ago. Before that he was engineer of bridges and buildings.

THOMAS L. COSTIGAN, principal assistant inspector for the building inspection department, Washington, D. C., has been appointed superintendent of street cleaning, succeeding J. W. Paxton, resigned.

W. R. ROOF, assistant engineer of bridges of the Chicago Great Western R.R., has been appointed bridge engineer.

H. D. MORAN, superintendent of the Casparis Stone Co., Connellsville, Penn., has resigned to become superintendent of the plant of the Southern Mineral Co., Winnfield, La.

C. L. PERSONS, assistant engineer on special work for the Chicago, Burlington & Quincy R.R., has been appointed assistant chief engineer of the lines east of the Missouri River. Mr. Persons has been with the Burlington system since 1904. From 1908 to 1916 he was locating engineer on the lines east, and in the latter year was assigned to special work, as a member of the chief engineer's staff.

M. A. STAINER has become assistant valuation engineer for the Fort Worth & Denver Ry., with headquarters at Fort Worth, Tex.

J. X. COHEN, who was designing engineer for the Syracuse, N. Y., intercepting sewer board, is now associated with Chester & Fleming, supervising engineers for the Field Artillery Firing Center at Stithton, Ky.

ELMO A. FUNK, city engineer of Anderson, Ind., has resigned to enter the engineering department of the Hill Pump Co. at Anderson.

EARL STIMSON, engineer maintenance of way of the eastern lines of the Baltimore & Ohio R.R, has been appointed general superintendent maintenance of way and structures of all lines under the jurisdiction of A. W. Thompson, Federal manager. Mr. Stimson was born in Cincinnati in 1874. He was educated at the University of Cincinnati and at Cornell University, being graduated from the latter university in 1895. The same year he entered railroad service in the maintenance of way department of the Baltimore & Ohio Southwestern. He was promoted to assistant engineer in 1896, to resident engineer in 1899, to assistant division engineer in 1901, division engineer in 1902, engineer maintenance of way of the Baltimore & Ohio Southwestern in 1905, and engineer maintenance of way of the eastern lines of the Baltimore & Ohio in 1910.

R. T. MCCLELLAND, of the engineering department of the Blaw-Knox Co., Pittsburgh, Penn., has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps.

CARL P. ABBOTT, formerly assistant works engineer for the Air Nitrates Corporation, Muscle Shoals, Ala., has become works engineer.

J. B. MYERS, district engineer maintenance of way of the Baltimore & Ohio R.R., with office at Baltimore, has been made engineer maintenance of way of the eastern lines, succeeding Earl Stimson, promoted.

OBITUARY

GEORGE WILLIAM DICKIE, naval architect and marine engineer, who had been associated with engineering and shipbuilding on the Pacific Coast for nearly 50 years, died suddenly at his home in Oakland, Cal., Aug. 17, at the age of 74. A native of Arbroath, Scotland, Mr. Dickie came to the United States in 1869, establishing himself in San Francisco. Soon after this time he designed the first successful triple-expansion engine built in the United States, and a few years later designed the first Scotch marine boiler on the Pacific Coast. From 1870 to 1883 he was connected with the old Risdon Iron Works, first as a draftsman and later becoming consulting engineer, during which time he designed the machinery for deep mining operations for the famous Con-Virginia Mine, including the deepest pumping apparatus in use up to that time. In 1883 Mr. Dickie became general manager of the Union Works, remaining in this position until 1905, when the plant was purchased by the Schwab interests. During that period he designed many privately-owned ships as well as a large number of Government vessels, the best known of which are the old battleships Oregon, Wisconsin and Ohio and the cruiser Olympia, which became Admiral Dewey's flagship. He retired from active work about four years ago, but, following this country's entry into the war, offered his services to the Government. At the time of his death he was resident inspector for the United States Shipping Board at the Moore Shipbuilding Plant in Oakland. He was a member of the Technical Society of the Pacific Coast, the American Society of Naval Architects and Marine Engineers and the American Society of Mechanical Engineers.

NEWS OF ENGINEERING INDUSTRIES

For the Public's Benefit, Now and After the War

Washington Authorities Admit Soundness of Co-operation — Urge Pooling and Agreements Among Industries

(Washington Correspondence)

War throws into high relief many fundamentals. Our policy on big business has been to enforce competition. We could not dissociate coöperation from the probability of exploitation of the public. We admitted the economic soundness of coöperation, but our legislators were not equal to the task of establishing mechanism for securing the advantages and at the same time checking the predatory tendencies. The Sherman law and its successors were the best they could do. The shortcomings of these laws are now thrown into relief Pooling—a crime hitherto under the law—is suggested by the Government itself, while all manner of agreement between erstwhile competitors is urged by the authorities. The saving grace is price-fixing or the threat thereof if the coöperating producers are disposed to use their advantage against the public.

In other words, we have full coöperation, with just enough Government control to protect the public. Germany learned how to do this years ago. It has taken a bitter war to force us to see the way.

So far, the clearest endorsement of pooling comes in an order from the Fuel Administration to the cement manufacturers. It provides, among other things, that if two or more manufacturers find that they can save fuel by using jointly their allotments, they may use, upon permission from the Fuel Administration, "at one or more of such plants to be operated by them jointly, sufficient fuel to manufacture 75 per cent of the aggregate of the average annual production of all such plants when operated separately, the manufactured product of such jointly operated plants being distributed to the individual manufacturers as may be agreed between them."

Attention is called to the last clause, regarding distribution of the product. Under this regulation a company owning one of four mills in a given location could shut it down, disband its distribution organization and yet share in the returns on cement to the manufacture and marketing of which it contributed only its coal allotment. It is just this sort of shutting down and pooling that the lime manufacturers have proposed to the War Industries Board, though their proposal includes also the restriction of distribution, to prevent cross hauling (such as is now enforced in the distribution of coal). The lime manufacturers' case, too, is still more interesting because their restriction is to 40 per cent of former production, while the cement reduction is to 75 per cent.

There is no need to detail here the advantages of such pooling in the saving of man-power, the more efficient use of fuel and the saving in transportation. These are so evident that the proposal of the lime manufacturers will surely be endorsed by the War Industries Board.

These recognitions of the economic advantages of pooling and coöperation by a Government which heretofore has frowned on these practices are material gains to be put on the rather bare credit side of the war ledger. But if we hold the principles sound only for war-time, the gain will be slight. These practices should enter the structure of the remade laws that should follow the war. War has merely been the incident to show that we can secure the advantages of pooling and coöperation without also risking the assumption of the disadvantages.

Regional Advisers to Government Appointed by War Board

The United States has been divided by the War Industries Board into 20 districts headed by men appointed as regional advisers. These advisers will serve "as the points of contact between the Government and the business men of the country," and, together with subchairmen, as assistants, will act as advisers to the Government in an effort to organize the business men "to assist the Government in carrying out its war program." The districts will be known as the Boston, Bridgeport, New York, Philadelphia, Pittsburgh, Rochester, Cleveland, Detroit, Chicago, Cincinnati, Baltimore, Atlanta, Birmingham, Kansas City, St. Louis, St. Paul, Milwaukee, Dallas, San Francisco and Seattle districts. The men appointed, it is explained, will "keep in touch with business men and conditions and inform the Government as to the supply and industrial situation in their respective districts."

Indifference Deadly, Warns Chairman Hurley

"Wake Up, America" with Reference to Merchant Marine Urged by Shipping Board

The United States Shipping Board, through its chairman, Edward N. Hurley, warns the nation of the peril to the newly-created merchant marine program through indifference. In two years the carrying capacity of the fleet of merchant ships now building will be 25,000,000 tons.

To prepare for utilizing this tonnage in the short time intervening between now and the time it will be released from war work, Mr. Hurley points out, requires immediate thought on the part of manufacturers and merchants. It was the indifference of the past century that proved so deadly to our first merchant marine.

This country will have at least 3000 ships, of modern design, to accommodate which port facilities and bunkering stations are being established all over the world, and efforts are being put forth to operate the fleet efficiently.

The Shipping Board points out that one of the chief obstacles hitherto encountered in the establishment of a merchant marine was the fear of cheap foreign labor. The idea prevailed that to obtain and hold an export trade would necessarily mean the lowering of wages and American standards of living. Now, however, it is recognized that the development of foreign trade must begin with more efficient methods in our own factories. Cheapness, in connection with foreign trade, and the capture of foreign markets by lowering American standards of living, are bogies which have been exposed by recent studies of the Shipping Board. The only foundation for foreign commerce is now generally understood to lie in the American manufacturer's ability to study labor and costs together, increase efficiency and decrease labor turnover and waste.

In calling for teamwork by all organizations throughout the country, Mr. Hurley asks the following questions: "Are you taking steps to use these ships to increase your own prosperity? Do you realize that American products of factory, farm, and mine can be delivered to customers in foreign countries on terms which will build a lasting trade? Do you realize the possibilities of bringing back raw materials to extend your products and trade? Are you applying the new world vision to the interests represented in your organization and learning what ships can do towards widening your market?"

New List of Priority Industries in Preparation

The Priority Committee, under direction of the War Industries Board, is preparing a new list of preferred industries. In the announcement received from Washington it is stated that although the list is not yet complete it will probably be twice as long as the one issued last April, which contained about 32 classes.

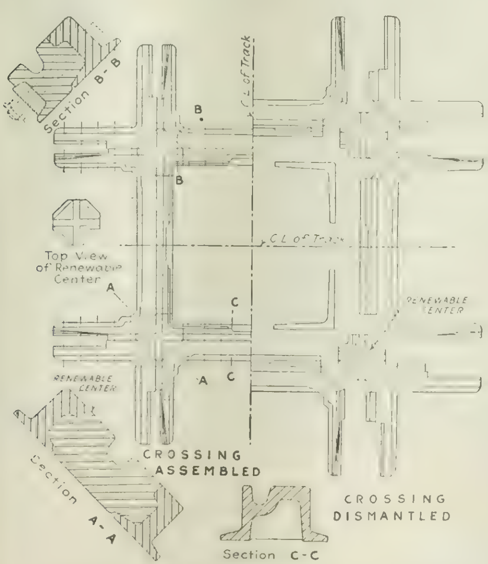
The new list will indicate what constitutes war work as interpreted by the War Department, and will be of assistance in solving the "war work or fight" ruling by men engaged in the essential industries listed.

The new list may be expected within the week. According to the statement from Washington, this amplification has been due to the widely expanded war needs and the increasing demands of important industries of civilian origin. The list is established on six basic elements of industry which are: Material, facilities, fuel, transportation, labor, capital. Each of these is represented on the Board except capital, and, it is stated, a working arrangement is established between capital and the War Industries and War Finance Boards.

Railway Track Crossing With Renewable Centers

Renewable centers for track crossing frogs of cast manganese steel have been designed in order to provide for ready repair of the parts subjected to the most severe wear, without the expense of taking up the heavy and costly crossing. Wear from passing wheels is concentrated at the intersections of the grooves or flangeways, so that these parts may require attention while the remainder of the crossing is in good condition.

In the new construction, as shown by the accompanying drawing, the crossing is built up of eight main castings, with four separate blocks or intersection pieces fitting between them. The main castings are bolted together, and the corners are reinforced by heavy inside knees. This type of crossing is made by the Balkwill Manganese Crossing Co., Cleveland.



CASTINGS PERMIT REPAIR OF TRACK CROSSINGS

Government Names Contractors on List to Lose Common Labor

A local ruling made in the District of Columbia which, if extended to the whole country, would apparently stop all construction work, was announced Aug. 22. The labor board of the United States Employment Service of the District of Columbia, acting in conformity with the declaration of the labor recruiting program, has issued a list of 25 activities which are classed as nonessential and from which the release of laborers, porters, janitors and other unskilled workers may be expected. The list includes the drivers of auto trucks engaged in work other than fuel or Government work, teaming other than delivery of products for war work, builders and contractors not engaged in the erection of structures for war work, and mercantile stores.

It is stated that the voluntary release of these men by their employers is expected without formal orders, but should this not occur formal orders will be served by the board. It is also stated that it may be necessary for the board to add to this list from time to time. Classifications are given for centralizing war labor recruiting programs for war work and include the manufacture or the erection of structures directly or indirectly supplied to the Government for war work (indirectly supplied meaning goods delivered under subcontracts, coal mining, railroads and farming, in so far as the latter is protected against labor recruiting). The making of products to be used ultimately for war purposes but not delivered directly to the Government, its contractors or subcontractors is not considered war work, and will be subject to demand on its supply of common labor as it is needed.

Plant Conditions To Be Studied to Reduce Labor Turnover

The conditions of war workers in factories will be studied by the United States Employment Service in an effort to solve the labor turnover which, according to the Employment Service, has assumed such large proportions as to endanger the volume of production. Representatives of the service and an expert in industrial management will visit one of the largest war plants of the country which has suffered from excessive turnover, and make a study of the internal conditions of the plant, in order that measures may be taken to keep the men at work. The plant at present is requiring 2000 unskilled workers a week, owing to the constant change and leaving of men

The establishment of the Employment Service has checked the rushing of workers from one plant to another by private recruiting agents, and has reduced the labor turnover to a large extent. The Employment Service believes that a further reduction of the turnover may be made by studying the internal conditions of the plants, for the purpose of removing conditions that cause the men to leave their work after a few days or weeks.

Business Notes

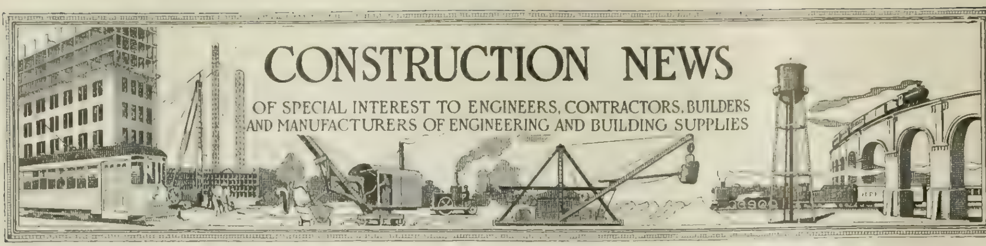
The West Coast Lumbermen's Association has established a Washington office at 519 Munsey Bldg., Washington, D. C. The office will be in charge of Dwight H. Davis, recently of Chicago, and formerly connected with the lumbering industries of the West coast. It is announced that the offices will be fully equipped to afford headquarters for the members at the capital.

E. P. Dillon, manager of the power division of the New York office of the Westinghouse Electric & Mfg. Co., has resigned to become general manager of the Research Corporation of New York.

Trade Publications

"Warner Heavy-Duty Truck Trailers" is the title of two bulletins received from the Warner Manufacturing Co., Beloit, Wis. One illustrates its two-wheeled heavy-duty 1¼- to 5-ton capacity trailers, the other its four-wheeled type, of 1½- to 7-ton capacity.

"Housing Labor" is the subject of a 36-p. book, 8 x 11 in., issued by the Gordon-Van Tine Co., Davenport, Iowa. Its main purpose is to advocate frame buildings made with lumber ready-cut and shaped for erection.



Six Months' Excavation and Miscellaneous Contracts Compared

Amount of Private, City and State Contracts Greater than that of Federal Government Work

The total amount of contracts awarded for private, state and municipal work exceeds that of the Federal Government work as reported in the columns of *Engineering News-Record.* The private, state and municipal work will be classed as private work in the following comparisons. The total amount of private contracts reported is $22,542,589 and for the Federal Government $11,390,077.

The private work does not include the port and canal work now in progress at New Orleans recently described in *Engineering News-Record.* It was announced that it would be done by day labor and it was estimated to cost about $6,000,000. Without this large item the percentage of the above figures amounts to 66 for private and 34 for Government work. In excavation and dredging alone the division is 57% for private and 43% for Government work. The miscellaneous items include some railway contracts, equipment, such as boilers, generators, heating systems, etc., together with such construction as dams, locks, port works, etc. Seventy per cent. of these contracts are in private and 30% in Government work.

Figs. 1 and 2 show these distributions by districts, and it will be noticed that Federal Government work predominates in the Northeastern and Middle Atlantic States only in Fig. 1. There is a slight preponderance in the Southern States for the miscellaneous contracts in Fig. 2. It will be noted especially that all the excavation and dredging work reported from the Middle Western States is private.

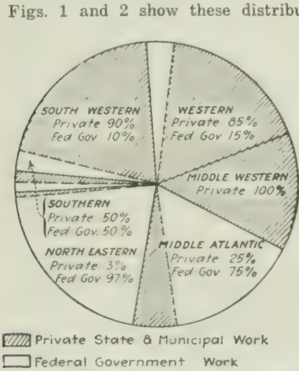


FIG. 1. EXCAVATION AND DREDGING CONTRACTS BY DISTRICTS

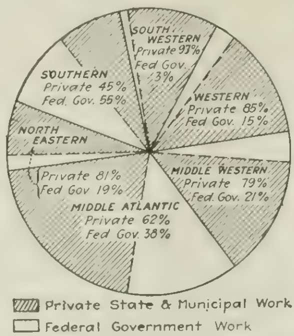
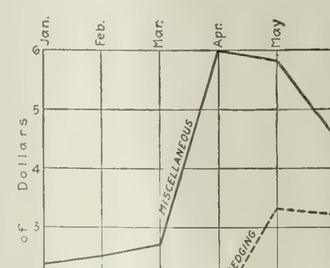


FIG. 2. MISCELLANEOUS CONTRACTS BY DISTRICTS

Most of the railroad items included under miscellaneous contracts are for Federal Government work in cantonments, especially those of the Navy, as well as marine railways in shipyards. The railway systems of the country have their own coterie of contractors, especially skilled, who have the machinery adapted for that work, so that railroad work is not represented to any large extent in any contracting news columns. Fifteen railroad items reported, including the Government work, amount to $2,164,478. There are 124 items under the miscellaneous columns reported for equipment, most of which were awarded by the bureau of yards and docks, Navy Department, for cantonment and naval station work. There are 119 construction items reported such as dams, culverts, retaining walls, fills, etc. Under the three headings, of excavating and dredging and miscellaneous, almost 300 items were reported, on only 40 of which no price was given. Of the items on which prices are given the average is about $11,000.

There are only eleven contracts reported ranging from $5,000,000 up, four of which are $1,000,000 and over, only two reaching the $2,000,000 mark. The Federal Government awarded one for ordnance proving grounds in Massachusetts, and another amounting to $1,993,000 is for river channel improvement at Columbus, Ohio. The two of $1,000,000 each are for dredging Hell Gate channel by the Government and for rebuilding blast furnaces by the Carnegie Steel Co. Eight of the items mentioned are for private work and amount to $6,635,000; the other three are for the Government and amount to $3,712,000.

On account of the war conditions in Canada, construction has been disorganized to a large degree. The construction news therefore is incomplete, but some large contracts are under way. In the Winnipeg district a $2,000,000 contract was awarded for tunneling under the Red River; a $600,000 contract was awarded in Quebec for work in connection with drydocks, there is a $200,000 contract on dams at St. Marys Rapids in Ontario, and the Dominion Government has a $770,000 drydock contract under way at Vancouver, B. C. All told, eight items are reported from Canada amounting to $3,894,500, and four contracts are reported on which no price is given. These include 14 miles of railway in British Columbia and a large drydock at Frederickton, N. B. At Vancouver foundations for a large grain elevator, on which no price is given, are also reported.



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A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, SEPTEMBER 5, 1918 — Number 10

Unified Air Service Promises Better Results

INDIGNATION is a mild word to characterize the feelings aroused the country over by the senate committee report on airplane production—or lack of it. Until the Hughes report appears it may be well to say no more than that the whole airplane procedure until within recent months showed absence of efficient engineering direction, both within and without the army, combined with overweening confidence on the part of inexperienced engineers and promoters. Happily there has been much improvement since John D. Ryan became head of the Bureau of Aircraft Production and still more may be expected now that the entire airplane program has been unified under Mr. Ryan as Director of Air Service and Second Assistant Secretary of War.

More Electric Driven Pumps Would Conserve Men and Fuel

HOW to keep enough competent men to operate water-works plants is a constant and increasingly serious problem in many cities. Substitution of electric for steam power is helping out materially in some places. There are many small plants and a goodly number of large ones where electricity from central stations could be substituted for steam with a saving alike of man-power and fuel. The change should not be made by city councils or water boards without first securing competent engineering advice.

Speed Construction Methods Will Persist

SPEED construction has been the engineering wonder of the war. What has had to be done has been done. Of the great essentials to victory time has been the most effectively used. With all this speed, however, there has gone the old assumption that it is tremendously expensive and means a lavish use of men and equipment beyond the economic possibilities of peace times. One of the real engineering lessons of the war would be lost if this view prevailed. On some kinds of work, of a sort that could readily be divided into units each with multitudes of men, costs undoubtedly became abnormal, but in numerous operations permanent in nature, though driven by military necessity, the time saving was the result of careful planning, of concentrated execution and an esprit de corps which multiplied the effect of effort. Contractors and engineers will not be slow to capitalize this experience when peace returns. A premium on speed will still be asked, for there is a human limit to everything, but time standards will be revised and many new enterprises will credit to themselves thousands of dollars in earlier profits and saved capital charges as a practical result of methods developed in the war-drive construction of 1917 and 1918.

Are You Ready to Join the Fourth Liberty Loan Drive?

VICTORY for our righteous cause is nearer every day, but it is still a long road to Berlin. More men, more munitions, more supplies, all in vast numbers, must be sent overseas. More ships must be built to carry them. More money must be loaned our allies. More aid must be given to Belgium, to Russia, to all who have felt the heel of tyranny and are starving and bleeding for freedom. More billions must be provided to meet our commitments. To that end the Fourth Liberty Loan Campaign will begin Sept. 28. Are you ready? It is not enough to pledge your own subscription to the utmost. Other must be fired with zeal. Team work is required. Engineers, contractors, manufacturers, supply men, every reader of *Engineering News-Record,* are you ready to help—individually, through your firm or corporation, through your trade association your local, state and national technical society? Read the comprehensive plan announced on advertising page 110. Then be ready to do your part. Put the Fourth Liberty Loan over the top and shorten the road to Berlin.

Saving Engineers' Time by Motor Transportation

SCARCITY of engineers for municipal service makes it more important than ever to save their time. The Chicago Board of Local Improvements has reduced somewhat the time spent by its field engineers in getting to their work by planning meeting places and daily routes. It appears that there is still much loss of time due to reliance upon infrequently run street-car and suburban railway trains to reach outlying districts and then having to walk considerable distances to get to the work of the day. In the north division of the city there was an average time loss of 20 minutes in walking to and from work alone. Record of the actual time spent by the field parties in work and in getting to and from work is being kept by the engineers this year. Besides loss of time due to lack of transportation facilities it often happens that an engineer is needed on two jobs at about the same moment. One of the jobs is either held up or else the work is carried on at the risk of errors, inefficiency and increased cost. Motor transportation has been suggested as a remedy. It is used elsewhere, though not as much as it well might be.

With the present shortage of municipal engineers and the high salaries which they are either drawing or justly entitled to draw, conservation of their time and energy by the use of automobiles and all other proven facilities should be effected without delay

Value Based on Cost of Service

REPEATEDLY the courts have decreed that public utilities are entitled to a "fair return" on "fair value." The meaning of "fair value" is still as great a bone of contention as it was a decade ago. Original cost, reproduction cost, production cost, capitalized earnings—all have their advocates. And the advocates of each theory have had much from courts and commissions to support and to refute their theories. As yet, however, nobody knows what this elusive "fair value" is. Elsewhere in this issue Dean Raymond argues for a combination of investment and cost of operation—under the reasonable contention that the cwner is justly entitled to interest on the former and profit on the latter. It is not clear how this could be applied to competitive enterprises like railroads, where the interdependence of rates must never be lost sight of; but for the local monopoly it seems to have much to commend it.

The Whine and Smile in Labor Management

WHAT a relief to meet a manufacturer these days whose first word is not a complaint over labor difficulties and labor shortage.

Recently we had one of those pleasant experiences. Our guide through a plant of 5000 men said little about the labor policies of the company. He trusted to the discernment of his visitors. But one would be blind, and insensitive in addition, to fail to see and feel the spirit of contentment, of interested endeavor, that pervaded the shop; or to notice the high average age of the workers and the very small proportion of foreigners.

These things do not just happen. And the story came out in talking with the factory and the general executives. First in importance, the White Company, motor car and motor truck manufacturers, for their plant at Cleveland is the one in question, has believed in the mature man, has valued highly his experience and steadiness. Secondly, the company has acted on the belief that the high-class men it seeks must be paid well and must progress. Consequently, it has voluntarily advanced wages with the cost of living, using Bradstreet's index figures as the basis. The wages per man have been almost doubled since 1914. There is no profit sharing. The full wage goes into the pay envelope each week. With this intelligent wage policy has gone the highest consideration for the welfare and comfort, and even the opinions and feelings of the men. No important move affecting them is made without getting the views of the shop committee, composed of one committeeman for every 10 men—a large committee, securing thorough representation.

The reasons for these policies are not philanthropic or sentimental, but are based on commonsense, hard-headed business judgment and belief in the doctrine of fair play.

"If we had a $25,000 machine in the shop," says E. W. Hulet, the superintendent, "we would put it in a glass-cased room, appoint an expert to run and take care of it and cover it at night. Why should we not treat a $25,000 man as well?" And at 6 per cent. any man who receives $1500 wages a year has a capitalized value of $25,000.

The executive heads resort to equally simple argument. "No one can run a business from a distance," said Walter C. White, sales manager. "The place for the manager is at the plant, not out on yachts, in Florida, or at the seashore. When you are on the job, you can quickly find out how things are running. If there are difficulties, don't run away. Face them, see the other fellow's point of view, and settle them on the basis of the square deal."

And the results?

No labor shortage—

Practically no spoiled work—

No strikes—

And, despite a doubling of wages an increased cost per dollar of output of only 3 per cent.

And yet the moss-backs, the divine-right industrial rulers, inveigh against labor, and form their associations for defense and sometimes for camouflage.

A little vision, a little sincerity, a little of the spirit of fair play and they would have less use for the associations.

And while they whine and fight, the Fords, and the Whites and the Filenes who have the vision and act on it go on smiling.

Contrasting Views of Water Meters

SHARPLY contrasting views of water meters are shown in clippings from newspapers in Chicago and Evanston. In Chicago, meters are little used, badly needed, strongly opposed, and, in the clipping, grossly misrepresented. In Evanston, meters have recently been introduced on a large scale and the clipping from that city shows that the dire allegations against them before their introduction were only expressions of popular fallacies or disingenuous arguments.

Following headlines alleging meter graft and robbery of the people, the Chicago *Eagle* of July 27 declared in nine paragraphs here made into one:

"The health and pocketbooks of the people are again menaced. The water meter promoters are at it again. This time a section of the daily press is backing the scheme. Water meters mean less water. Less water means poor health. Water meters are costly. They are unnecessary. The man who proposes water meters at this time is a traitor to the public."

Contrast the foregoing unsupported allegations from a city with few meters which has long been notorious for water waste and is now almost criminally burning fuel needed in war industries to pump vast quantities of water to run to useless waste with the following judicial words from the Evanston *News Index*, two days earlier.

"Last year when the meter system was installed in the homes of the city there were dire prophecies that there would be this summer no beautiful lawns, no flourishing gardens. Evanston was to become a place of

dry and barren waste because the people would hear the click of the meter registering nickels and dimes and dollars every time the hose was turned on the plants and the grass. But experience has shown that it was trouble seeking pure and simple to look forward to any such outcome of the establishment of a system by which the water user paid for what he used and for nothing else. It has apportioned the expense of running the plant in a fairer way. It has, most important feature of the new plan, effected the repairing of leaks which, before the water lost had to be paid for, were unattended, and has thus reduced the total used by the city, saved fuel and labor, and had no bad effect whatever upon the appearance of lawns and the flourishing state of the garden."

Comment is superfluous, but it may well be urged that Chicago engineers and engineering societies get behind and keep behind the water meter ordinance for which much valiant work was done a few weeks ago. The ordinance was "filed." It should be taken from the file and passed immediately, so a water and fuel saving campaign may be started without delay.

Another Threat to Stop Construction

REGULATIONS such as that of the local labor board of the District of Columbia, reported on p. 429 of this journal last week, even if inspired by the Department of Labor, should be carefully considered before being applied all over the country, according to the local lights of hundreds of local labor boards. The District board announced, among other things, that all construction work, except that for direct war purposes, must do without common labor, and that all truck drivers and teamsters not engaged in hauling material owned by or destined for the Federal Government must seek a more useful occupation. The manifest gap between the wording of the second part of this ukase and the curtailment in trucking which it is possible to effect without starving the public suggests that it may not be the intention to apply the first-mentioned section of the regulations literally to construction work. If so taken, however, this pronouncement furnishes an example of the difficulty connected with assuming control of common labor and leaving skilled labor in private hands. Withdrawing the common labor will shut down construction work completely. What is to be done with the skilled labor thus released? Have any plans been made for putting it to use? Of course, some of these skilled workers will go into the army. The majority of them, however, will not be so used under the present exemption plans of the Government. Most of them would have to throw away their skill and learn a new trade to go into a direct war industry, and a large part of them would have to move a considerable distance to reach such an industry.

Will all these things be considered? Will due consideration be given to the effect on the rapidly soaring cost of living of the great industrial waste entailed by stopping all construction? Does the Government plan to take over all residential construction in the worse congested cities which would be brought to a halt by this order? Has full consideration been given to the fact that this country owes the world other serious obligations consequent upon winning the war, and that it must be ready to meet them? Will this order of the Washington labor board be applied in the knowledge that this country is the last resort of the Allies, and that should it be compelled industrially to go the way of France and Great Britain there will be grave danger even yet that we shall lose all we are fighting for?

The country, those interested in building construction and especially contractors have a right to be fully informed on these points before local boards throughout the land begin applying these suggestions. According to varying local interpretations the contractors especially should at this moment be organized to advise with the Government on the stoppage of construction work and to furnish information from which correct conclusions can be drawn and wise action taken. The national organization of contractors which is being formed should be pushed along by every firm in the country. It is now even more necessary than before that the machinery of such an organization be got into action at the earliest date possible.

How Will the New Selective Draft Ages Affect Industry?

UNDER the new draft law passed by Congress and signed by President Wilson last week all men between the ages of 18 and 45 not now in military service are subject to call. The selective principle is retained, but the law itself says nothing about classes to be exempted.

The prospective passage of the law has stirred industry as has nothing since the war began. How will the selective principle be applied? Evidently the line will be drawn tighter than ever between the essential and nonessential industries. In other words, the "Work or Fight" principle will apply, but in the essential industries themselves what effort will the Government make to protect itself by retaining in the industries the men who are carrying the burdens of those industries—who furnish the executive brains, the energy and the enthusiasm? A great many of these men are between 35 and 45. Needless to say, their withdrawal would be a calamity. It is hard now to keep the industries going. Nothing less than stoppage would result if the main springs, the active managers, were taken. And with the decline of these industries would go not only the destruction of our industrial war program but also the net income of these companies and the consequent ability to pay taxes and buy Liberty bonds.

Beyond question our industrial structure, under the easiest condition, must suffer a very considerable alteration. This is to be expected. But the country would be the better off if business men were informed quickly of the Government's policy. Certainty should succeed uncertainty as quickly as possible. Only so can preparations be made for taking care of our industrial enterprises. The time for adjustment is all too short in any event.

A general policy needs to be declared. If interpretation is left to the local draft boards, the results to the industries and the Government may be serious.

So far the Government has applied the selective draft principle intelligently. The confidence created in the Government and in the Secretary of War should be retained by a frank declaration from the Secretary to the business men of the country at once.

American Army's Water-Works Projects in France Number About Four Hundred

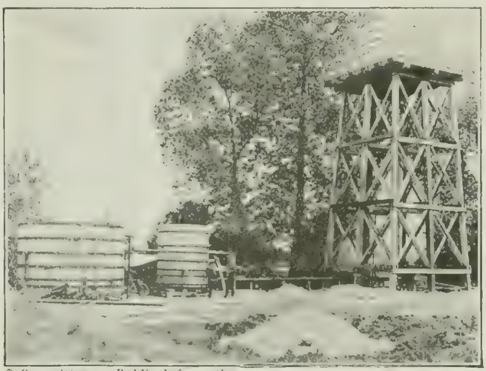
Great Range in Size and Character of Systems of Supply—Several Mechanical Filters Under Way—Laboratory Division Controls Quality of Water

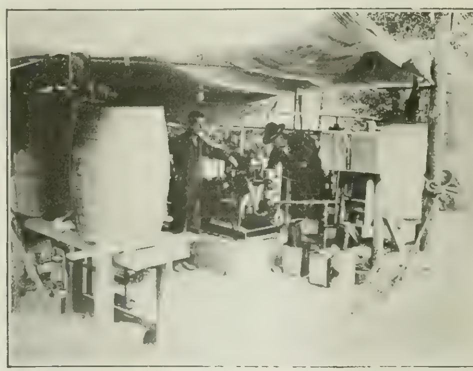
BY ROBERT K. TOMLIN, JR.

War Correspondent of Engineering News-Record

THREE HUNDRED AND SEVENTY-FIVE separate water-works projects—ranging in scope from the utilization of a shallow farm well to the building of a curved concrete dam, pipe line and mechanical filtration plant—represented the volume of work on hand in France early in June by the water-supply division of the American Expeditionary Forces. These activities are entirely distinct from those described in the article "Water-Supply at the Front" in *Engineering News-Record* of May 9, p. 892. The figures given above indicate the extent of the program which is being carried out by our water-supply engineers, and should disillusionize those to whom "the front" and "France" have taken as a matter of course. In France, however, conditions are vastly different. Water-supply systems with house connections are decidedly the exception in all but large cities. Small towns often are supplied from wells or from springs by means of pipe lines and public taps at various points in the village streets or squares.

With the coming of the American Army into France, it became necessary at the very outset to prepare an extensive program of water-supply for hundreds of localities. For example, there are the cantonments, training areas, railroad yards and terminals, aviation fields, supply depots, ordnance plants, repair shops and hospitals—to say nothing of the big developments required





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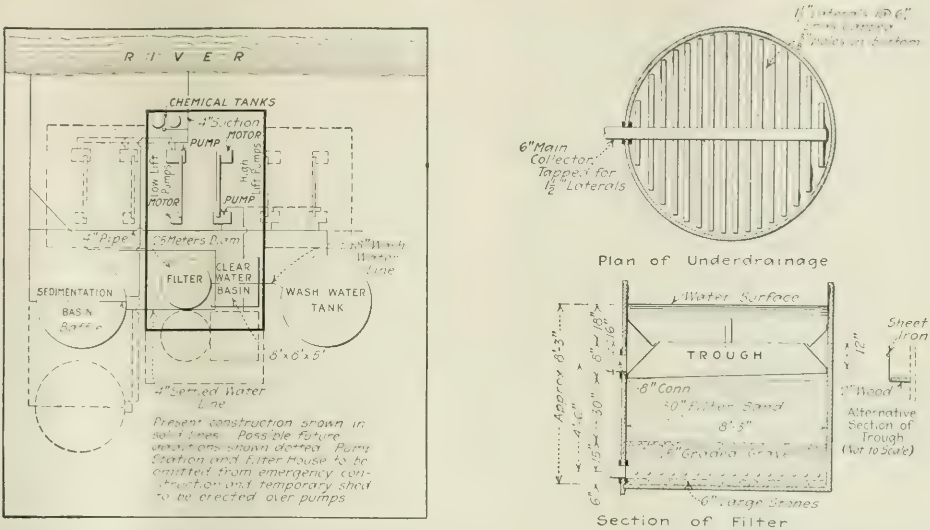
FIRST AMERICAN WATER-FILTRATION PLANT FOR USE OF THE AMERICAN EXPEDITIONARY FORCES IN FRANCE
1 GENERAL VIEW OF TANKS 2 PUMPING MACHINERY

become synonymous terms. As I pointed out in a former article, there is, between the coast and the so-called zone of the armies, an area containing hundreds of important centers of one sort or another, all essential parts of the military machine, where the services of the engineer are in demand. It is natural, however, that there should be a tendency for interest to focus upon the great drama which is being played in the immediate vicinity of No Man's Land and to pass by the less sensational, but highly important, activities which are being conducted in the areas of the services of supply.

Troops in large numbers are stationed in or near French villages or at sites which have been developed from farm land into large centers of population since our entry into the war. All demand water-supplies. Where existing systems are available, they are used or enlarged, but over here there is no such general provision of water-supply systems in small towns as in the United States. By the American at home the finding of running water, even in houses of small towns, is at base ports where, according to the official figures made public in July, American troops were landing on French soil at the rate of a quarter of a million per month. It is clear, therefore, that the problem of water-supply in the areas back from the front is one of segregated projects in great number rather than of a single large project.

An engineer organization reporting to the Director of Construction and Forestry, a brigadier-general, at the headquarters of the services of supply, has been formed to handle the water-supply work. At its head is a captain of engineers who was formerly principal assistant engineer in charge of the design of the $200,000,000 Catskill aqueduct for New York City. Assisting him are other engineers, experienced in the various special lines of water-works construction, filtration, sterilization, pumping machinery, etc. An important part of the work is the control of the quality of the water-supply. Laboratories for the chemical and bacterial analysis of water have been established at a number of points and are under the control of a director of labora-



FIGS. 1 AND 2. DETAILS OF FIRST MECHANICAL FILTRATION PLANT BUILT BY AMERICAN ENGINEERS IN FRANCE

tories who was formerly director of the Illinois State Water Survey.

All projects designed to obtain supplies from navigable streams or to pump water into existing French pipe lines required, originally, the approval of the French Ministry of War and also that of the local French officials. In the early stages of the work progress was delayed by the necessity of attending to a great many formalities, but recently the procedure has been simplified, and in the matter of requisitions of land, permits, etc., we are now dealing directly with French local officials, such as representatives of *Ponts et Chaussées*, prefects and mayors. This change in practice followed a request by the French Ministry of War for the submission of complete reports and plans on all water-supply projects contemplated for the use of the American Expeditionary Forces. With the limited force of men available and the huge number of projects in hand, the granting of such a request would have meant practically the shutting down of regular work for a good many weeks to prepare reports and wait for them to pass through official channels and receive the necessary approval. An understanding has been reached lately, however, whereby cumbersome procedure of this sort may be by-passed and our dealings conducted directly with the local authorities in the town or village where we are planning to operate.

As to the types of water-supply installations on which our engineers are engaged, there are, first of all, the large hospitals. At most of the 10,000-bed hospitals the water requirements are estimated to be 460,000 gal. per day. On these projects there are generally two alternatives, pumping from a river or obtaining a supply from wells. The use of liquid chlorine for water sterilization is included in many of the American Army projects.

Near the docks at one of our base sections an artesian well 700 ft. deep has been driven and is yielding about 500,000 gal. per day of excellent water, requiring no purification or sterilization.

Railroad water points must be established at frequent intervals. Negotiations are under way with the French railroads for increasing or supplementing their supplies along lines to be used by the American Army. The actual needs at these points are determined by the director general of transportation and the work is then turned over to the director of construction and forestry for whom it is handled through the water-supply division.

One of the more elaborate installations has involved the construction of a curved concrete dam 50 ft. high, and a new mechanical filtration plant. At another point an old French slow sand filter plant is being remodelled as a rapid filter.

At a port where American troops arrive in large numbers it has been necessary to supplement the existing water-supply by pumping from a river 800,000 gal. daily. The pumping station has been installed and 600 ft. of 10-in. pipe and 2200 ft. of 8-in. pipe laid. Sterilization here is by means of liquid chlorine. The French requirements as to the quality of water which we introduce into their mains are very high—no b. coli in one liter. With the liquid chlorine sterilization methods in use, we have been successful in meeting these requirements by applying a heavy dose of liquid chlorine and, later, dechlorinating with a thiosulphate solution.

The first filtration plant built in France by American engineers is situated at an aviation production center, and its general features are shown by Figs. 1 and 2. It supplies about 100,000 gal. of water per day (and may ultimately be enlarged to a capacity of 500,000 gal. daily), and it consists of an 8-ft. wooden tank containing about 30 in. of sand and from 12 to 15 in. of graded gravel. The main collector is a 6-in. pipe tapped for 2½-in. laterals. It was, of course, impossible to secure strainers, so holes were drilled at 6-in. intervals

in the under side of the lateral collectors. The annular wash-water trough is made of old biscuit tins. For cleaning the filter sand a straight water wash is em-

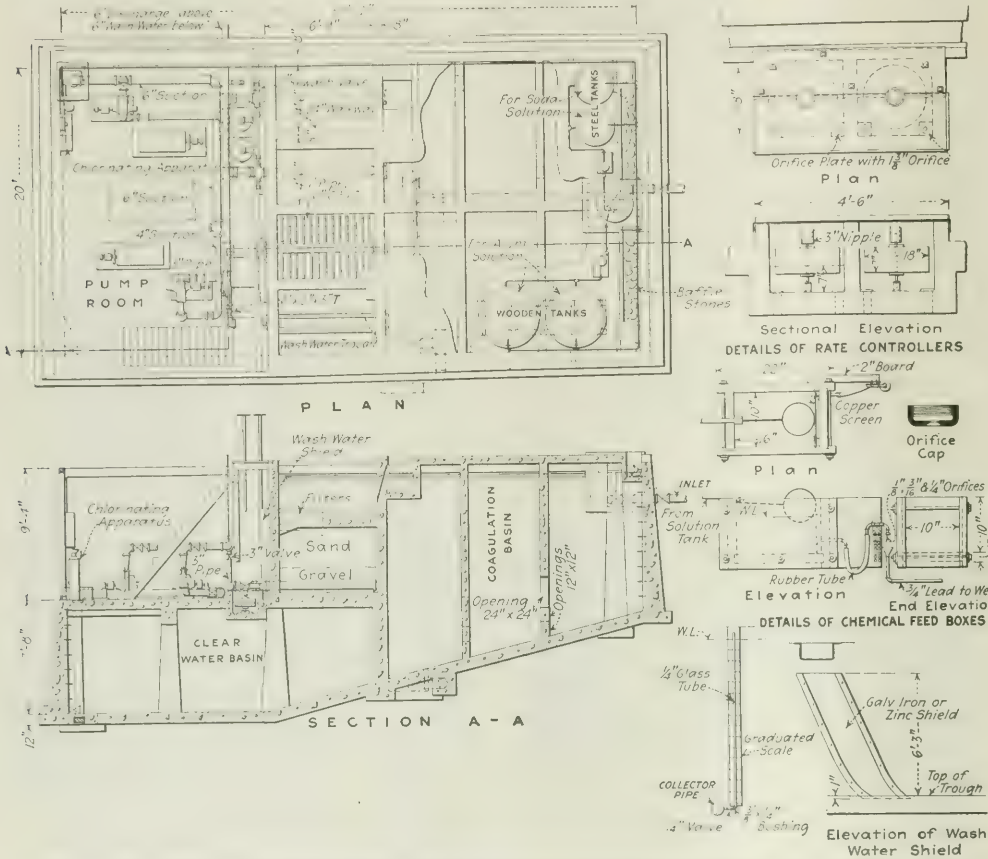


FIG. 3—ONE OF THE LARGER CONCRETE WATER-FILTRATION PROJECTS ON WHICH THE AMERICAN ARMY ENGINEERS ARE AT WORK IN FRANCE

ployed, the velocity of the upward flow being about 2 ft. per minute.

In this plant the raw water is pumped from a river, and first passes through a circular sedimentation tank with a vertical baffle. The coagulant is an alum solution applied at the suction lift at the rate of 2 grains per gallon. The clear-water basin is concrete-lined, and wash-water is taken care of in a wooden tank whose bottom is elevated about 30 ft. above that of the filter floor. The filter effluent is treated with liquid chlorine.

One of the novel features of this plant is the pumping layout. Both the low-lift and the high-lift centrifugal pumps are driven by the same motor by means of belting and pulleys from a single shaft. The high-lift pump works against a head, including friction in the distribution system, of 160 feet.

The engineer officer who had immediate charge of this project was formerly on the staff of Morris Knowles, consulting engineer, Pittsburgh. Speaking of the design of this first filter plant and other waterworks projects, he summed up the situation about in these words: "We must work with the materials at hand—not with what we might like to order in normal times, but with what we can get quickly. The procedure in design resolves itself into these steps: Get a copy of the stock list of materials at the storage yards in France, see that machinery, pipe and fittings are available and prepare a design which will fit them together."

A more elaborate filtration project is one serving a large hospital site, which is supplied from a 120,000,000-gal. reservoir formed by a curved concrete dam about 50 ft. high. From the dam a 6-in. pipe line delivers by gravity to a float chamber at the end of the coagulating basin. The water for this plant has low alkalinity and it is necessary to apply both soda ash and alum. The tank inlet is a concrete trough. The unusual feature is that this trough is filled with large stones which serve as baffles and cause a thorough mixture of the chemical solutions with the raw water before

entry into the coagulating basin. The latter is fitted with two baffle walls, as shown in the drawing, and the floor inclines toward a pump and blow off.

While the design (Fig. 3) provides for four mechanical filter units, with a combined capacity of about 330,000 gal. daily, only two of these units are being equipped at present. Each filter tank measures 4½ x 46¾ ft. and contains 30 in. of sand and 18 in. of gravel. The collector system is, in type, the same as that used at the aviation production center plant previously noted. The header is a 6-in. pipe into which 1-in. laterals, perforated with holes on the under side, are tapped. The filtered water is sterilized with liquid chlorine applied on the suction lift line of the pumps delivering to the distribution system.

The filter effluent passes through rate controllers of the type shown in one of the details of the drawings. These maintain a fixed head on pairs of 2½-in. orifices, the latter discharging into the clear-water basin.

The chemical feed control is another detail that should be noted. It is of a very simple type—a constant-head tank discharging through a flexible tube, the elevation of whose orifice end may be varied by the series of steel pin supports shown.

Another water-supply and purification project at an important base point has involved the creation of 1,500,000,000-gal. storage capacity in reservoirs 15 miles from an existing French slow sand filtration plant. This water is delivered about 10 miles of the distance by canals, and the remaining 5 miles by a 24-in. cast-iron pipe line laid on the ground surface. The old filter plant is being remodeled into a rapid mechanical filter. Before the pipe line was completed, it was necessary—so heavily was the existing plant capacity taxed—to bring water in tank boats to a point where it could be pumped into the reservoir supplying the old filter plant. The remodeled filters will have an output of 3,000,000 gal. daily.

Other Water-Supply Projects

Other places at which water-supply projects are completed, under construction or contemplated are the engine terminals and yards, the depots and repair shops, the remount stations where large numbers of horses are stabled, the aviation and the motor-truck assembly and repair centers. From these places demands for a supply of water come, and it is the duty of the water-supply division to investigate the needs and design the works. Construction is generally carried out under the direction of the commanding officer at the place where the works are to be installed. In a general way, the water-supply division performs a triple rôle—state department of health, consulting engineer and purchasing agent.

Not the smallest of its tasks is the obtaining and distributing of water-works supplies. From scores of places come calls for pipe, fittings, pumps, motors. Before the work of allocating these materials was controlled, it sometimes happened that one locality would attempt to "corner" the available supply of cast-iron pipe by direct requisition on the storage depots, leaving other water-works projects at a standstill for lack of supplies. Someone would hear that "they have just received some pumps down at ——" and the result was a rush to get there first and bring them back home. This method of scrambling for water-works supplies has been eliminated by compelling all requisitions to pass through the headquarters office of the water-supply division. One engineer spends all his time examining these requisitions and assigning the available stock where it is most urgently needed. Of course, there is generally not enough to go round. Then, too, requisitions often call for an excessive amount of material, the canny man at the other end of the line having evidently decided to put by something for the future. The result is that the engineer who allocates the material, snipping off items here, canceling whole requisitions there, is probably the most cussed-out individual in France today.

It is necessary for the water-supply division to look far ahead as to its needs. At the present writing its forecasts are completed up to April, 1919, and a regular schedule of priority for transatlantic shipment of material has been prepared. The method of requisitions for material to be placed in stock on wharves in America, with monthly tonnage priority cables, appears to be the only practical way to handle the matter, according to the chief of the division.

Quitman Garbage Incinerator Ruling

The ruling of the State Supreme Court of Georgia in the suit which resulted in an injunction against the location of a garbage incinerator in the center of Quitman, Ga., as noted in *Engineering News-Record* of Aug. 8, p. 292, has been supplied to this journal by Bennet & Harrell, of Quitman, who represented the city in the case. The decision (or syllabus?), which is comprised in a single sentence, is as follows: "Where a municipal corporation was proceeding, under contract with a crematory company, to erect an incinerator, or crematory, for the consumption of the garbage of the city, on a lot selected by it about 300 yd. from the business center of the city, upon a guaranty by the crematory company that the plant, when completed, would consume the garbage without offensive odors, etc., and where the construction of the garbage plant had proceeded to within two days of completion, and an equitable petition was filed by certain citizens, with families, living within 100 yd. of the crematory, to enjoin the further progress of the work, because of the offensive odors, gathering flies, etc., which it was alleged would be caused from the hauling and dumping of the garbage, thus endangering the life and health of the citizens and depreciating the value of their property, and where on the trial before a jury there was evidence from which the jury could find that within the city there were other available vacant lots in a different and more remote section, away from the heart of the city and residential section thereof, and that hauling of the garbage by the residences of the petitioners would cause flies and noxious fumes and poisonous gases emanating from the garbage to pester petitioners and endanger their health and lives and depreciate the value of their property, a verdict against the defendant, enjoining the completion of the crematory, was authorized."

Tractors Rough-Level Lands Before Sale to Settlers

Reclamation Engineers Get Costs of Putting Acreage on as Favorable Condition as Units First Entered Upon

LAND-LEVELING operations were initiated in 1917 by the United States Reclamation Service as one of the food-production measures advocated by the Department of the Interior. As an experiment two tractors were operated on the Truckee-Carson project to determine costs of land preparation. Since then three more have been ordered and the work of leveling will progress on a larger scale. The following notes are taken from a paper by P. N. Cronholm in the March *Reclamation Record*, the photographs having been taken by a representative of *Engineering News-Record* who visited the project.

LAND IS PLOWED FIRST UNLESS IT IS SANDY

The plan is only to rough level the lands so that the problems of today will be no more difficult than those encountered by the first settlers on the better lands. This requires study of farm layout and proper water distribution, and will result in the elimination of nonproductive areas and more production per acre.

Before the leveling is started the topography of the tract is taken. This is mainly to determine the direction of slope to be given to the lands to be rough leveled. It is used also in locating main ditches and drains that apply to the tract, as a whole, and to locate farm laterals and tail water drains.

On tracts where the general slope is hard to determine with the eye, contours every half foot in elevation should be taken; when the slope is quite pronounced intervals of 1 ft. are ample, and where the tract as a whole has a pronounced slope every 2 ft. is sufficient.

After the topographic sheet has been prepared each farm unit is studied in the field and the plan of rough leveling outlined. As far as practicable the direction of irrigation is made to agree with the slope of the land; in fact, the slope of areas as small as five acres is considered in the scheme of irrigation and division of farm units.

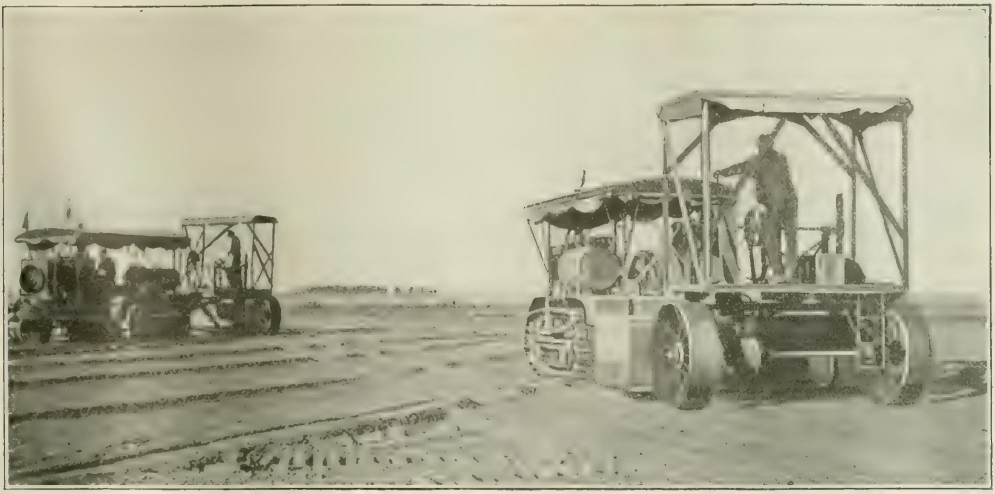
The "border-check" method of irrigation is rapidly growing in favor and is used almost exclusively on the Truckee-Carson project where lands are at all properly prepared or cropped. For this reason advantage is not taken of small level areas on farm units and to make compartments or basins of them it is usual to make grade and divide the lands so leveled into strips by building low, wide, parallel levees with the slope, 60 to 70 ft. apart. The slope of lands between levees, where soils are light, should not be less than 0.2 ft. per 100-ft. length; on more dense soils about 0.1 ft. per 100-ft. length is allowed as a minimum. The length of strips as they are being laid out by the Reclamation Service is from 330 to 660 ft., depending on topography and economic farm lateral layout and surplus irrigation water removal.

Where the general slope is steep, up to 3 ft. per 100-ft. length, depending somewhat on soils, it is possible, after a crop has been started, to use the "border-check" system of irrigation. However, to get a stand and avoid washing out the seed it is advisable, following seeding, to corrugate or furrow the lands between levees and use this method of irrigation until a fair growth has been attained. Where soils are very porous and percolation is so great that water will not find its way through the length of furrow, the length of run can be cut in two by providing a temporary supply ditch. After the crop has come through, this ditch can be dispensed with, water supplied from the ditch at the head of the lands, and the furrows and strip flooded as is the general practice with the "border-check" method.

When the lands between levees are being finished by the farmer he should keep in mind the importance of making the first 30 ft. of strip level in all directions; this permits uniform water distribution over the entire width before the water starts down the slope.

In laying out a farm unit to be rough leveled it is important to keep in mind the prevailing slope as indicated on the topography, possible water surface elevations and

WIDE SCRAPERS ARE USED IN ROUGH LEVELING



TRACTORS WORKED EVERY MINUTE OF DAYLIGHT ON LAND RECLAMATION PROJECT

the ditch and drain scheme as contemplated. After this has been roughly determined and the farm plowed to agree with the general scheme of the entire tract, a line of elevations is taken around a 5-, 10- or 20-acre portion of the unit, depending on the general slope, if any. Stakes are then set at the lower and upper ends of the land as guides for the tractors doing the rough leveling. The lands were first plowed but not disked. The sod crumbles under the weight of the equipment, and as the shaping of the land progresses the lumps disappear. In fact, sandy lands need not be plowed at all.

The lands are generally laid out in squares or oblongs, and with the view of requiring the least ditch length on each farm. The final leveling and shaping of the lands is to be done by the farmer at the time the levees and ditches are constructed. Work of this kind is usually done with horses attached to fresnos or tailboards.

If some satisfactory lighting scheme in the form of floodlights can be evolved it is intended to work the machines 24 hours per day. Should this prove practical, about 500 acres per month can be prepared; however, as it is more probable that only 16 hours will be worked, the acreage rough leveled per month will be about 300.

The two machines operated in 1917 worked 16 hours nearly every working day throughout the season. The amount of rough leveling done has averaged 126 acres per month, including all lost time, at an average cost per acre for operation of plant and equipment of $18.50; depreciation, equipment and plant, $5; engineering, $1.50; project, general, $3.75; total, $26.75. To this must be added $6 for plowing, which includes several plowings on some portions, and makes the total cost per acre $32.75.

In the tract where work is being done there are thirteen 80-acre units. Some leveling has been done on nearly every unit, and as the remaining acreage is noticeably rougher than that leveled it is assumed that when the tract is done the cost will average $40 per acre.

So far only unentered public lands have been worked on. The leveling of uncultivated settled lands has been considered but not decided upon; in fact, the terms at which the Government will require the return of the expenditures of rough leveling have not yet been determined.

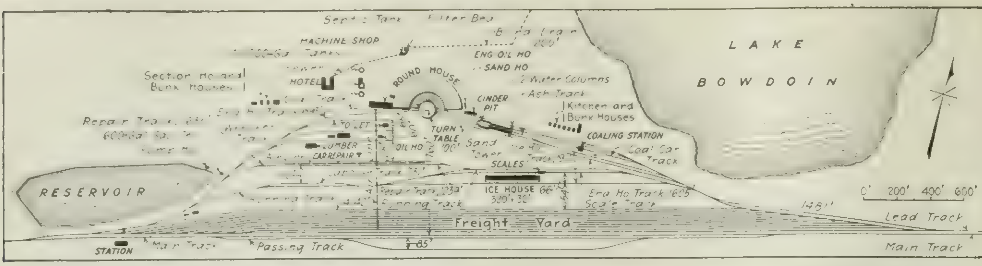
New Division Terminals Built To Meet Labor Law

Standardized Layouts at Ends of Shortened Runs Have Double-Deck Coaling Stations and Water-Treating Plants

TWO additional division points with freight terminal facilities, Wolf Point and Bowdoin, have been made necessary on the Montana district of the Great Northern Ry. in order to shorten the train runs, and thus enable the freight-train service to conform to the eight-hour law limiting the time of duty for train crews. The layouts are based on the company's standard general plan for division terminals, but have been modified and somewhat cramped at both places by reason of topographical conditions. Water-supply and coaling facilities present special features of the equipment. The layout of the terminal at Bowdoin, Mont., is shown in the accompanying plan.

The Montana district of the Great Northern Ry. extends from Williston, N. D., to Havre, Mont., a distance of 309 miles. It had originally a single intermediate division point at Glasgow, Mont., 156 miles from Williston, making two runs of a little more than 150 miles each. The distance has now been divided into three runs of a little more than 100 miles each, by the establishment of new division points at Wolf Point, 106 miles from Williston, and Bowdoin, 103 miles farther west. The new terminals were put in service Nov. 17, 1917, and the former terminal at Glasgow has been abandoned

Traffic at each of the new division points averages about 10 trains each way in 24 hours. No classification



LAYOUT OF THIS DIVISION TERMINAL AT BOWDOIN, MONT., IS A MODIFICATION OF STANDARD PLAN, GREAT NORTHERN RAILWAY

is made, but freight trains are held in the yard for the changing of engines and crews. The freight yard has 11 tracks about 4000 ft. long, and space is provided for nine additional tracks. These are connected at the west end to a ladder parallel with the main track, and at the east end to a ladder opening from a 4000-ft. switching lead which also parallels the main track. The spacing of the main and lead tracks is 20 ft. c. to c., and the body tracks are spaced on 14-ft. centers. The ladders are at an angle of 1:7 with the body tracks, and have No. 9 frogs in the turnouts for these tracks.

Beyond the yard are two car-repair tracks 1300 to 1600 ft. long, and space is provided for four more tracks, all spaced on 20-ft. centers. Two of them will be covered with a shed for a length of 800 ft. Between the repair yard and the freight yard are a caboose track and a running track, the latter being for engine movements.

Beyond the repair tracks is the yard for materials, with storehouse and lumber shed. At the east end of the yard is an icehouse with a track for supplying refrigerator cars. Adjacent to this is a scale track having a 150-ton scale with a table 50 ft. long. A compressed air line for power purposes and for testing brakes leads from the boiler house to the car repair tracks and the freight yard.

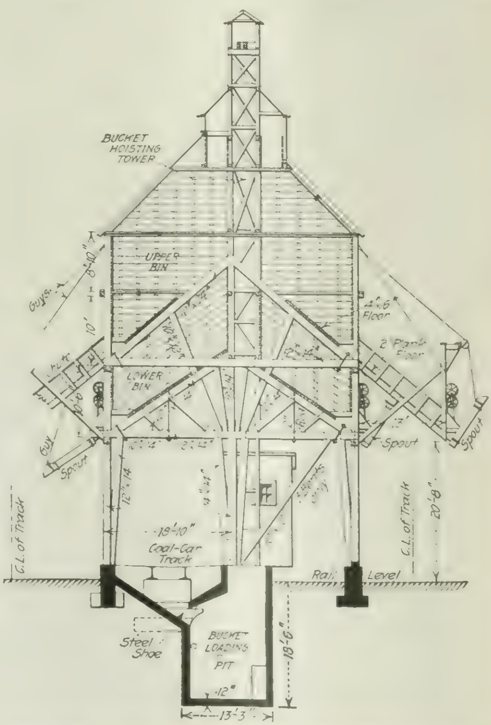
Engine terminal facilities are arranged outside of the freight yard and the repair yard. At the east end they are reached by a running track parallel with the ladder.

The 500-ton coaling station comes first. This station has a coal car track with receiving pit beneath it and engine tracks on each side. Beyond this are two tracks served by water cranes and extending over concrete cinder pits 70 ft. long, with provision for a future length of 140 ft. A depressed track for ash cars is placed between the two pits, the ashes being shoveled down inclined surfaces to the cars. The two outer tracks provide for moving engines past those standing at the coaling station and cinder pits.

These four engine tracks converge upon a 100-ft. tractor operated turntable, beyond which is a single track leading to the main line. A 25-stall roundhouse has been built, and provision is made for a 21-stall extension. This building is of brick, and has a frame roof.

The stalls are 104 ft. long, and an annular space 61 ft. wide separates the house from the turntable. Adjacent to the house are a machine shop and a boiler room. A stub track provides for coal cars to serve the boiler room, and a similar parallel track accommodates the wrecking train of the division.

The coaling stations are a special design of the Williams-White type with vertical bucket hoist. They are of frame construction. Each is capable of handling from one to four kinds of coal, as may be required, and of delivering coal to engines on four tracks, two on each side of the building. The 500-ton elevated bin is a double-deck structure divided into four compartments, which are fed by two 1½-ton buckets operating in a tower in the center of the bin. These buckets are arranged to dump in either direction, so that in combination with deflecting chutes they can discharge into any one of the compartments. The hoist is operated by a 20-hp. oil engine placed in a fireproof house, and



COALING STATION CAN HANDLE FOUR KINDS OF COAL AND SUPPLY FOUR ENGINES AT ONCE ON FOUR TRACKS

the buckets are automatically dumped and reversed for reloading. Extension spouts provide for delivering coal from the upper compartments of the bin to engines on the outer tracks, as shown in the drawing.

The water-supply at Wolf Point is taken from six drilled wells, 50 ft. deep, and is pumped to a 100,000-gal. tank on a steel tower 50 ft. high. This water is treated in a softening and sedimentation plant having a capacity of 200,000 gal. daily. Treated water is delivered to a 100,000-gal. tank 20 x 30 ft. on a timber tower 30 ft. high. From this it is piped to the standpipes or water columns for supplying the engines, and also to the shops and the repair yard.

At the other terminal, water is taken from Bowdoin Lake. As this lake is very shallow and the water becomes extremely bad toward the end of winter, a reserve supply is pumped to a reservoir of 1,000,000 gal. capacity. The company intends to take the supply eventually from an irrigation ditch diverting water from Milk River, and as this will be available only during the irrigation season, the reservoir was built to permit of its being filled by gravity flow. When further storage is needed a second reservoir can be built, or the sides of the present one may be raised to increase the capacity, the additional water being pumped either from the ditch or from wells near the roundhouse. Under the present laws, however, the U. S. Reclamation Service cannot grant the right to use the irrigation water, and the lake must be depended upon.

Water-treating plants are installed at both places and are similar to those constructed at numerous points along the 640-mile stretch between Devil's Lake, N. D., and Cut Bank, Mont. They are of the type designed by C. Herschel Koyl, engineer of water service for the Great Northern Ry. Economy in the use of water has been the subject of special attention at the two new terminals. Arrangements have been made for the use of raw water wherever it will serve the purpose, such as for washing out boilers, while warm treated water is provided for refilling the boilers.

Grading and tracklaying at Wolf Point were done by A. Guthrie & Co., St. Paul, while the buildings and the water-treating plants were constructed by W. F. Hill, Superior, Wis. At Bowdoin, the grading, track-laying and construction of buildings and water-treating plant were done by Grant Smith & Co., of St. Paul. The two coaling stations were built by the Howlett Construction Co., Moline, Ill.

Design and construction of these new terminals were under the direction of A. H. Hogeland, chief engineer of the Great Northern Ry. H. J. Seyton and G. A. Zachrison were assistant engineers in charge of work at Bowdoin and Wolf Point, respectively. Both reported to P. S. Hervin, resident engineer at Great Falls, Mont.

Cleaner and Better Streets for Detroit

Coöperation in a movement for cleaner streets is being urged by H. H. Esselstyn, the new commissioner of public works of Detroit. Street cleaners, garbage collectors, representatives of social, civic, business and political organizations, and the public generally, were recently invited to attend a conference and make suggestions regarding the cause and cure of dirty streets and pavements in bad repair.

Computing the Lateral Pressure of Saturated Earth

Proposed Method Takes Account of Separation of Hydrostatic From Earth Pressure, But Allows Full Hydrostatic Pressure

By A. G. Husted

Engineer, Department of Public Sanitation, Indianapolis, Ind

FORMULAS giving the lateral pressure of earth against vertical walls may be found in many textbooks and handbooks. These formulas, however, usually refer to dry earth, and not to earth which is saturated with water. The writer has had occasion, when designing structures wholly or in part below water level, to calculate the lateral pressure of saturated earth, and being unable to find a satisfactory method for computing these pressures, has worked out the method herein set forth.

The usual formula giving unit lateral pressure is $p = w\ h\ \tan^2 (45° - \frac{1}{2}\Phi)$, where p is the unit lateral pressure, w is the weight of earth per cubic foot, h is the distance below the surface, and Φ is the angle of repose. Since the unit pressure varies directly with the depth, the total pressure per unit length of wall is equal to one-half the unit pressure at the bottom multiplied by the height. Thus $P = \frac{1}{2}w\ H^2 \tan^2 (45° - \frac{1}{2}\Phi)$, where P is the total lateral pressure and H is the total height. This is the form in which the formula is usually given. In this discussion, however, the formula giving unit pressures, $p = w\ h\ \tan^2 (45° - \frac{1}{2}\Phi)$, will be used, for obvious reasons.

Relation of Lateral Pressure to Vertical

As has been noted before, this formula assumes that the lateral pressure at any point bears a definite relation to the vertical pressure, this relation depending entirely upon the angle of repose. It will thus be seen that the second part of the equation can be divided into two parts, $w\ h$ representing the unit vertical pressure and $\tan^2 (45° - \frac{1}{2}\Phi)$ representing the relation between lateral and vertical pressures.

Two methods of applying this formula to cases involving saturated earth have been and are still in quite general use. One of these methods consists in computing the total lateral pressure in the usual way, using for w the weight of dry earth and for Φ the angle of repose of dry earth. To this pressure, then, is added full hydrostatic pressure below the plane of saturation. This method may quite often give results close enough to actual conditions for ordinary purposes of design, but it appears to the writer to be at variance with the fundamental formula. In the first place, no allowance is made for the fact that saturated earth has a smaller angle of repose than dry earth, and in the second place it is assumed that earth weighs the same in water as it does out of water.

Another method of calculating lateral earth pressures consists in computing the total lateral pressure in the ordinary way and adding to this partial hydrostatic pressure below the plane of saturation. The amount of the partial hydrostatic pressure to be added is determined by taking the difference between full hydrostatic pressure and lateral earth pressure for an equivalent

depth. This method, however, can easily be proved erroneous by applying it to a fill of completely saturated earth. In this case the partial hydrostatic pressure to be added will be the difference between full hydrostatic pressure and lateral earth pressure for the total depth of earth. It can thus be seen that the total lateral pressure at the bottom would be exactly equal to full hydrostatic pressure. This is absurd.

In order to correct the errors in the above mentioned methods, a method has been worked out which the writer believes to be theoretically correct. In this method the following assumptions are made:

> Lateral earth pressure varies directly with the vertical earth pressure for earth with any given angle of repose and is equal to the vertical earth pressure multiplied by $\tan^2 (45° - \frac{1}{2}\Phi)$.
>
> Water exerts full hydrostatic pressure laterally as well as vertically, regardless of the amount of space occupied by earth.

It is a well-known fact that the angle of repose of earth in water is less than the angle of repose of dry earth. Therefore, the ratio of lateral pressure to vertical pressure is greater below the plane of saturation than above. On page 580 of Merriman's "American Civil Engineers' Pocket Book" the angle of repose of dry soil is given as 36°53′, while that of soil under water is given as 15°57′.

Above the plane of saturation the lateral pressure is computed in the usual manner. Below the plane of

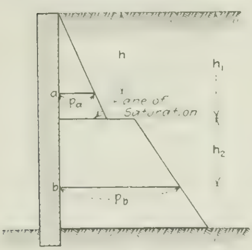


FIG. 1

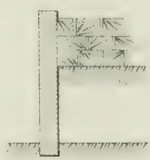


FIG. 2

saturation the lateral pressure is obtained by multiplying the total vertical pressure less the buoyant effect of water by $\tan^2 (45° - \frac{1}{2}\Phi)$ and adding to this the full hydrostatic pressure. For example, in Fig. 1 the unit lateral pressure p_a at point a which is above the plane of saturation is $w_1\, h \tan (45° - \frac{1}{2}\Phi)$. W_1 is the weight of dry earth per cubic foot, h is the distance of the point a below the surface and Φ_1 is the angle of repose of dry earth. Likewise the unit lateral pressure p_b at point b below the plane of saturation is $(w_1 h_1 + w_2 h_2) \tan^2 (45° - \frac{1}{2}\Phi_2) + 62.5\, h_2$. W_1, as above, is the weight of dry earth per cubic foot, h_1 is the distance from the ground surface to the plane of saturation, w_2 is the weight per cubic foot of earth under water, h_2 is the distance of the point b below the the plane of saturation, and Φ_2 is the angle of repose of earth under water.

It will be noticed that in this method, for points below the plane of saturation, hydrostatic pressure and earth pressure are separated; that full hydrostatic pressure is allowed; that the vertical earth pressure is obtained by adding the total weight of earth above the plane of saturation to the net weight (weight under water) of earth below the plane of saturation; that the lateral earth pressure is obtained by multiplying this vertical pressure by $\tan^2 (45° - \frac{1}{2}\Phi_2)$; that the total lateral pressure is obtained by adding the hydrostatic pressure to this lateral earth pressure.

It can be readily seen that if a smaller angle of repose is assumed for saturated earth than for dry earth, there will be a decided increase in the unit lateral pressure at the plane of saturation. In other words, the unit lateral pressure an infinitesimal distance below the plane of saturation will be much greater than that at an infinitesimal distance above the plane of saturation.

At first thought this appears absurd, but it can be seen that it should be so. It can perhaps be best illustrated by an exaggerated example. Take the case of a retaining wall supporting a bank of earth loaded with timbers (Fig. 2); the lateral pressure of the timbers against the wall is zero, but at an infinitesimal distance below the surface of the earth the pressure is a considerable amount due to the load that is superimposed.

The difference is plainly due to a difference in the angle of repose.

The problem of obtaining the resultant lateral pressure is comparatively easy after the unit lateral pressures have been computed. This can be best illustrated by a practical case. Take for example a wall supporting 10 ft. of earth, the lower 6 ft. of which are below water level and hence saturated. Assume dry earth at 100 lb. per cubic foot, and earth under water at 70 lb. per cubic foot. Assume a natural slope for dry earth of $1\frac{1}{2}$ to 1 ($\Phi_1 = 33° 41'$) and for the earth under the water of $2\frac{1}{2}$ to 1 ($\Phi_2 = 21° 48'$).

Lateral pressure at the plane of saturation due to dry earth $= 100 \times 4 \times \tan^2 (45° - 16° 50.5') = 114.4$ lb. per square foot.

Lateral pressure at plane of saturation due to saturated earth $= 100 \times 4 \times \tan^2 (45° - 10° 54') = 183.2$ lb. per square foot.

Lateral earth pressure at the bottom $= (100 \times 4 + 70 \times 6) \tan^2 (45° - 10° 54') = 374.6$ lb. per square foot.

Hydrostatic pressure at the bottom $= 62.5 \times 6 = 375$ lb. per square foot.

Total lateral pressure at bottom $= 374.6 + 375 = 749.6$ lb. per square foot.

Total resultant lateral pressure above the plane of saturation per foot length of wall is $114.4 \times \frac{1}{2} \times 4 = 228.8$ lb. This is applied at a point $1\frac{1}{3}$ ft. from the plane of saturation or $7\frac{1}{3}$ ft. from the bottom of the wall.

Total resultant lateral pressure below the plane of saturation is $\frac{1}{2}(183.2 + 749.6) \times 6 = 2798.4$ lb. This is applied at a distance of $\frac{6}{3}\left(\frac{749.6 + 2 \times 183.2}{749.6 + 183.2}\right)$ or 2.4 ft. from the bottom.

The resultant lateral pressure against the wall per foot of length is then 228.8 lb. + 2798.4 = 3027.2 lb. This is applied at a distance of $\frac{228.8 \times 7.3 + 2798.4 \times 2.4}{3027.2}$ = 2.77 ft. from the bottom.

Water-Supply, Sewerage and Heating for Florida Home

Engineer Designs and Supervises Construction of Domestic Systems — Iron Removal — Imhoff-Dortmund Tank

By W. G. Kirchoffer
Sanitary and Hydraulic Engineer, Madison, Wis.

After having designed water-supply and sewerage systems for individuals, corporations, and municipalities for the past twenty years, the writer had the pleasure during the past winter of not only designing these systems for his own winter home at St. Petersburg, Fla., but of building them as well.

At this place water is found in the sand under a layer of hardpan at a depth of about 16 ft. and the usual method is to drive a 1½-in. pipe and "point" to the proper depth. The point was 4 ft. long, of No. 60 gauze. The water obtained from this well is soft, but contains iron and tannic acid, which colors the clothes in the laundry, and on being heated for the bath produces a dark brown suspended precipitate. When fresh it is not a bad drinking water, certainly as good as most Florida waters.

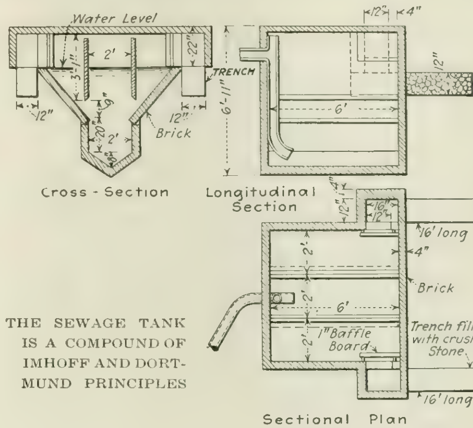
For use in the laundry the water was treated the night previous with a small quantity of lime and allowed to settle in a common tub. In the morning it was strained through three or four thicknesses of linen. The straining removed the objectionable precipitate.

For pumping equipment I was able to obtain a second-hand "tank" pump with a 2½-in. cylinder and a 4-in. stroke. This had to be operated by hand. For the storage of water two 50-gal. barrels were used, as no galvanized-iron tank, or the material to make one with, could be purchased. These barrels were located in the attic of the house with the tops approximately level with the top of the expansion tank on the heating system. This gave a pressure of about 10 lb. per square inch at the pump, which was sufficient for all purposes.

Combination Sewage Tank

The sewage from the house was carried by a 4-in. sewer to the rear of the lot, where a digestion tank was constructed. This tank was constructed so as to combine the principles of the septic, Imhoff and Dortmund tanks.

The sewage enters the central deep compartment and is carried to a point near the bottom by a vertical vitrified pipe. From this digestion chamber the liquefied sewage rises to the slots below the baffle boards and passes into the side chambers. One-half of the sewage is supposed to flow each way. The bottoms of these chambers are built on a slope of 1.2 to 1, so that any organic matter settling out will slide down the steep slopes and be returned to the central digestion chamber instead of passing out of the tank or being retained in the side chambers. The outlets are at the end opposite the inlet and they are also protected by baffle boards so as to prevent any floating solids in the side chambers from leaving the tank. This tank may be said to consist of a central digestion tank of the Dortmund type and two side settling chambers of the Imhoff type. However, the essential difference between this



THE SEWAGE TANK IS A COMPOUND OF IMHOFF AND DORTMUND PRINCIPLES

and an Imhoff tank is that the sedimentation chambers follow rather than precede the digestion tank. It is expected that by this arrangement a better digestion of the sludge will take place and the clarification of the effluent will be more complete than that which takes place in an Imhoff or septic tank, where the sewage is extremely fresh. The effluent from this tank flows into two ditches 12 in. wide by 18 in. deep, filled with crushed rock (broken concrete). This was covered with old boards and a covering of earth was put over the whole.

The tank has a capacity sufficient for 10 to 12 persons, but only three used it the past winter, with very satisfactory results.

The amount of radiation was determined by the B.t.u. method, the following assumptions being made: Outside temperatures, 40°; inside, 70°; changes of air per hour, two; B.t.u. given off by one square foot of radiation per hour, 200. For a difference of temperature of 30° multiply each cubic foot of space by 0.6 B.t.u. For 30° difference in temperature multiply square feet of glass by 36 B.t.u. For exposed wall 15 B.t.u. For each square foot of floor and ceiling nine B.t.u. per hour.

The house was of the ordinary frame construction without plaster, but the exterior walls of all the rooms except the living-room and den were ceiled as an after consideration, so that the radiating surface provided is liberal for these rooms on the basis assumed.

Hot-Water Heating System

The requirements for this plant were so small that a hot-water heater having a capacity of 335 B.t.u. per hour was specified. The sizes of pipes were chosen from standard tables for hot-water heating. This heater was provided with a coil for heating water for the bathroom, independent of the heating system, or by opening two valves the entire heating capacity of the heater could be applied to the hot-water tank.

An expansion tank was provided in the attic on the same level as the top of the water-supply barrels, so that when the hot-water tank was connected to the heating system the expansion tank would not overflow.

The overhead system of distribution was adopted so

as to eliminate air troubles, and as far as possible keep heating pipes in the room, rather than under the floor, where they would have been exposed to outside air.

Wood is used as fuel at present, as there was plenty of waste from the lumber used on the house and from trees removed to make room for it.

It is not expected that this plant will have to be used continuously, but mostly mornings and evenings during cool spells and for the bath. Under these conditions wood firing will not be objectionable.

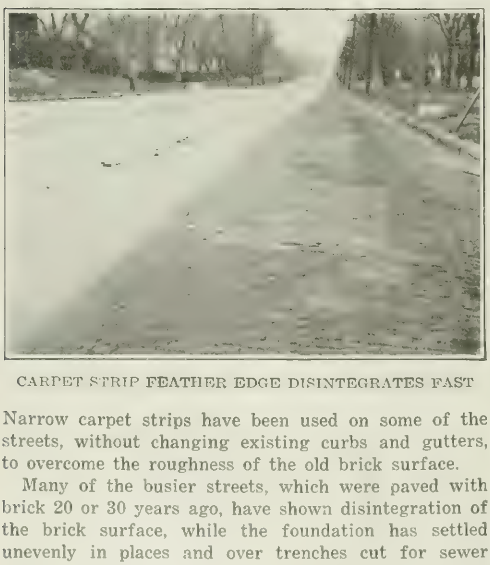
A local plumber wanted $200 to install the heating system, not including the heater and radiators, which I considered as excessive. The mason who was putting in the sewerage system and his colored helper offered to do the work for me by the day, with the result that more than $100 was saved on the heating system. All of the work was done by these two men on all three systems, under my constant supervision. The costs were as follows:

HEATING PLANT	
Freight and drayage	$22.73
Pipe and fittings	49.20
Labor	26.00
Eight radiators, 204 sq.ft.	74.33
Heater	65.36
Total	$235.83
WATER SYSTEM	
Pump	$10.00
Hot-water tank	10.15
Well	10.55
Pipe and fittings	7.95
Total	$38.65
SEWERAGE	
Brick, lime and cement	$28.59
Mason, two days' time	10.00
Helper, two days' time	4.00
Total	$42.59
Total of three systems	$317.07

Resurface Brick Pavements with Asphaltic Concrete

Raised Crosswalks Have Been Eliminated and Narrow Strips of Surfacing Have Been Used on Wide Streets in Topeka

PROCEDURE in resurfacing old pavement laid with comparatively soft brick, at Topeka, Kan., includes the removal of raised crossings at intersections, the substitution of concrete for the brick gutters and the covering of the old surface with asphaltic concrete.



CARPET STRIP FEATHER EDGE DISINTEGRATES FAST

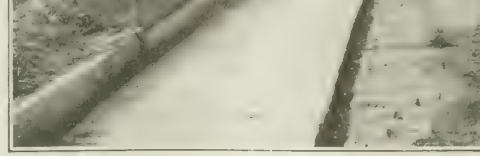
Narrow carpet strips have been used on some of the streets, without changing existing curbs and gutters, to overcome the roughness of the old brick surface.

Many of the busier streets, which were paved with brick 20 or 30 years ago, have shown disintegration of the brick surface, while the foundation has settled unevenly in places and over trenches cut for sewer or public utility installations. However, it is assumed that this surface and the foundation have become stable under the traffic of years, even at depressions, and consequently the wearing surface is applied without leveling the old pavement, unless it has entirely broken down.

The advent of the automobile has so emphasized the inconvenience and narrowing effect of raised crosswalks that, even on the wider streets, the citizens have demanded a change in design to meet the wishes of the user of the roadway, rather than the doubtful convenience of the pedestrian. On Topeka Ave., a 130-ft. street, where eleven blocks were resurfaced in 1917, and three more are being repaired this season, all of the crosswalk humps are leveled by relaying the old brick flat monolithically, and with grout filler, thus replacing the old deep sand bed. For the gutters the brick and sand bed are replaced by concrete 2 ft. wide, which is 6 in. deep at the undisturbed sandstone curb and 8 in. deep at the outer edge. This leaves a 2-in. edge against which to butt the asphaltic concrete, but does not lessen the former depth of the gutter. Photographs of the depressed walks and concrete gutters are shown.

For a few of the wider streets, 1½-in. asphaltic concrete carpet strips have been laid for a width of 8 ft on each side of the car tracks, and 16-ft. strips have been laid on streets having no tracks. The feather edges of these carpet coats as first laid were their vulnerable points and they have been abandoned for a 45-deg. slope banked with a hot iron and tamped by hand, the roller not being permitted to work within 6 in. of the edge. The thin edge was found to oxidize and crumble after a year's wear, and, once started, the disintegration extended rapidly toward the center.

While laying the asphaltic surface, it is the practice to take samples and make an analysis of the asphaltic



ABUTTING EDGE FOR ASPHALT FORMED BY GUTTER

mixture every day, and to retain a small portion in a tin box, properly labeled, as a sample of the mixture used. One of the vital points in getting the carpet strips to stick, is in the preparation of the old brick surface. It is essential to sweep the surface perfectly

REMOVE CROSSWALK HUMPS BY RELAYING BRICK FLAT

clean, and have it absolutely dry. It is then painted with 60% of asphaltic cement, which is cut back with 40% of domestic distillate. This makes the consistency such that it may be readily brushed over the brick surface, leaving a thin, even coat which will be perfectly dry in 24 hours or less. The 1-in. binder course and the 2-in. wearing surface, on repaving work, are applied with substantially the same precautions observed in the laying of new work on a concrete base. Depressions, however, are filled first with the binder to make the surface level.

The carpet strips are contracted for by the ton. Last year the cost of repaving, exclusive of curb work, was 90c. per square yard, but this year the price has been raised to $1.10 per square yard. The repaving work is done by contract under the immediate direction of W. E. Baldry, city engineer. It is paid for by the assessments on abutting property.

Flow in Chicago Water Tunnels Is Tested by Salt Solution Method

CAPACITY TESTS of the northwest lake and land water intake tunnel system at Chicago, described in the 1917 report of Department of Public Works, showed good results for brick-lined tunnels and a smaller coefficient of roughness than is usually found in tunnels of this size. The intake system consists of 20,700 ft. of 10-ft. tunnel from the Carter H. Harrison crib (14,033 ft. from shore) to the Green Street shaft, whence one 8-ft. tunnel extends 19,856 ft. to the Central Park Ave. pumping station and another 8-ft. tunnel extends 22,183 ft. to the Springfield Ave station. A short 7-ft. branch connects the 10-ft. tunnel with the Chicago Ave. station.

The mean velocity of flow was determined by observing the time it took for a sodium chloride solution to pass between various points, electrical indicators being used for the purpose. Water elevations were also noted. The amount of water passing through the 10-ft tunnel was larger by 41.05 cu.ft. per second than the sum of the flows in the two 8-ft. tunnels. This represents the leakage through the 7-ft. branch to the Chicago Ave. pumping station.

Considering the variations in velocities the factor C varies only from a maximum of 126 to a minimum of 120 for the 10-ft. tunnel and the coefficient n varies from

PUMP, PITOMETER AND HYDRAULIC OR SALT-SOLUTION TESTS OF CHICAGO TUNNEL CAPACITY

	Flow in cu. in. per second	
	Central Park Ave. Station	Springfield Ave. Station
By pumping record..............	167.28	140.42
By pitometer	119.22	118.77
By hydraulic tests	130.17	115.94

0.0139 to 0.0145. The values of the coefficient of roughness n give an average of 0.0141 for the Central Park Ave. tunnel and 0.0134 for the Springfield Ave. tunnel. Assuming the hydraulic test figures in the accompanying table to be the correct pumpage, the slip is equal to 22.18% for the Central Park and 17.43% for the Springfield Ave. tunnel. The tests were made by F. A. Smith, assistant engineer, under the direction of John Ericson, city engineer.

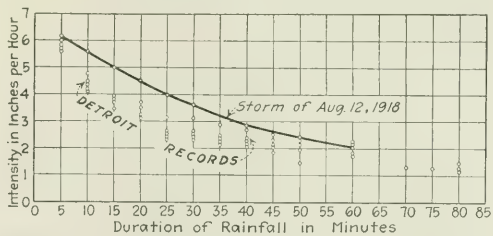
Record Rainfall at Highland Park

By George H. Ruhling
Resident Engineer, Filtration Plant, Highland Park, Mich.

WHAT is believed to be a record rainfall intensity for Michigan fell in Highland Park, Detroit, on Sunday, Aug. 12. The storm, following a drought of six weeks, broke at 3:48 p.m., accompanied by a high wind and much electricity, and was at its height at 4:35, stopping at 6:38.

The accompanying table and diagram were compiled from the gage register which has recently been installed on the roof of the Highland Park city hall by the city engineer, and from records of the United States Weather Bureau at Detroit.

That the excessive rainfall was quite local in char-



HIGHLAND PARK RAINFALL ON AUG. 16 EXCEEDING DETROIT RECORD FOR PERIOD 1896 TO 1915

acter is shown by the fact that the United States Weather Bureau at Detroit, only 5½ miles away, recorded only about ½ in. of total rainfall.

Much damage was done in Highland Park. A large

RAINFALL AT HIGHLAND PARK, MICH., AUG. 12, 1918

Duration of Rainfall, Min	Amount of Rain, In	Intensity, In per Hr	Occurring From	Occurring To
5	0.51	6.12	4.32 p.m.	4.37 p.m.
10	0.93	5.58	4.28	4.38
15	1.25	5.00	4:28	4:43
20	1.50	4.50	4:25	4:45
25	1.66	3.98	4:23	4:48
30	1.80	3.60	4:20	4:50
40	1.90	2.85	4:18	4:58
50	1.97	2.36	4:15	5:05
60	2.01	2.01	4:15	5:15
Total	2.21			

number of cellars were flooded with water backing up from the sewers, which are built on the combined plan. In some streets the water reached a depth from 12 to 15 in. It was, in a way, fortunate that the water could not get into the sewers faster than it did, as the damage through backing up into cellars might have been much greater. The filtered water reservoir for Highland Park, now being constructed, was filled with flood water from the Davison Ave. sewer to a depth of 15 in. About 350,000 gal. of water had to be pumped back into the sewer before construction could go on.

Steps Toward an Ethical Standard for Engineers

Adopt Definitions—Resist Exploitation of and By Engineers—Stop Trying To Shift Just Burdens

DURING the year since its organization, the committee on professional ethics of the Cleveland Engineering Society has made a thorough study of codes of professional ethics prepared by doctors, lawyers and architects as well as by engineers. It hopes to publish in time a booklet wherein all the material found needful for the society will be presented in concise form, together with specific "Do's and Don'ts" and specific instances of violations of standards. At a recent meeting of the society David Gaehr, chairman of the committee, made some remarks on engineering ethics. They are summarized as follows:

Obviously, a logical and fair classification of men engaged in engineering should be made at once, approved by the national and local societies and brought home to the public. Those who have been styling themselves engineers without being eligible to membership in the profession should be forced to discontinue the use of the title.

Eliminate Engineering Parasites

If those able to produce evidence entitling them to be called engineers will band together in a way that should make all professional men feel at home, then the craftsman, tradesman and engineer parasite may be eliminated from the field of professional engineering. Then and then only can we look forward to a new era for the engineer, an era in which he will pursue a dignified calling the primary object of which will be service to humanity and the secondary object a livelihood. By coöperation through their national society architects have accomplished remarkable results in the way of gaining improved public esteem and bettered financial returns. Physicians and lawyers have taken advanced stands and controlled their interests. None of these professions would countenance many of the conditions under which the engineering labors heavily.

We would urge that members of the Cleveland Engineering Society agree on definite standards to which a man must conform before he may call himself an engineer. Such standards should emphasize not only technical qualifications but also, and as strongly, those of character. If a man would be called an engineer and be a member of the Cleveland Engineering Society he should be bound in honor by the standards of ethics adopted by our society, irrespective of his business relations or employment. Inasmuch as the enforcement of a code of ethics pertains especially to the local societies, we should bring the subject to their attention, requesting their coöperation in a nation-wide endeavor to raise the standing and standards of the profession.

Marshal Forces Not to Attack But to Resist

The next step is to eliminate from within those things which undermine self-respect. For instance, certain public and commercial enterprises have been quick to recognize and exploit the vulnerable side of engineers, so that methods of obtaining business which at one time may have brought temporary gain for a few have developed to such magnitude as to make it increasingly hard for honorable men to apply their talent in the practice of their profession in exchange for reasonable compensation. We must marshal our forces, not to attack, but to resist, in concert, the common practice of exploiting engineers, as well as to stop once for all the reproachable activities of some engineers whereby other members of the profession and the public fail to receive a square deal. It is plainly wrong from a business standpoint for any high-grade man to render services gratuitously except in emergencies or for obviously charitable reasons. Charity extended in a business way is a farce, and nothing has undermined the standing of the profession more than the placing of services free of charge at the disposal of prospective clients. Everyone knows that only a small percentage of proposal work ripens into contracts. Hence, for all "charity" work the wrong man pays, and in the end the public suffers injustice.

Financial Burden on Client or Contractor

Although vested with great responsibility in large enterprises, the engineer leaves to the client or contractor the financial burden of failure due to his faulty specifications or design. This is typically expressed in the so-called "grandfather clause" providing that if specifications and drawings contain any omissions the contractor shall make them good without charge.

A committee on ethics does not lack standards, but its work is to bring them home to individuals in instructive and forceful manner. "If ye know these things, blessed are ye if ye do them," must be reinforced by the penalty provided for infractions of stipulated restrictions and obligations.

June Collections of Camp Wastes

Garbage and allied wastes collected at army camps in June by the Conservation and Reclamation Division of the Quartermaster Corps totalled 13,391,809 lb., divided as follows: Fats and tallows, 30,435 lb.; bones, 486,927 lb.; other garbage, 12,011,353 lb. Old metal, rubber, rags, bottles, lumber and various other wastes collected aggregated 4,837,647 lb., of which 1,679,855 lb. were sold for $53,049, the remainder being turned over to army organizations for various uses. Manure amounting to 44,054 tons was collected and sold for $11,908; 1043 tons of hay and straw waste brought $5879; and miscellaneous wastes yielded $9294. Revenue from garbage is not reported. The grand total of wastes of all sorts collected in June was 19,649,882 lb.

Build Permanent Pavements at New Aëronautical Station

Town-Site Roadways of Concrete Have Sub-Base Throughout At Langley Field Station—Special Templet Is Used for Warped Crown

By Samuel H. Lea
Hampton, Va.

EXCEPTIONALLY strong pavement construction for the traffic expected at Langley Field town site, Hampton, Va., includes a concrete slab of 7 in. average depth laid upon a 3-in. cinder sub-base. Unlike many of the Government stations which have sprung up on account of the war, this new aëronautical experiment station is being constructed along permanent lines. The topography of the country being very flat, various means were employed to break up the monotony of the landscape, and a layout of driveways resembling park practice resulted. Because of the flat grades, it was found necessary to obtain drainage by deepening the gutters, and the templet used to drag longitudinally the warped concrete surfaces thus formed is of novel construction.

FIG. 1. HEAVY CURB AND SLAB CONSTRUCTION USED AT LANGLEY FIELD

The field is situated on a low-lying peninsula ranging in elevation from 6 to 9 ft. above mean low tide, and is practically flat. The soil is alluvial and proximity to the coast and low elevation make it wet and spongy. This condition, combined with frequent rains, raises the ground-water level to within 2 to 4 ft. of the surface, and at times necessitates considerable pumping in the pavement excavation. When once drained, however, the soil gives a good foundation.

There are about five miles of streets in the town site, requiring 69,000 sq.yd. of pavement. There are 50,350 lin.ft of curb and about 40,000 cu.yd. of roadway excavation. On account of the curved alignment of the streets, numerous irregularly shaped intersections are necessary. This makes difficult form work and pavement finishing necessary.

Because of its special construction with footing, the curb is built before the pavement proper is built; in fact, before the roadway is excavated. A half section of the pavement and curb is shown in Fig. 1. The curb trenches are dug with a trenching machine mounted on caterpillar tractors. The footing, 24 in. wide and 4 in. thick, is built of 1:3:6 concrete. The curb is constructed in 5-ft. sections of 1:2:3 concrete, and has premolded expansion joints ½ in. thick at 50-ft. intervals. Steel curb bars protect the exposed corners. A small gasoline mixer, using one bag of cement to the batch, mixes the concrete footing, and a steam mixer, of 14-cu.ft. capacity, is used for the curb. Fig. 2 shows the completed curb layout at a boulevard intersection.

The street crowns are laid out a few inches below the general ground level, requiring shallow but fairly uniform excavation, for which three steam shovels are employed. These have dippers of about ½ cu.yd. capacity and do excellent work in the shallow cutting. The excavated material is either deposited back of the curb or loaded into bottom-dump wagons and hauled away. The shovels travel on mats which are moved ahead as the work progresses. Great care is taken to prevent the dipper from striking the completed curb. In the past winter the ground was frozen to a depth of several inches, and two methods were used for removing the frozen material. Building bonfires to thaw out the ground was first tried; then dynamite was used to break up the crust. The latter method was followed with limited success for several weeks.

After rough grading is completed fine grading is done by hand, the surface being compacted with a 5-ton steam roller. The subgrade is covered with boiler cinders to a depth of 3 in., when rolled. These form a better sub-base for conditions here than crushed stone or gravel. Fig. 3 shows the fine grade before rolling, while Fig. 4 shows the roadway after the sub-base is spread.

Sand and gravel are delivered on the field by rail, loaded by mechanical loaders into bottom-dump wagons and hauled to the work. Portland cement, conforming to standard specifications, is received by rail, hauled to the work by motor trucks and deposited along the curb. Washed gravel and sand, of good quality and well graded, are used for the aggregates.

The flat grades make it necessary to provide surface drainage for the pavement by means of gutter grades. These are formed by deepening the gutter while keeping the center line at a fixed height with relation to the

FIG. 2. CURVED ALIGNMENT AT AËRONAUTICAL STATION MAKES CURB CONSTRUCTION DIFFICULT

curb. Catchbasin gratings at the low points alternate with the gutter summits, giving a minimum gutter grade of 3 in. per hundred feet. The pavement has a circular crown, the rise from the gutter to the center varying with the width of the paving and the distance from the catchbasins. The center of the road is generally made 1 in. below top of curb.

FIG. 3. FINE GRADING COMPLETED READY FOR ROLLING

On account of the warped surface produced by these conditions, it was impossible to drag the surface longitudinally with the ordinary stiff templet. To overcome this difficulty a trussed templet with movable strikeboard, designed to conform to the variable crown at all points, was developed. It was made in two sizes for the different widths of roadway. The complete design of this templet and a description of its use will be found in "Hints for the Contractor" for this issue. Fig. 5 shows this templet in operation directly behind the concrete mixer.

The roadway concrete is laid in one course in the proportion of 1:2:3, and is reinforced with No. 25 road mesh placed 2 in. below the surface. The reinforcement is placed on a layer of freshly spread concrete and spreading continues with the templet mentioned above. Before concrete is placed in the roadway the subgrade is checked and all inequalities are eliminated. In dry weather the sub-base is sprinkled, and at all times the concrete is mixed fairly wet, but excessive use of water is discouraged. Two concrete gangs are being used to expedite the work.

At street intersections the center line is 1 in. above the normal grade. At the corners, where the groin lines meet the curb, gutter summits are formed from which the water flows both ways to the catchbasins. Grade stakes are set about 6 ft. on centers on the center and groin lines, and are connected by screeding strips from which the concrete is struck off with short, straight edges, the strips being removed as soon as possible and the spaces filled with fresh concrete. In this way the surfaces are more exactly formed than is possible by the stake and lute method.

The finisher's bridge used on the 24-ft. and 32-ft. roads is shown in Fig. 5, in the foreground. The bridge is mounted on small wheels and rolls on top of the curb. It is simple in design and rigid enough to support three men clear of the concrete. The finisher, working from the bridge, follows the striking templet at a time interval depending upon the weather. He first uses a wooden hand float, and follows this with a darby or long, narrow hand float, which removes considerable excess water from the concrete, pushing it over the surface of the pavement to the gutter. The darby has worked very well in the absence of a roller to remove the excess water. An illustration shows the finisher using this tool.

Transverse expansion joints, protected by steel plates cut to the exact crown of the street, are spread from 25 to 35 ft. apart. At street intersections joints are placed at the point of curve of the curb, and separate the intersection from the rest of the pavement. The joints are $\frac{1}{4}$ in. wide and are filled with premolded joint filler which extends through the entire thickness of the pavement. Longitudinal expansion $\frac{1}{2}$ in. thick is placed along each curb line. For the transverse joints, the filler projects about 1 in. above the surface and the concrete is finished square against it by means of a divided float, which straddles the joint. Filler and plates are assembled, and installed in the usual manner, tops of armor plates being set about $\frac{1}{4}$ in. below the surface of the concrete. The installing device is removed from the armored joint as soon as the concrete has set sufficiently to finish the surface.

The water-supply for the field is obtained from a local water company through a 6-in. main. A large proportion of the supply is used locally, and only a limited amount is available for concrete work. After numerous vexatious delays because of lack of water, it was decided to use ground water for the mixer. This is obtained from convenient wells and basement excavations by means of gasoline pumps.

The completed pavement is protected for about three weeks, while curing, by a shallow covering of earth which is kept wet, after which it is removed and the pavement opened to traffic. The finished pavement has a good appearance, being free from waves and having no large cracks.

Careful records are kept of each day's work for each mixer, the notes being tabulated as shown in Fig. 6, which contains the complete data for a typical day. A graphic record showing the exact location of the work and other data is also plotted, and a weekly progress report is kept on a map of the town site.

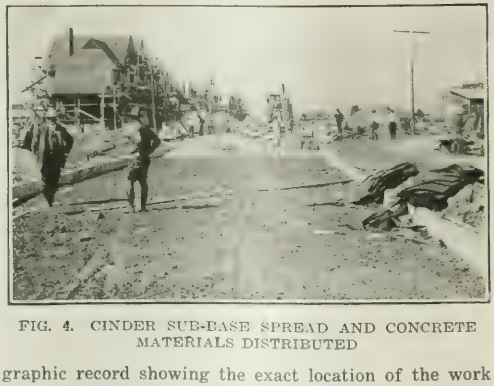


FIG. 4. CINDER SUB-BASE SPREAD AND CONCRETE MATERIALS DISTRIBUTED

The accompanying statement of cost contains figures that are high when compared with prices for similar

FIG. 5. TRUSSED ADJUSTABLE TEMPLET AND FINISHING BRIDGE BEING USED AT LANGLEY FIELD

work before the war, but which are not excessive, considering present conditions and the high quality of the work.

COST PER SQUARE YARD OF COMPLETED PAVEMENT

Cement, 1.4 sacks	$0.588
Sand, 2.8 cu.ft.	.182
Gravel, 4.2 cu.ft.	.392
Reinforcement, joints, etc.	.358
Hauling and unloading material	.400
Water for mixing	.050
Labor, overhead and percentage	1.500
Total cost per sq.yd.	$3.470

Work was started Nov. 27, 1917, and continued until Dec. 8, when the concrete paving was discontinued on account of severe weather. The work of excavating the roadbed was continued through the winter, and some work was done during that time on the concrete curb. On Feb. 25, 1918, paving work was resumed and has continued ever since. The work is now almost completed.

The construction is being carried on under the direction of the Department of Military Aëronautics.

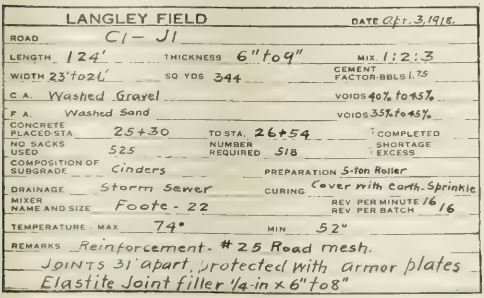

LANGLEY FIELD DATE Apr. 3, 1918.
ROAD C1 – J1
LENGTH 124' THICKNESS 6" to 9" MIX 1:2:3
WIDTH 23' to 26' SQ YDS 344 CEMENT FACTOR-BBLS 1.75
C A. Washed Gravel VOIDS 40% to 45%
F A. Washed Sand VOIDS 35% to 45%
CONCRETE PLACED-STA 25+30 TO STA. 26+54 % COMPLETED
NO SACKS USED 525 NUMBER REQUIRED 518 % SHORTAGE EXCESS
COMPOSITION OF SUBGRADE Cinders PREPARATION 5-ton Roller
DRAINAGE Storm Sewer CURING Cover with earth-Sprinkle
MIXER NAME AND SIZE Foote - 22 REV PER MINUTE 16 REV PER BATCH 16
TEMPERATURE - MAX 74° MIN 52°
REMARKS Reinforcement - #25 Road mesh.
Joints 31' apart, protected with armor plates
Elastite Joint filler 1/4-in × 6" to 8"

FIG. 6. RECORD OF THE PERFORMANCE OF THE PAVING GANG FOR A TYPICAL DAY

Col. William Lay Patterson, Signal Corps, U. S. A., is post commander, Lieut. J. McInerny, S. R. C., is in charge of construction and Lieut. W. H. Scott, S. R. C., is in charge of roads. The J. G. White Engineering Corporation was contractor for the work up to Aug. 10, H. J. Upson being superintendent and the writer road engineer.

Kentucky Undertakes Road Maintenance

State participation in highway improvements in Kentucky, which hitherto has been limited to assistance in the construction of new roads, has now been extended to cover maintenance. The recent General Assembly passed without a dissenting vote a bill which authorizes the State Commissioner of Public Roads to determine the standard of maintenance for roads which are constructed with state aid. Failure of county authorities to maintain roads in proper condition will forfeit their county's share of state-aid funds for new construction, and such funds may be expended by the commissioner in bringing the state-aid roads up to the prescribed standards. Previous to the passage of this bill all maintenance had been in the hands of local authorities. Notice of the provisions of the law has been sent to county road engineers, county judges and other local officials, and beginning with the season of 1919 maintenance work will be carried out before any new construction is attempted. A large mileage of roads has been built under state-aid since 1915, and it is hoped that the counties will carry out the necessary maintenance. If failure to do this is shown by the reports of division engineers of the Department of Public Roads the department will undertake the work. The policy will be to concentrate on maintenance rather than construction during the war. Rodman Wiley is commissioner of public roads.

Elimination of Idleness by Systematic Study

Graphic Charts Show Significance of Increase in Efficiency by Reducing Machinery Idleness Among Industries

By Charles Whiting Baker
Consulting Editor, Engineering News-Record

Need for intensive production in every industry, which has extended so far that idleness has now been made a statutory offense in several states, makes the systematic study of idleness in industrial organizations of special importance. Every engineer knows, at least theoretically, the great advantage of graphic charts over tables of figures in enabling the mind to grasp the significance the figures contain. In a number of war industries extensive use is being made of graphical records to make clear the causes which may be operating to cut down maximum output.

The value of such charts in studying the operations of an industry, making evident the opportunities for increasing the output and reducing the cost has been brought before the profession by Henry T. Gantt, in papers read before the American Society of Mechanical Engineers. Mr. Gantt has used this method for some time in his work as a consulting engineer for industrial plants.

Efficiency engineering, so called, has placed its chief emphasis on obtaining a larger output from the individual workman, but Mr. Gantt deserves credit for calling attention to the great opportunities for increasing output by decreasing the idleness of machinery. The substitution of automatic machines for hand labor has gone so far that there is as much need for systematic records of the "time-keeping" of these machines as for the workmen whose names appear on the payroll.

It is well understood that in no industry can all the machines, tools and equipment be worked at full capacity all the time. In an industry making a standard product, such as shoes, cotton cloth or plows, some approach may be made to keeping all the mechanical equipment working continuously at full capacity; but in most productive enterprises variation in output is part of the working condition, and the "peak of the load" must be provided for. It is nevertheless most valuable to the executive heads of an industry to have a continuous record of what the various units which make up the plant are doing, and especially of how much of their time they are standing idle.

Charts may be made for individual departments of a plant, and nothing is more common in manufacturing industry than to have heavy losses incurred by the over-development of some one department at the expense of the others, often without the fact being fully realized by the men in responsible charge. Charts of the type of that here shown tell such a clear story of what is going on in a plant—the cost of those standing idle when they should be running, and what departments or machines are worked to capacity and must be supplemented in order to increase output—as to recommend more extensive use than at present.

In order that the charts shall give a correct record, careful study must be given to the method of obtaining the rate of idleness expense chargeable to the different machines or departments. The general method of obtaining this is to ascertain first the cost of maintaining the different machines, benches and work spaces in condition for operation. Under this head are included interest on first cost, taxes, maintenance and depreciation, including an allowance for obsolescence on the buildings, machines and tools. All these items may be summarized as rent, since they include what would be charged to rent if the plant were leased.

To the sum thus found there must be added the expense of supervision—first, of the plant as a whole, and second, of the individual department. This is a part of the operating expense. If a tool or department is idle, this expense must be divided among the tools or departments that are working the same as the expense for rent of land or buildings is charged. The result in either case is to increase the cost of product. The cost of supervision must therefore be included in order to make up an accurate estimate of the loss incurred due to an idle machine.

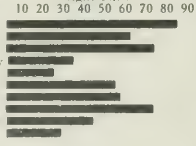
When the total rate per hour of idleness expense has been computed for each important tool or department, it is a simple matter for the cost clerk to enter daily on the chart the idleness expense from the time cards turned in for each individual tool by the workmen.

The classification of the causes to which the idleness is due is an important part of the system, and is made on the cards turned in by those in charge of the various machines. Thus the manager has placed before him daily or weekly, not merely the lost time of each of the various units which make up his plant, but the principal causes of this lost time. He is therefore able to act intelligently in taking measures to reduce lost time so as to increase output and reduce cost.

The application to construction work through the use of the daily records of the working time of such ma-

CHART SHOWS MONTHLY ITEMIZED COST OF UNAVOIDABLE AND AVOIDABLE IDLENESS

Working Period............Weeks 26 Days Period Ending March 30, 1918



			Details of Expense of Idleness Due to							Expense of Idleness				
No. of Machines	Machine Class	% Of Capacity Used on Day and Night Turn (10 20 30 40 50 60 70 80 90)	Lack of Orders	Lack of Help	Lack of Raw Material	Lack of Tools	Repairs	Moving Machines	Total	Unavoidable %	Unavoidable Amount	Increase in Expense of Product %	Avoidable	Remarks
10	⅜-in. auto screw		$9 40	$26 91	$7 05	$31 68	$114.30	$18 67	$208 01	10	$140 71		$67 30	
4	⅝-in. auto screw		116 64	3 24			132.84	29 16	281 88	10	57 02		224 86	
18	1 in auto screw		310 28		130 91	26 62	256 46	144 34	868 61	10	432 08		436 53	
4	1¼-in. auto screw		12 88	26 95	161 70		40 04	16 94	258 51	10	67 76		190 75	
29	2 in auto screw		313 17	13 99	201 33	358 26	2,277.03	1,188 27	4,352 05	10	595 38		3,756 67	
7	2-in. auto screw		224 40		77 84	5 60	38 39	154 42	500 65	10	181.02		319 63	
4	2⅜-in auto screw		9 24	118 27			73.92	44.35	245 48	10	81 31		164 47	
19	2¼-in auto screw		169 86	34 20	34 20	231 42	680 58		1,150 26	10	538 38		611 88	
2	Chucking lathes		577 45	14 96			104 72		697 13	5	65 82		631 31	
2	Milling mchs....		41 86				68		42 54	5	6 02		36 52	
1	Drill press						43 47		43 47	5	2 17		41 30	
Total, 100			1,785.18	238.52	613.03	653.58	3,762.43	1,596.15	8,648 89		2,167 67		6,481 22	

chines as steam shovels, piledrivers, concrete mixers and similar important units is obvious. The added feature of setting down in dollars and cents the daily idleness expense for each machine, with the causes of the idleness, is most important. The mere keeping of such records not only points the way to cut down such expense, but automatically tends to stimulate everyone in responsible charge to reduce idleness wherever possible.

Cost of Service the Chief Factor in Rate Regulation

Rational "Fair Value" Is Held to Be Sum of Interest on Investment and Profit on Operating Expenses, Capitalized at "Fair Return" Rate

By William G. Raymond
Dean, College of Applied Science, State University of Iowa, Iowa City

In a little book, "What Is Fair?", recently published, the author discusses methods of valuation of public utility properties, and finds difficulty in harmonizing court decisions with what appears to him to be rational procedure. Further study of the problem has suggested a method of procedure believed to be wholly in accord with the dictum of the courts: (1) That the utility is entitled to a fair return on the "fair value" of its property used in the service of the public; and (2) that the public may demand that no more be charged for service than the service is reasonably worth. The idea was presented in the book referred to, but was not so fully argued as now; it is based on the following considerations:

1. It appears to be clear from a reading of the Smyth vs. Ames case (169 U. S. 466), in the decision of which the foregoing principles were announced, that the court could not have meant exchange value when it said "fair value," because, as has been said since in other decisions, exchange value depends on earnings, earnings depend on rates, and rates are in question.

2. The court in Smyth vs. Ames did not define "fair value." Courts and commissions have been struggling with the definition ever since, and in an effort to arrive at a quantity that should represent "fair value" have leaned toward "cost of reproduction less depreciation," estimated as of the day of inquiry but estimated according to no fixed rule or method, actually adopting different methods in different cases; sometimes deducting depreciation and sometimes not; sometimes adding "going value" and sometimes not; often finding "going value" by mental processes not capable of satisfactory explanation (see the report of the Master in the Des Moines gas case), and varying the process in other matters. The United States Supreme Court has definitely recognized "going value," as distinguished from development expense, as a proper element of "fair value."

3. The value of the service rendered must be based on its cost, and the utility corporation is entitled to a fair profit on that cost. This furnishes a clew to a definition of "fair value," which is:

Fair value as used by the courts in rate cases is that value the fair return on which provides a fair profit on the cost of the service performed.

4. The cost of the service can be estimated by perfectly clear, logical and defensible methods, with no introduction of hypothetical or speculative quantities.

The procedure would be as follows:

1. Find the sum invested in the plant and fix a fair rental made up of interest, depreciation allowance, insurance and taxes, if taxes are assessed against the physical property.

2. Find the cost of operation, made up of rental, labor and materials, including ordinary maintenance not included in the depreciation allowance.

3. Determine a fair profit rate on the cost of operation and from this the resulting profit sum. In general, the profit rate on the cost of operation should be higher than the fair-return rate on the fair value of the property, and should be fixed to recognize high operating efficiency where this is shown, and with regard to acquired earning capacity as indicated later.

4. The sum necessary to be earned through rates is the cost of operation plus the profit sum on operation.

5. The "fair value" of the investment or property is found by adding the interest on the investment and the profit sum from operation and capitalizing at the "fair return" rate on "fair value."

This method would seem to give that one fair value which so many attorneys and economists have asserted should be found that may be used alike for rate-making and purchase. It recognizes the value of the business, so often called "going value," but finds it in a perfectly clear and logical way, although it is not distinctly separated.

Let an example be given—the interest and profit rates used being purely for illustrative purposes and not suggested as the proper rates for any particular case.

The proper cost of a certain plant, with or without depreciation, according to judgment or facts, is \$100,000. Exclusive of rental the annual cost of operation is \$20,000. What is the "fair value," assuming that 8% is a fair return on "fair value," and that the company can borrow at 5%? If the company can borrow for 5% it should charge, say, 6% as rental interest. The "fair value" of the investment or property, as derived in the accompanying table, is \$111,875. This is not the commercial value necessarily. In the

DETERMINATION OF FAIR VALUE IN HYPOTHETICAL CASE

Rental		
Interest on \$100,000 at 6%	\$6,000	
Depreciation allowance, say 2½%	2,500	
Insurance, say ½%	500	
Taxes, say ½%	500	
Other cost of operation	20,000	
Total cost of operation		\$29,500
Profit, say 10% on operation		2,950
Total fair charges		\$32,450
Fair profit	\$2,950	
Interest as above	6,000	
Net return		\$8,950
Capitalized at 8%		\$111,875

absence of other evidence, as discussed later, it is the value upon which 8% is a fair total net return. The commercial value might be more or less, depending on the fixed charges.

If half the investment is borrowed, the payment of interest is $2500 and the balance of net earnings will represent 12.9% on the owner's actual investment.

The Proper Rates

Perhaps it may be argued that the foregoing differences of rates are not determined on a sound basis; that the rate allowed on the physical property should be the same as that allowed on operating expense, and that the latter as a base for profit should be confined to expense other than rental.

If this opinion should prevail the fair value of the investment or property would be the investment in plant plus one year's operating expense, but operating expense should then include depreciation, insurance and taxes, included above in rental. Applying this reasoning to the foregoing example and assuming 8% as a proper fair return, we have

Fair return on plant		$8,000	
Operating expense	$23,500		
Operating profit = 8% of $23,500 =		1,880	
Total return			$9,880
Fair value at 8%			$123,500

or the sum of the investment and one year's operating expense. The value is greater than by the other assumption.

Or it may be advanced that the interest charge should be only at the rate that the company pays, 5% in the foregoing case, but with 8% still allowed as a fair rate of return on the whole property. Under this theory the lessened net earnings in the first case, in which the interest is an item of the cost of operation, would be $1100, and the return to the owner on his actual investment would be 10.7%. Under the second assumption the total net profit would be $6880, and the return on the owner's investment would be about 8.75%, assuming as before that half of the whole investment is borrowed. Which of the several viewpoints should be adopted may be a matter for discussion.

The method suggested is based more upon the second principle laid down in Smyth vs. Ames than on the first, but recognizes the first and gives a fair return on the fair value of the property whether the business is one involving large capital outlay with relatively small operating costs, or small capital outlay with relatively large operating costs. If applied from year to year the method would seem to encourage extravagance in operation, but with rates fixed for a period of years economy of operation would mean the greater return. Where marked efficiency is shown by evidence submitted in any case, a higher profit rate should be allowed in computing the profit on operation.

The method here suggested is founded on the belief that even though it be sometimes true that a property is worth more than the sum that would be found by the application of the principle, and sometimes that it is not worth so much, yet in the normal ideal case the two principles of fair return and fair charges ought to mean the same thing in a valuation.

Some difficulty may be found in estimating the value of the service to the consumer. In a later case (Cotting vs. Kansas City Stockyard Co., 183 U. S. 79) an addition is made to the second principle announced in Smyth vs. Ames; namely, that the value of the service to be considered is the "value of the service rendered to each individual," and not the value of the service to the customers in the aggregate. This addition is argued at some length and seems to be announced as a general principle; but an interpretation given it by the Supreme Court of the State of Maine helps some. In the case of Brunswick and Topsham Water District vs. Maine Water Co., 99 Maine, 371, the justice says:

"In the aspect now being considered, the worth of a water service to its customers does not mean what it would cost some one individual, or some few individuals, to supply themselves, for one may be blessed with a spring and another may have a good well. It means the worth to the individuals in a community taken as a whole. It is the worth to the customers as individuals, but as individuals making up a community of water takers. In the very nature of things, a water system is usually intended to supply a somewhat compactly settled community, or a community whose geographical limits are somewhat restricted. . . . Such a community must in general stand as a whole. The rates for such a system are generally and properly uniform, although the expense of supplying some, as those nearer the source of supply, is actually less than that of supplying those at the outermost limits. Still, the benefits are uniform and uniform rates are reasonable."

Individual Consumers, Not the Aggregate

This instruction of the Maine Supreme Court appeals to the engineer as sound and as an entirely proper interpretation of the dictum of the United States Supreme Court, that the test of reasonableness of rates to the customer is reasonableness to the individuals and not to customers in the aggregate. Thus one difficult question is disposed of but another is left, seemingly scarcely less difficult; that is, What is the reasonable worth of the service to the individuals as a community? And here the Supreme Court of Maine helps again. The preceding quotation was based upon or followed these enlightening sentences:

"We do not doubt that when the worth of a public service of this kind to the public or customers is spoken of, necessarily one of the elements to be considered is the expense at which the public or customers as a community might serve themselves were they free to do so, and were it not for the existence of the practically exclusive franchise of the supplying company. . . . In estimating what it is reasonable to charge for a water service—that is, not exceeding its worth to the consumer—water is to be regarded as a product and the cost at which it can be produced or distributed is an important element of its worth. It is not the only element, however. The individuals of a community may with reason prefer to pay rates which yield a return to the money of other people higher than the event shows they could serve themselves for, rather than make the venture themselves and risk their own money to loss in an uncertain enterprise."

Here seems to be justification for the method of approach suggested in this paper, a method based on the second of the two fundamental principles laid down in the Smyth vs. Ames case, the worth of the service to the consumer, and on an interpretation of that prin-

ciple essentially identical with that stated by the Supreme Court of Maine.

Computations made as in the illustrative examples above given do not necessarily give the final fair value, but they give what may be called the primary or principal basis on which fair value rests. It may be that higher rates to individuals than rates based on cost of service can be shown to be entirely reasonable, and when this is possible and is done, and such higher rates are in force, the value of the property may be more than the estimate based on cost and an assumed profit rate will show unless the profit rate assumed has been selected with this consideration in view. On the contrary, it may well be—indeed, it is known to be in some cases—that rates based on cost of service and an assumed reasonable profit are more than can be charged; are more than the traffic will bear. When this is so the value of the property is less than is shown by the cost of service plus the assumed profit; then it may be, and in some cases is, actually less than the investment, and sometimes has been only salvage. But it still remains true that the owner ought to be permitted by the public to earn at least a fair profit rate on the reasonable cost of service if he can do so; that is, if the business will stand the tax, as it will in the case of every needed and properly planned and operated service.

Comparison with Other Methods

Emphasis heretofore has been almost if not quite universally placed on the first principle laid down in the Symth vs. Ames case; namely, that the utility owner is entitled to a fair return on the fair value of its property used in the public service. Many enormously expensive litigations have grown out of the attempt to apply this principle. Many differences of opinion have developed. The court has implied in its decisions that cost of reproduction of the property at the time the question arises is the best basis of fair value. It has further implied that the property changes in value from day to day with the fluctuation of prices of the materials and labor that enter into its construction. Yet cost of reproduction as of a given date is a very uncertain quantity and depends on a considerable number of much discussed assumptions about which there is quite general disagreement among engineers and among lawyers. But the assumption that the value of a long-lived public utility property varies from day to day with the fluctuations of the prices of the materials and labor that enter into its construction seems so impossible of adoption in connection with the regulation of rates, and so unreasonable in its application to permanent investments in such properties, as to warrant some consideration. Rates cannot be made anew from day to day. In the nature of the case they must be stable for considerable periods of time, during which prices of materials of which the physical part of a utility property is made may undergo violent fluctuations.

Consider a water or gas property in a moderate-sized community. It could be built within a few months, and a very considerable part of its cost, probably nearly half, is for cast-iron pipe. If the plant had been built in 1904 when cast-iron pipe was quoted at about \$19 a ton, and valued in 1907, when pipe was quoted at about \$31 a ton, and if half the outlay was in pipe, the value of the property because of the change in the prices of pipe alone would show more than a 25% increase over the investment, while the very next year, when the price of pipe dropped to \$20 the value would drop to about that of the investment. And the pipe was not of constant price through any one whole year. The pipe in the ground has an estimated life of from 50 to 100 years. The plant is a long-lived plant. Rates may be changed once a year as taxes are, but this is of doubtful wisdom, and five-year intervals are more common for municipal utilities. Shall a large part of an investment made in 1907 be destroyed in 1908 by a public regulation of rates to fit the temporary 1908 prices of materials that were purchased in 1907? Or shall the public be taxed to pay the high rates based on the temporary 1907 prices of long-lived materials purchased in 1904? The reasonable answer seems to be "No."

Fluctuations in Operating Costs

Any such property as is being considered, when it has been in existence long enough to be called an old property, will have parts purchased in times of high prices, parts purchased in times of low prices, and parts purchased in what may be called times of normal prices. The company cannot sell its pipe in times of high prices as the merchant sells his merchandise. What it would cost the community to serve itself with its own plant would not vary with the prices of the materials that entered into the construction of the fixed plant. The money that it would borrow to build the plant would bear a constant rate of interest throughout the life of the bonds issued. When materials are consumed in operation, the variation in the prices of these materials does affect the cost of operation and may affect the value of the property if rates are not changed from year to year to correspond, and for this reason it may be wise to fix rates annually. But by allowing a slight margin in rate fixing, the larger profits in times of low prices will be offset by the smaller profits in years of high prices, so that, except in such very abnormal times as the present war times, adjustment of rates may well be at longer intervals.

It may be true in a certain theoretic economic sense that the value of any composite changes with the changes in the prices of its constituent elements, with the changes in the interest rate on money, etc. But with respect to long-lived stable properties of the public utility class, there seems to be no practical reason for varying rates with change of prices of the materials that enter into the construction of the physical property involved, except as by long-continued and perhaps permanent rise or fall in prices, replacements shall have materially increased or diminished the actual investment in the property. The investment will always be shown by properly kept accounts, and may be estimated fairly well in spite of poorly kept accounts. Therefore, it is submitted that the true basis of value of a public utility property is actual investment or estimated actual investment, increased as it may be by the effect of a fair profit on the cost of the service that the investment and the franchise have made possible, and increased further, when proper evidence is produced, by the effect of reasonable but higher rates than those computed

from assumed profit rates; or diminished by the effect of rates that are all that the traffic will bear but are lower than those computed from assumed profit rates.

The conclusion of this discussion is that reasonableness of rates must be determined more by cost of service than by hypothetical values of involved property; and that value for rate making, purchase or taxation should be based more on the fair profit that may be earned on the cost of the service performed than on hypothetical estimates of reproduction cost with going values added, for the estimated amounts of which no reason can be given. The method is thought to be a rational method, in harmony with a proper interpretation of the law as expressed in the decisions of the United States Supreme Court, and quite worthy of the careful consideration of valuation experts, whether lawyers or engineers.

Five and a Half Million Yards Dredged by Large Fleet at Hog Island

Schedule Kept by Careful Planning in Spite of Severe Winter and Interference with Pipe Lines From Progress of Work Ashore

ALTHOUGH the unusually severe winter stopped the operation of floating plant after but 300,000 yd. of the total 5,500,000 had been dredged at the site of the Hog Island ship plant, and although progress of work ashore by the time the river was free of ice had blocked the laying of pipe lines from certain areas and made necessary the replanning of the work, the dredging has been kept up to schedule and has already progressed so far that it will be possible to launch and fit out the ships as fast as they can be assembled. The work has been carried on with four to five hydraulic dredges, one used entirely for rehandling, six to seven bucket dredges and one to three dipper dredges, most of the excavation being disposed of in three impounding basins on the property.

Where Excavation Lay

From the ends of the fifty launching ways to the 18-ft. contour 870,000 yd. had to be removed, leaving a bottom which slopes from 12 ft. at the ways to 18 ft. below mean low water at a distance of 235 ft. out. Most of the yardage, however, lay in the fitting-out basin and around the seven piers and one wharf being built there. At the east inshore end of this basin was a small triangular area from which it was possible to remove something less than 100,000 yd. in the dry during the winter. A 400-ft. channel in the fitting-out basin and extending to deep water in the river had to be dredged to a depth of 30 ft. below mean low tide, while the berths between two of the easterly fitting-out piers were made of the same depth. The remainder of the fitting-out basin was dredged to a depth of 18 ft. below mean low water. The yardage taken out to this depth amounts to 3,850,000 yd., while that removed below the 18-ft. depth will come to 780,000 yards.

There are three impounding basins on the property, which will not hold quite all of the yardage to be removed. The Henson basin at the east end of the launchways has a capacity of 500,000 yd., while the north basin, lying back of the launchways, the shops and the storage yards, will receive about 1,600,000 yd. The largest basin, at the west edge of the property, was formed by building crib dikes out across the old Essington Channel to some shoals between Hog Island and Tinicum Island. This basin will contain upward of 2,360,000 yd. Its construction necessitated the dredging of a new Essington channel between the basin and Tinicum Island. However, as the building of the dikes changed the direction and force of the tidal currents and has caused considerable scouring on the shoals mentioned, the dredging of the new channel has been left to the last and will not involve more than 100,000 yards.

Work Delayed During Severe Winter

A hydraulic dredge began work soon after the contract for the yard had been awarded last fall, off the easterly group of ten launchways, and pumped 300,000 yd. into the Henson basin before ice in the river made it necessary to lay up the equipment. It had been planned to pump all of the dredging from before the ways directly into this basin and into the north basin, but by the time the ice broke up in the spring construction on the launchways, the shops and the yards had progressed to the point where it would have been inefficient to attempt to maintain a pipe line across them. The remainder of this excavation, therefore, was completed with dipper and bucket dredges, and the Henson basin was filled by dumping the spoil from the bucket dredges at the suction of a 30-in. hydraulic dredge which rehandled the material. It was necessary to leave a bank near the shore and to support the cofferdams within which the outboard ends of the launchways were constructed, and this material will be some of the last to be removed on the work.

Winter Forces Change of Plan at Fitting-Out Basin

It had been intended to put the hydraulic equipment at work first on the three fitting-out piers and the east portion of the 30-ft. channel, where the bulk of the dredging lay, and pump as much as possible of this material into the north impounding basin. Ice, however, prevented work at this point until the middle of March, and all that could be done was to remove the high part of the excavation to within 1 ft. of low tide. This was done by a traveling derrick with a grab bucket and the spoil was carried away in railway cars.

During the winter, however, a drag-line excavator and a steam shovel completed the dikes around the north impounding basin. Much of the material used was frozen hard, and some difficulty was experienced with the dikes later on this account. When it became possible to use the hydraulic dredges, the west classification yard and some of the shop buildings had progressed so far that a pipe line could not be laid directly from the center of the heavy dredging, and it was necessary to move the 30-in. rehandling dredge from the Henson basin to a point west of the deep excavation in the fitting-out basin, from which a line could be run to the north impounding basin. The deep dredging at the east end of the fitting-out basin was, therefore, completed with dipper and bucket dredges, while the hydraulic equipment was concentrated on the 18-ft. dredging at the west side of the basin, with two of the remaining four machines pumping into the north basin and the other two into the west basin.

The bucket dredges were used to clear out as rapidly as possible the site of the piers so that piledriving could proceed. This was done by driving a certain number of the pier piles with floating equipment to support track for two-way land piledrivers which completed the work. This dredging progressed so well that the shore bulkhead and the four easterly piers had been practically completed by the middle of July, and a large number of piles driven for the next two piers.

Old Stone Dike Removed

A stone dike reaching from the west end of the launchways to a point within the site of the west impounding basin which had been built some time previously extended for a good part of its length to 8 ft. above mean low water. It was necessary to remove 1300 ft. of this dike, cutting a 1000-ft. gap at the east end of the basin and a 300-ft. gap at the west end. This work was done by a 5-yd. dipper dredge which did not take part in the other operations, the stone removed being used to complete the portion of the dike left in place to full height.

The dikes around the west impounding basin, a considerable length of which were located in water 12 to 14 ft. deep, were made of timber cribwork, built and sunk in place in long sections against guide piles, filled with sand pumped by one of the dredges and banked with riprap on the outside to prevent scour from tidal currents. This work, which was begun toward the end of the winter and completed in May, was carried out by the Bates & Rogers Construction Company.

Large Number of Dredges Used

For a time five hydraulic dredges, a 15-in., an 18-in., a 20-in., a 22-in., and a 30-in. machine, were on the work. The largest dredge was used entirely for rehandling, and the small dredge and the 22-in. dredge mainly for handling material in the west basin. The other two dredges pumped directly into the north basin. These machines were all of about the same type, having a pump speed of 250 to 275 r.p.m., and carrying 40 to 50 lb. pressure in the discharge line with a velocity of about 10 ft. per sec. Three of them are still on the work. There are now five bucket dredges and two dipper dredges at the site, the latter of 3 and 3½-yd. sizes. A 3 and a 3½-yd. bucket dredges were also on the work for a time, while there still remain a 2½ yd., a 3½-yd., a 5½-yd. and three 7½-yd. bucket dredges. When running at full capacity the nine bucket and two dipper dredges supplied about 14,000 yd. a day to the 30-in. rehandling dredge, a quantity considerably below its capacity.

All the bucket dredges except the small one, and all the hydraulic dredges, have operated 24 hours a day, the crews living aboard the dredges.

Up to the present the scow haul to the rehandling dredge has been short, two scows to a bucket dredge being sufficient. Five tugs and fourteen scows supplied by the dredging contractor have been on this work, while the hydraulic dredges have been handled when it was necessary to move them by tugs belonging to the American International Shipbuilding Corporation. A considerable part of the yardage, however, will have to be towed away from the site and disposed of by the contractor in private basins. This will make it necessary to increase the number of tugs and barges when the present basins are filled and the large dredge is removed.

The 20-in. and 22-in. hydraulic dredges were rented on the basis of handling 6000 yd. a day, while the 18-in. dredge was expected to handle 4000 and the 15-in. dredge 2500. Allowances were made for varying conditions of digging, but in the sandy mud with a small percentage of gravel which formed the bulk of the work these averages were maintained. The bucket dredging work was contracted for on a straight yardage basis including the service of the dredges, tugs and scows.

The dredging work was carried out for the American International Shipbuilding Corporation, agents of the Emergency Fleet Corporation, by the American Dredging Company.

Determining the Regulating Effect of a Storage Reservoir

Differential Equation for Inflow, Outflow and Storage Relations Solved by Using Time Interval as Independent Variable

By Robert E. Horton
Consulting Hydraulic Engineer, Albany, N. Y.

In most flood-regulation cases arising in practice the thing to be determined is the maximum stage which will be reached where the rate of inflow to the reservoir varies continually and where the area of water surface also varies with the depth on the spillway. A new method is here offered for this determination, one that is easier than any before available.

If I is the rate of inflow to a storage reservoir at any moment, Q the rate of outflow, and S the corresponding rate of gain or loss of storage at that instant, A being the area of the reservoir surface and H the depth of water above spillway level, then

$$S = A\frac{dH}{dt}$$

$$\text{also } S = I - Q,$$

$$\text{and } Q = CLH$$

The differential equation to which these functions lead is not capable of direct general integration in such a manner as to give H directly in terms of T. Various solutions of this equation have, however, been by series and by graphical methods.

For a small rise dH in water-surface level during the time interval T, the volume relations between inflow, outflow and storage are expressed by the formula,

$$IT = A\,dH + \frac{Q_1 + Q_2}{2}T$$

where Q_1 and Q_2 are the rates of outflow from the reservoir at the beginning and end of the time interval T. The quantities A, Q_1 and I being given, either T or dH can be determined by a process of trial and error or successive approximations if the other quantity is assumed. In the solution of this problem dH has generally been assumed, as it would appear at the outset that this would lead to a simpler solution of the problem than if a time interval T was assumed for the purpose of determining dH.

So far as the writer is aware, the earliest application

of this method to the determination of the regulating effect of a storage reservoir is given by Lieut.-Gen. J. Mullins in his "Irrigation Manual," published for the Madras Government in 1890 (pp. 215 to 223 in the section on "Reservoirs, Their Influence as Flood Regulators"). This publication is not generally available in this country. However, the formulas of General Mullins and the solution of a problem of flood regulation for a proposed storage reservoir on Genesee River are contained in the reports of the late George W. Rafter on Genesee River Storage ("Report of the State Engineer and Surveyor of New York" for 1894, pp. 390-392; and continued in the report for 1896, pp. 722-724).

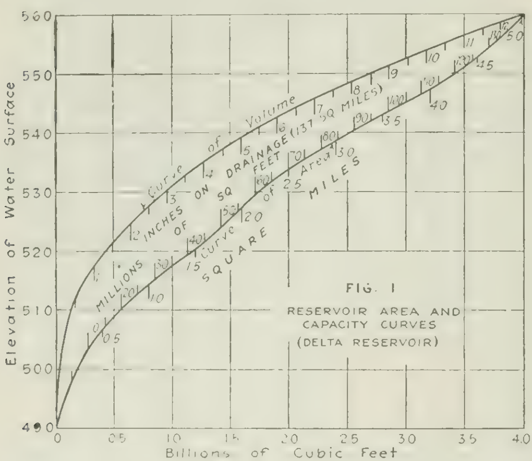
A similar solution of the problem involving the assumption of a series of values of dH for the purpose of determining the time T by a process of trial and error was developed by Glenn D. Holmes, and used by him in a study of flood regulation of proposed New York State Barge Canal reservoirs in 1906. Another solution of the problem in which the computation is simplified by the use of an auxiliary function curve is given by H. K. Palmer in *Engineering News* of Mar. 21, 1912, pp. 524-525. Mr. Palmer's method involves the mechanical quadrature of the function curve which he uses. It also depends on a process of successive approximations for the determination of T and is complicated in case the inflow rate I is variable. Other solutions are suggested by T. R. Running in *Engineering Record* of Jan. 17, 1914, pp. 67-68, and by A. S. Fry in *Engineering-Contracting* of Apr. 19, 1916, pp. 369-372.

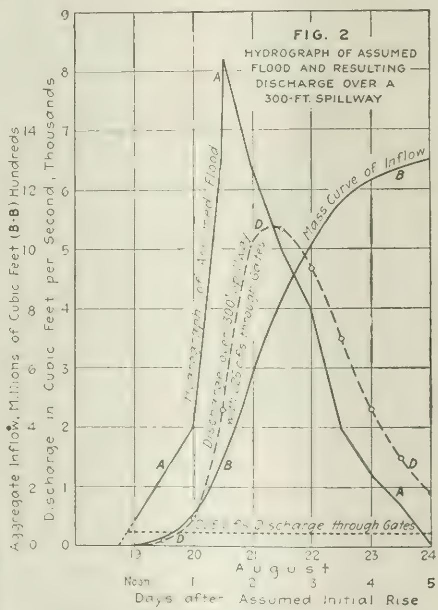
TABLE I. COMPUTATION OF AUXILIARY FUNCTIONS FOR DETERMINATION OF FLOOD REGULATION BY SPILLWAY DISCHARGE

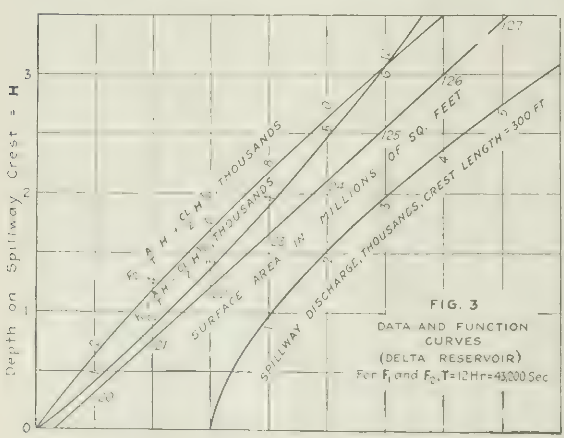
Head on Spillway H	Area Above Spillway A	$\frac{A}{T}H$	C	$H^{3/2}$	$\frac{CL}{2}$	$\frac{CL}{2}H^{3/2}$	$F_1 = \frac{AH}{T} - \frac{CL}{2}H^{3/2}$	$F_2 = \frac{AH}{T} + \frac{CL}{2}H^{3/2}$	$Q = CLH^{3/2}$
0.5	120,440,000	1,395	3.33	0.35	500	175	1,220	1,575	350
1.0	121,550,000	2,815	3.50	1.00	525	525	2,290	3,340	1,050
1.5	122,650,000	4,260	3.55	1.84	532	979	3,281	5,239	1,950
2.0	123,740,000	5,725	3.60	2.83	546	1,530	4,195	7,255	3,060
2.5	124,860,000	7,220	3.65	3.95	547	2,165	5,055	9,385	4,330
3.0	126,000,000	8,750	3.70	5.20	550	2,865	5,885	11,615	5,730

Length of spillway crest = L = 300 ft.; length of period = T = 12 hr. = 43,200 sec.; C = variable coefficient of discharge for spillway

In connection with the design and construction of a small storage reservoir on Oneida Creek in 1901, the writer conceived the idea that the solution of this problem could be simplified by assuming T as the independent variable in the equation given above and solving for dH. In this solution, the determination of H for any chosen time interval, T, is made dependent upon the equation of values of two special functions. Curves of the values of these functions can readily be computed and plotted for any given reservoir, after which the solution of any problem of flood regulation by this reservoir can be very simply obtained.







CURVES FOR REGULATING RESERVOIRS

TABLE II COMPUTATION OF FLOOD REGULATION BY SPILLWAY DISCHARGE FOR CONDITIONS IN FIG. 2.

Date	Hour	Length of Period T	Inflow at Beginning of Period	Mean Inflow for Period I	Outflow Through Gates K	Head on Spillway—Start of Period H_1	F_1	$F_2 = I - K + F_1$	H_2 = Head on Spillway—End of Period	Discharge Over Spillway at End of Period
Aug 19	Noon	12 hours	425	812	225	0	0	587	0 20	100
	Midnight	=	1,200	1,600	225	0 20	520	1,895	0.61	480
20	Noon		2,000	5,100	225	0.61	1,450	6,325	1.76	2,500
	Midnight	43,200	8,200	7,300	225	1 76	3,800	10,875	2 82	5,200
21	Noon	seconds	6,400	5,700	225	2 82	5,530	11,005	2 86	5,320
	Midnight		5,000	4,500	225	2 86	5,650	9,925	2 63	4,670
22	Noon		4,000	3,000	225	2 63	5,250	8,025	2 18	3,500
	Midnight		2,000	1,600	225	2 18	4,530	5,905	1 67	2,300
23	Noon		1,200	950	225	1.67	3,600	4,325	1.27	1,510
	Midnight		700	375	225	1 27	2,830	2,980	0 92	920
24	Noon		50	50	225	0 92	2,130	1,955	0 62	500

This method of solution of the problem is direct: *i.e.*, it eliminates the process of trial and error or successive approximations which are used in all the other methods described. It is also much simpler in application if the necessary function curves have been computed.

In the following paragraphs the theory is given on which the method is based, together with an example illustrating its use. A convenient form of area and capacity curve for a large reservoir is shown by Fig. 1.

Several cases of flood control by a reservoir are: (1) Reserve storage to retain entire flood inflow; (2) reserve storage to retain inflow excepting a nearly constant outflow through gates; (3) reserve storage below spillway to retain partial inflow with or without constant discharge through gates, remainder wasted over spillway; (4) reservoir full to spillway level at start.

In order to determine the reserve storage required to control a given flood in Case 2 plot a hydrograph of the flood and determine the area above the ordinate corresponding to the discharge rate through the gates. For example, with the flood shown in Fig. 2, and a constant outflow through gates of 225 cu.ft. per second, the necessary storage reserve to prevent waste over spillways (*i.e.*, to regulate outgo to 225 sec.ft.) would be as follows: Total volume of flood, 1,277,000,000 cu.ft.; volume in excess of 225 sec.ft. required storage, 1,182,000,000 cubic feet.

In Case 3, a mass curve of the inflow, or the inflow less the outflow through the gates, if any, may be used to determine the time at which the reservoir will become filled to crest level, Fig. 2, line B. After the spillway level is reached, the further determination of the regimen of the flood below the reservoir may be accomplished as follows:

Let H_1 and H_2 be initial and terminal heads on the spillway crest for any chosen unit period time.

Then the average rate of discharge in second-feet during the unit period is

$$CL\frac{H_1^{3/2} + H_2^{3/2}}{2}$$

The average rate of gain or loss of storage in second-feet is

$$\frac{A\,(H_2 - H_1)}{T}$$

Where T = time unit, seconds;

L = length of spillway crest, feet;

C = coefficient in weir formula (if variable, use mean of values for H_1 and H_2);

A = mean surface area of reservoir between H_1 and H_2, square feet;

I = mean rate of inflow to reservoir during time T, second-feet;

K = rate of outflow through gates, etc., if any, second-feet;

We have for time T; *Rate of Inflow = Rate of Gate Outflow + Rate of Spillway Outflow + Rate of Gain (or — Rate of Loss) of storage.* Substituting symbolic values we have:

$$\frac{CL}{2}H_2^{3/2} + \frac{CL}{2}H_1^{3/2} + K + \frac{A\,(H_2 - H_1)}{T} = I \qquad (1)$$

Transposing to get terms containing H_2 in the left-hand member, we have,

$$\frac{CL}{2}H_2^{3/2} + \frac{A}{T}H_2 = I - K + \left(\frac{A}{T}H_1 - \frac{CL}{2}H_1^{3/2}\right) \qquad (2)$$

$$\text{Letting } \left(\frac{CL}{2}H_2^{3/2} + \frac{A}{T}H_2\right) = F_2\text{, and}$$

$$\left(\frac{A}{T}H_1 - \frac{CL}{2}H_1^{3/2}\right) = F_1$$

Equation 2 can be written, $F_2 = I - K + F_1$ (3)

F_1 and F_2 are functions of H. A series of values of each is computed for chosen values of H, and curves plotted showing the relation between H, and F_1 and F_2. (See Fig. 3.)

For the first period, starting with the water surface at the elevation of the spillway crest, $H_1 = O$, so that $F_1 = O$. I and K are known and F_2 is found from Equation 3. With F_2 determined, the corresponding value of H_2 can be taken directly from the F_2 curve (Fig. 3). For the next period $H_1 = H_2$ of the period preceding and the corresponding F_1 is found on the F_1 curve and Equation 3 again solved for F_2, after which the procedure is the same as before.

The following example is taken from a calculation of the effect of the New York State Barge Canal Reservoir at Delta, N. Y., in regulating the flood shown by the line A, Fig. 2. The reservoir is assumed full to spillway level at noon on Aug. 19; the spillway crest is 300 ft. long; there is a constant discharge through gates of 225 sec.-ft. At midnight Aug. 20, H has been found to be 0.20 ft. For the following 12-hr. period, H_1 will equal 0.20 and the corresponding F_1 = 520 from the curve. The average inflow for the period equals 1600 sec.ft.; $F_2 = I - K + F_1 = 1600 - 225 + 520 = 1895$, from which H_2 = 0.61 = head on spillway at noon and equals H_1 of the following period. For a precise calculation the end of the next time unit should be coincident with the maximum.

As a check on computation: *Total Storage + Area Value Under Curve of Discharge = Area Inflow Curve.* The discharge over the waste weir corresponding to each value of H_1 and H_2 being computed, a set of diagrams may be plotted showing in terms of time: (1) Rate of inflow to reservoir; (2) rate of outflow from reservoir; (3) depth of waste weir.

Computations should be carried beyond the point of maximum outflow. The diagrams show directly the reduction in maximum discharge volume and the lag or delay in run-off occasioned by the reservoir.

The less the spillway length, the greater, as a rule, will be the range in depth on the crest and the consequent regulation. When the initial stage is below the spillway crest, the gates opened at beginning of rise and closed when the water reaches the spillway level will sometimes give the best regulation and the greatest reduction in flood volume below the reservoir.

The accompanying tables show details of the computation of the function curves (Fig. 3) and also of the regulated-flood hydrograph, Fig. 2, line D. It is sometimes convenient to use two sets of curves for F_1 and F_2, one set for a short time interval for low heads, and the other set for a longer time interval for greater heads or depths on the spillway.

Army Motor Trucks Carry Water Purification Plant

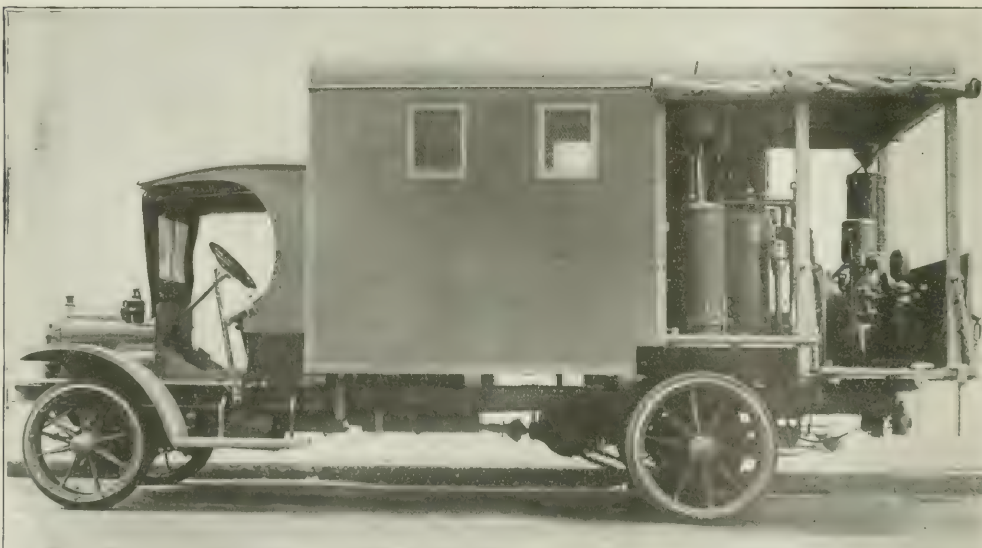
Provided with Mechanical Filter, Chlorinating Apparatus and Testing Laboratory, They Insure Safe Water for Troops

By Robert K. Tomlin, Jr.

War Correspondent of Engineering News-Record

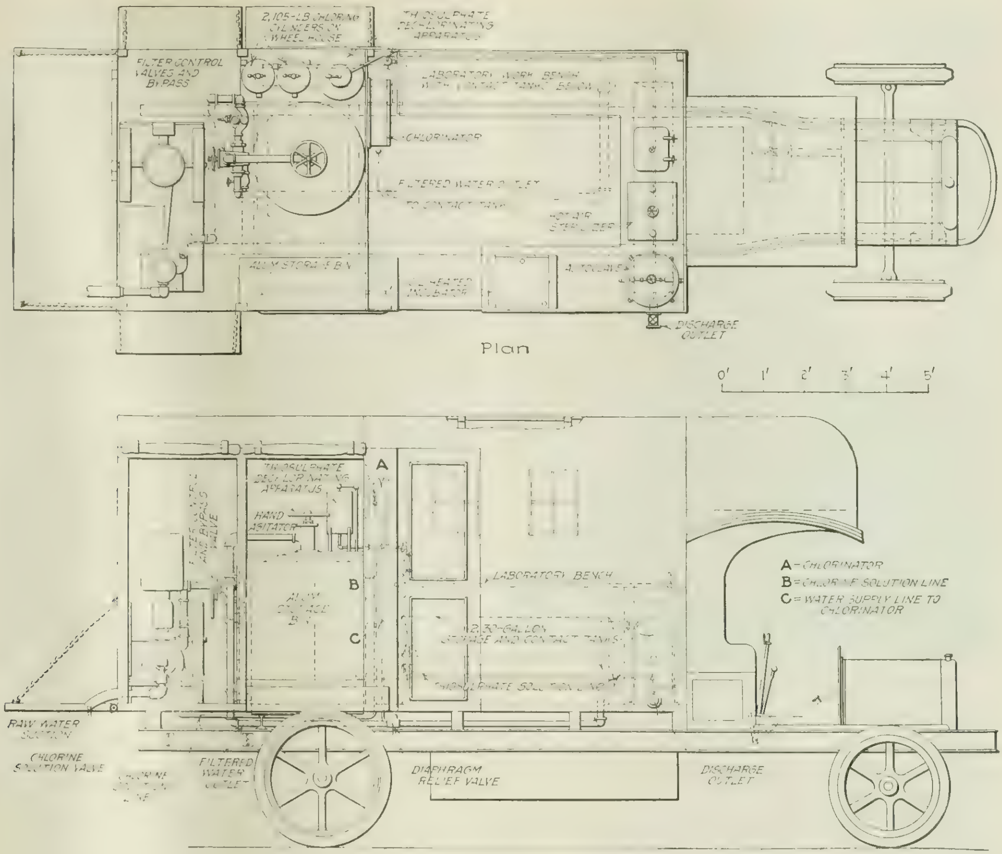
FOR emergency filtration, sterilization and analysis of water supplied to American troops at the front in France, specially designed mobile plants, mounted on standard motor trucks, have been placed in service. The first outfits of this sort were sent to a division in an American sector early in June. They are the forerunners of others which, it is planned, will be used pretty generally by the American Expeditionary Forces for producing temporary supplies of potable water pending the creation of the more or less permanent "water points" which present military engineering practice has developed for the advance zones. While they embody no principles of water treatment which have not been employed for years past in the United States, the portable plants are nevertheless unique in so far as sanitary engineering practice of the allied armies is concerned. They represent an ingenious adaptation of standard American methods of water purification, on a comparatively large scale, to the special needs of Army service, the features of the new outfits being mobility and such compactness in arrangement that a complete water purification plant and analytical laboratory are carried on the chassis of a 3-ton truck.

There are at the present time three different types of these motor-truck plants. The first is known as the "Steri-Lab" and comprises a pump, a pressure filter, a chlorinating apparatus and a laboratory. The second, the "Chloro-Pumping" outfit, is like the first, except that it carries no pressure filter, and has a pump of greater capacity than the "Steri-Lab." The third is essentially a laboratory on wheels for the chemical and bacterial analysis of water. These mobile plants were designed and equipped by the Wallace & Tiernan Co., Inc., of New York, working in collaboration with officers of the Corps of Engineers.



ALL THE STERI-LAB EQUIPMENT IS COMPACTLY ARRANGED AND CARRIED ON A THREE-TON TRUCK

The details of the "Steri-Lab" truck are shown in the



SIDE ELEVATION AND PLAN SHOW DETAIL OF MOBILE WATER PURIFICATION PLANT

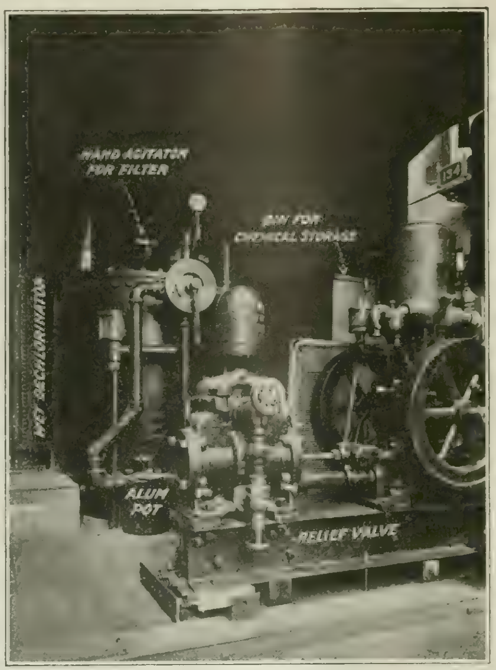
accompanying drawing and photographs. At the rear end is a gasoline-driven pump of the double-acting piston type with a rated capacity of 20 gal. per minute which may be operated against a pressure of 100 lb. per square inch. It is equipped with 50 ft. of 2-in. hose, foot-valve and strainer. The pump delivers direct to a Roberts mechanical filter of the pressure type, a 30-in. diameter vertical tank mounted over the rear axle. This filter has a hand agitator and is fitted with an alum pot. An alum storage bin is mounted over the right rear wheel of the truck.

Chlorine gas is applied at the pump suction, and the dose generally is much heavier than that employed in ordinary municipal water-works practice. It may vary from 4.5 to as much as 10 parts per million. A contact period of from 10 to 15 minutes is afforded by cylindrical tanks mounted under the work bench of the laboratory compartment of the outfit. With such an intensive application of chlorine, which is adopted to insure absolute safety in the quality of the treated water, it will frequently be necessary to dechlorinate with a thiosulphate solution applied through an adjustable sight feed. The chlorine is carried in 105-lb. cylinders. To a large extent our water-supply sterilization will be carried on with chlorine obtained from the gas service of the American Expeditionary Forces.

The filtered and sterilized water passes either to a discharge valve, where it can be fed to tank carts or stationary storage, or it may be left in the contact tanks for storage there. These four tanks have a capacity of 30 gal. each, and are tested for a pressure of 100 lb. per square inch.

The forward part of the truck body is occupied by the testing laboratory. This room is completely inclosed, and provided with a door from the rear and wire-glass windows on the side. It is completely equipped as a water-testing laboratory, with working bench, wash sink, water under pressure through faucets, hot air sterilizer for sterilizing glassware, autoclave, bottle and instrument rack, and a full line of laboratory utensils. The laboratory will be used to test waters before and after treatment and for such tests as are required on other occasions.

This type of machine will be able to sterilize 1200 gal. of water per hour when operating through its full system. A bypass is provided around the filter, so that if



CORNER OF WATER ANALYSIS LABORATORY—PUMPING PLANT, PRESSURE FILTER AND DECHLORINATOR

a water supply is encountered which does not require filtration to remove turbidity and color, but simply chlorination to make the water bacteriologically safe, the capacity may be increased.

The second type of mobile plant, or "Chloro-Pumping" outfit, is carried on a 1½- instead of a 3-ton truck. Here there is no pressure filter. The pump has a capacity (40 gal. per minute) double that of the "Steri-Lab" machine. This outfit is designed for emergency work during an advance or a retreat where filtration may be dispensed with. The chlorinating and thiosulphate apparatus is of the same kind as that previously described.

The "laboratory," or third, type of truck is also carried on a 1½-ton chassis. It is fitted with the usual equipment for making chemical and bacteriological examinations of water. All racks and cases are felt-lined to prevent glass breakage. Water for laboratory use is contained in a tank fitted with a hand air pump to supply pressure. On this truck will be carried a bicycle for the use of the laboratory assistant in collecting samples.

Distribution of Internal Work in Beams and Slabs

Difference in Amounts of Energy Stored in Steel Indicates Dissimilarity in Structural Functions of Concrete

BY HENRY T. EDDY
Dean and Professor Emeritus, University of Minnesota

THE writer has recently calculated the amount of the energy of elastic deformation expended in elongating the reinforcing steel and in compressing the concrete in the specimen beams cited by Humphrey and Losse in Technological Paper No. 2, U. S. Bureau of Standards, Table 26, page 60; and he has compared these amounts with the total work of deflection due to the action of the load. These beams had seven different steel ratios, from 0.0049 to 0.0196; they were loaded at their one-third points. The calculations are too lengthy for insertion here, but they show that at steel stresses of 16,000 lb. per sq.in. in the middle third the mean energy stored in the steel was 62.5% of the work of the load, and the mean energy of compression of the concrete was 34%, with not over 10% variation from the mean value, while at steel stresses of 32,000 lb. per sq.in. in the steel (whose yield-point was between 35,000 and 43,000) the mean energy stored in the steel was 67% and the mean energy of compression of the concrete was 30%.

These two kinds of stored energy, that stored in the elongation of steel and that in the compression of the concrete, account for so nearly all of the energy expended during deflection that the residue is negligible. Very little energy storage of any kind other than those already considered is possible.

In attempting to make similar calculations respecting flat slabs, the test data available suffice to calculate the energy stored in the steel with considerable accuracy, but do not appear sufficient to furnish a basis for any such satisfactory calculation of the work done upon the concrete during deflection.

A detailed consideration of the test of the Deere & Webber building made by A. R. Lord in 1910 shows that at a mean steel stress of 9000 lb. per sq.in. at midspan the energy stored in the slab steel was 12.6% of the total work of deflection. The test of the Northwestern Glass Co. building made by F. R. McMillan in 1913 shows that at a mean steel stress at midspan of about 17,000 lb. the energy stored in the slab steel was 12% of the work of deflection. The test of the St. Paul Bread Co. building by W. H. Kavanaugh in 1912 shows that the energy stored in the slab steel was 12.8% of the work of deflection.

The present writer's general formulas for stresses and deflections of flat slabs, which have been found to be in good agreement with all test results available up to the present time, give the work stored in the slab steel as 12.7% of the total work of deflection at high test loads. At lighter loading the percentage might differ slightly from this, but the difference is not important.

These results seem to show conclusively that in slabs the percentage of energy absorbed by the steel is much smaller than in beams—say only about one-fifth as much. If so, the stresses in the slab steel are much smaller than they would be by beam theory, lending confirmation to the claim made on other grounds by the writer that they are less than one-fifth as great.[1]

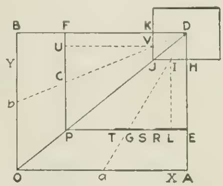
If only one-eighth of the total energy of deflection, then, is stored in the slab steel, the question is, where is the rest of it to be found? It must be found in the concrete, which consequently must play a much more predominating role in flat slabs than in beams, as it is evident that it does in the first place, because the steel ratio in flat slabs is commonly only about half that in beams.

In the opinion of the writer, direct tensions in the concrete parallel to the steel cannot possibly supplement the steel tensions in such a way as to cause the concrete to take four or more times as much direct tension as the steel. That is incredible on the face of it, for were it so the removal of all the steel should not greatly reduce the strength and resistance of the slab. At the high steel stresses in slabs under test it is not possible that any important assistance to the steel should be derived from direct tensile stress in the concrete at points of maximum steel stress, although considerable work may be expended in direct tension of concrete in parts of the slab where the steel stresses are smaller. It would seem impossible that more energy should be expended in direct tension of concrete parallel to the steel than upon the steel itself. That would leave three-fourths of the work of deflection still to be accounted for.

The writer has attempted to give an explanation of the mechanical action of the concrete matrix in holding crossed rods together in "Reinforced Concrete Construction," p. 127, where it is shown how lines of diagonal tension and compression in the concrete form the connection between the reinforcing rods. In this kind of coaction between the steel and concrete in fine-grained reinforcement, energy is expended on the concrete throughout the entire tensile region of the slab in a manner not found in beams.

It must be remembered that in the compression areas of the concrete the compression takes place in two directions at once instead of occurring in a single direction only as in beams, thus storing more energy in compression per cubic unit than in beams for a given intensity of stress.

But there are still other kinds of resistance afforded by the concrete in slabs not found in beams. At midspan of the panel sides there is at the top of the slab longitudinal compression and transverse tension. The two acting at once constitute a state of stress equivalent to a horizontal shear on vertical planes cutting the sides obliquely. Shears of opposite sign occur at the bottom of the slab. The opposite shears constitute twists about horizontal axes that are oblique to the sides of the panels.



QUARTER PANEL OF FLAT SLAB, COLUMN CENTER AT D

But these twists, arising directly from the action of the longitudinal stresses of the bending moments, are not the most important and generally diffused twists that exist in the slab. For, let *OADB* in the sketch be a quarter panel of a uniform continuous plate with center at *O* and center of column cap *HKJ* at *D*, uniformly loaded. The edges *AH* and *BK*, the median lines *OA* and *OB*, and the diagonal *OJ* are all lines of zero shear at all points. The total load on *AOJH* is supported by the vertical shear at *JH*, and the total load on *BOJK* by the vertical shear at *JK*. The shear on *JH* is equal and opposite to the sum of all the shears on parallel vertical sections like *PE*. If *W* be the total panel load outside the caps, then the upward shear at *JH* is $\frac{1}{8}W$, and the downward resultant shear of the load on *OAHJ* is $\frac{1}{8}W$ applied at its center of gravity *G*. Lay off *TS* and *RE* each equal and parallel to *JH*, and suppose the resultant downward shear of the load to act at *TS*. Let upward and downward shears of the same amount be applied at *RE*. Since these last constitute a system in equilibrium they can be added to the system already existing at will. The upward shear at *JH* and the equal downward shear at *RE* constitute a bending moment about the axis *OX* of amount $\frac{1}{8}W \times IL$. The upward shear at *RE* and the downward shear at *TS* constitute a twisting moment about *OY* of amount $\frac{1}{8}W \times GL$. The load $\frac{1}{8}W$ upon *OAHJ* is carried to the cap and fully supported there by these shears and moments and produces no other shears or moments. Similarly the load $\frac{1}{8}W$ on *OBJK* produces a bending moment about *OY* of $\frac{1}{8}W \times UV$, and a twisting moment about *OX* of $\frac{1}{8}W \times CU$. But $GL = \frac{1}{2}UV$ and $CU = \frac{1}{2}IL$. Hence the statical moment of the load about either axis is one-third twisting moment and only two-thirds bending moment.

Twisting moments cause no longitudinal stresses in the slab as do bending moments. Hence, however small the cap may be, the bending moment due to two quarters of a panel can never exceed two-thirds of $\frac{1}{8}Wl$ and for a cap of size $0.2l$ the bending moment is found to be less than $\frac{1}{16}Wl$.

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[1] "A Further Discussion of Steel Stresses in Flat Slab Floors," American Concrete Institute, twelfth annual convention, Chicago, February, 1916.

The large applied twisting moments on sections parallel to PE and PF, which have heretofore apparently been entirely overlooked, increase in uniform plates uniformly from E and F to P. Resistance to these twisting moments absorbs energy of deflection throughout the entire area of the slab. But in a floor slab the distribution of the resistance is controlled by the relative rigidities of these sections and may increase irregularly.

The above-demonstrated reduction of the bending moment below the value $\frac{1}{8}Wl$, which has been almost universally accepted hitherto, is one of the reasons for the small percentage of energy found in the slab steel. Another form in which slab concrete stores energy is in the twist about vertical axes which can be demonstrated to exist in vertical slab elements that extend through the slab from the top to bottom surface, due to variations of rigidity in resisting twisting moments.

It is perfectly evident from the foregoing cursory examination of the subject, which is not assumed to be exhaustive, that in slabs the concrete is called on to afford resistance in several ways in addition to those represented in beam action. Since the same concrete can simultaneously and effectively fulfill these several functions at one and the same time, it is not surprising that slabs exhibit properties not found in beams and not at all to be accounted for by beam theory. Each separate kind of resistance that is called into play in a slab contributes just so much to its load-carrying capacity and diminishes by just so much other resistances that would be called for, did these not exist.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Heavy Motor Trucks and the Highways

Sir—The discussion, in your issue of July 18, of interurban roads for motor truck traffic, by Samuel Whinery, was indeed an interesting and timely one, as all of us who have any occasion to use the trunk routes for motor travel can bear witness.

Mr. Whinery's discussion brings to mind an experimental piece of track that was laid in Murray St., between Church St. and Broadway, New York City, in either 1899 or 1900. I do not know who was responsible for the experiment, or when or why the track was finally taken up, but it seems to me that it contained the solution of the present problem.

That was, of course, before the days of any great amount of motor traffic, and the purpose of the track was merely to minimize the amount of effort exerted by the horses in moving wagons through a city street, in the same manner that rails minimize the effort necessary to move horse-cars.

The track consisted of two fairly wide and rather shallow channels or troughs of steel, running longitudinally in the street and far enough apart to make a track of proper gage to accommodate practically any wagon or truck that would ordinarily be used in city traffic. Being very shallow, it required little effort to pull out of the track and pass around another vehicle which was met or overtaken, and having passed, to pull back and proceed as before.

I believe that a single pair of these channel or trough-shaped rails could easily be made a part of any new road construction which was intended for a moderately dense traffic, or, in other words, a traffic that is not too dense for "single track" operation. In practice, it would of course be necessary for both vehicles to pull out of the track when meeting or overtaking, in the same manner in which they now pull to the side on hard roads or out of the rut on earth roads, but, by reason of the shape of the rails, this would entail no appreciable effort.

On roads of denser traffic it would, of course, be necessary to provide for "double-track" operation by laying two pairs of rails, and it would then be unnecessary to turn out when meeting. When overtaking, only the faster moving vehicle would need to pull out of the track.

If these tracks were used, it would be advisable to pave the space between the rails and out to the shoulders with concrete, and it would also be necessary to have the rails firmly fastened to and supported by the road construction. Being of steel, they could stand the heaviest type of motor-truck traffic with hardly any wear, and should last indefinitely. At the same time they would relieve the paved areas from the punishment which they now receive, and which soon destroys even the best of them.

As compared with the type of industrial railways suggested by Mr. Whinery, the tracks described above have the advantage of requiring no switches or turn-outs. They do not require additional width of roadway, and they require no more grading than is necessary for any of the types of road now in use. Furthermore, they obviate the need for any special flanges or other attachments to the wheels of the highway vehicles.

From the standpoint of ultimate cost, the addition of one or two pairs of rails to a road under construction should be a comparatively inexpensive matter, since they would make possible a great decrease in the cost of maintenance and a great increase in the life of the road.

Another advantage of this type of track over the industrial track would be that it could be installed in as long or as short sections as financial conditions warranted, and that new sections could readily be linked up to those already constructed.

The exact cross-section of the rail, as well as the method of fastening and supporting it, would require considerable study and possibly some experimentation, but these are only details to be taken up at the proper time.

CHARLES F. DINGMAN,
Flynt Building and Construction Company.
Palmer, Mass.

Copper Sulphate Controls Algae Growth in Tieton Irrigation Canal

SIR:—Since the article by Paul Taylor in your issue of July 25, showing the effect of algae in increasing the value of Kutter's n in the Tieton Canal, was written, we have been able to eliminate this trouble by the use of copper sulphate.

About July 1 of the present year the growth again became sufficient to retard the flow in the canal. Copper sulphate to the amount of 200 lb. was suspended in burlap sacks in the water near the head of the canal. The entire quantity was dissolved in a few hours. A week later, when the canal was again inspected, the growth of algae had entirely disappeared along the water line, where it had been most abundant. It was not feasible to empty the canal, but apparently the entire growth has been destroyed.

The canal was carrying at the time of the experiment about 305 sec.-ft. The velocity in the open channel, where the copper sulphate was suspended, is about 3½ ft. per sec., and in the concrete-lined canal about 10 ft. per second.

Yakima, Wash. R. K. TIFFANY,
Project Manager.

City, County and State Plan for Reconstruction

Sir—In view of the editorial in your issue of Aug. 8, with reference to providing work for the returning soldiers at the close of the war, you will no doubt be interested to know that the City of Alton plans to spend $1,000,000 for a city hall, paving and other improvements as soon as the war is over. Our county has authorized a bond issue to build $1,500,000 worth of hard roads at the close of the war. This was carried by a vote of 7 to 1. The State of Illinois will vote Nov. 5 on building $60,000,000 worth of hard roads at the close of the war.

So you can see that our state, our county, and our city certainly agree with you in your recent editorial. The only way to meet the conditions that will prevail at the close of the war is to provide sufficient work for all while the nation is in the process of readjustment.

Alton, Ill. HARRY HERB,
Manager, Board of Trade.

National and Local Societies

Sir—For a number of years there has been a very strong sentiment among the engineers resident in the City of Duluth and the mining and industrial territory adjacent to form a local engineering society that would embrace all members of national societies and those who are actively engaged in engineering work and who have not yet joined or are not yet qualified to join such societies. Some of the older men of this locality have held back from organizing such a local society pending the actions of the national societies in laying out a plan that might guide and direct the form and membership of a local—with a view to uniting such locals, when formed, with a national organization.

Nothing having been done yet to point out the proper form of a local that might eventually enter a national, the engineers of Duluth met on Aug. 5 and organized and incorporated the Duluth Engineers' Club. The strength and support of this club will be local members of the great national societies who have practically all joined the club and who will probably constitute more than 50% of its membership. It is the aim of the Duluth club, and it has already been largely accomplished, to bring into its membership all men who are actively engaged in engineering work in and near Duluth. Its "general purpose is to create an instrument by which united action can be obtained by the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual; to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession and in general for the uplift of the community, the profession and the individual."

Such a society, with an eventual membership of three hundred, is now in existence and is willing to coöperate and work with a national organization—but where is the organization?

At the last regular meeting of the Committee on Engineering Coöperation held in Chicago, Mar. 29-30, 1917, there were present official representatives of at least two national societies, who spoke very strongly in favor of not attempting to form a new national organization that would embrace all local engineering societies, but instead to wait until the four national societies could have time to act and present for consideration a plan of organization. As shown by the resolutions drawn at that time by the Committee on Engineering Coöperation, this suggestion was followed, and the result was the presentation, by the four national societies, of the Engineering Council plan, practically a subcommittee of the United Engineering Society.

Studying carefully the charter and by-laws of the United Engineering Society and its committee, the Engineering Council, it is hard to understand how it can possibly function toward correlating the work and interests of local engineering societies throughout the country. It has apparently missed entirely the vital question under consideration by the Committee on Engineering Coöperation.

Many engineers have felt during late years that something should be done to unite all branches and all the different levels of the profession, and that this could be done in a complete and satisfactory manner only by and under the direction of the large nationals. It is vitally important to the well being and standing of the profession, as well as to the public at large, that the many thousands of men who are actively engaged in engineering work and who are not members of national societies, and perhaps never will be, should be brought under the influence of the profession in the best and most kindly way. If this can be successfully accomplished it will tend to remove many points of friction among engineers and build up an *ésprit de corps* among men who have had little interest in their work outside of its immediate financial returns. The local society is the first step toward accomplishing this result; when rightly organized and run it will be

the live nerve end of the profession that comes in touch with the public and will return to its governing head important sensations. Through the professional and social work of these locals the profession may build on a broad and solid foundation, and it never will become stable and solid until conditions at the bottom are sound.

As stated by C. E. Drayer of the Cleveland Engineering Society, "there should be no lowering of the standards of the nationals" and none will be necessary. Rather they might well be raised if there were proper organizations to fill the need now unprovided for. The lack of correlation between locals and some form of national organization will be felt in the coming revision of the constitution of the American Society of Civil Engineers by pressure being brought to bear to open up some lower level of membership that might be better taken care of in the local. If the leading national societies cannot rise to this demand and lay down a plan to provide for the necessity, there will be organized an association for that purpose, and it may well, in a very short time, become—at least in public opinion—the one engineering organization.

Detailed plans whereby the great mass of unrelated and uncontrolled material in the engineering profession could be brought under the Engineering Council should not be hard to arrange. This, if successfully done, would give tremendous strength to its work. The field that could be covered by its public affairs committee and its committee on engineering service would be enormous, and the possibility of intelligent control and direction of these thousands of men, in local engineering societies, by the nationals, would be of untold benefit to the public and the profession.

As stated editorially in *Engineering News-Record*, Aug. 8, several plans have been suggested, and it is squarely up to the profession to solve the question.

W. H. Hoyt.
President, Minnesota Joint Engineering Board.
Duluth, Minn.

Is Poor Drainage the Actual Cause of Most Highway Failures?

Sir—Is improper drainage the actual cause of any large percentage of the pavement failures which are an annual occurrence? The frequent reference to poor drainage as the cause of pavement failures leads to the query as to just what "drainage" is and as to what relation it bears to pavement failures.

The first part of this query is readily answered. Drainage, as usually understood is the art of removing gravitational water, and involves the use of ditches to remove surface run-off and the installation of subsurface drains wherever they are necessary for the removal of ground water. But the removal of surface run-off and of ground waters to the level of the subdrainage system does not insure that subgrades will be dry, for all soils absorb moisture readily and retain it persistently. A great deal of the water so absorbed is moved by capillary attraction and capillary attraction is, of course, uninfluenced by drainage systems, except as drainage systems may occasionally lower the level of the water table so far that capillary attraction cannot lift the water into the subgrade. But the water raised into and held in a soil by capillary attraction may be quite sufficient to render it soft and plastic.

Then, again, the advocates of drainage as a curative for all of the ills which befall a modern highway usually overlook the fact that there are a great many soils which, even when saturated, drain very slowly if at all. The writer's attention was recently called to the condition of a pavement on a fill some 12 ft. high. The metaling had failed under heavy traffic and, upon examination, it was found that water stood two inches above the bottom of the metaling. Examination showed that the fill had been tile drained.

This case was not unusual. Everyone knows that many clays are quite impervious—so impervious that they are very commonly used in producing water-tight cofferdams where a few feet of clay is often used to hold back water even against a considerable head. Just why men who know this should try to "drain" these same materials by the simple process of installing a few feet of tile has never seemed quite clear. But even if such clays could be more readily "drained" (and clays comprise a goodly percentage of most subgrades) this would be of small value, for the clays absorb moisture quite readily and retain enough to maintain themselves in a plastic condition for long periods after every protracted rain. But the moisture so absorbed and so retained is not one whit affected by the presence of any sort of drainage system, as every engineer knows. Where clays of this type are encountered, they should be wasted, for they are a constant source of trouble during wet weather.

Last, but by no means least, the advocates of extensive tile drainage seem to overlook wholly the fact that tile drains to be at all effective must be placed three or four feet under the surface of the ground. But in the spring, when subgrade conditions are the worst, subdrains are inoperative because the frozen ground which at this time underlies the surface prevents any water from getting down to them. This should be clear without any comment and, indeed, every drainage engineer who works in the northern part of the United States knows that his tile drainage systems do not begin to flow until two or three weeks after the spring weather has thawed the snow and melted the top of the ground.

There are pavement failures which are due to "improper drainage," but they are comparatively rare—very rare indeed on state road systems. It is, of course, beyond dispute that many road failures could be avoided if the subgrade could be kept perfectly dry, but there is no reason at all for assuming that even perfect drainage systems would keep the subgrade dry. As a matter of fact, they would not accomplish this result. There should, therefore, be a good deal more discussion of the bearing value of soils and their general behavior under the moisture conditions which really prevail in normal subgrades, more of a tendency to analyze pavement failures, and less satisfaction with the superficial explanation that if a pavement has failed there must have been some trouble with the drainage.

J. L. Harrison,
Falls Church, Va. Highway Engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Templet With Adjustable Edges Strikes Variable Crown Pavements

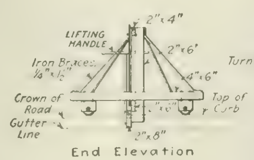
BY SAMUEL H. LEA
Hampton, Va.

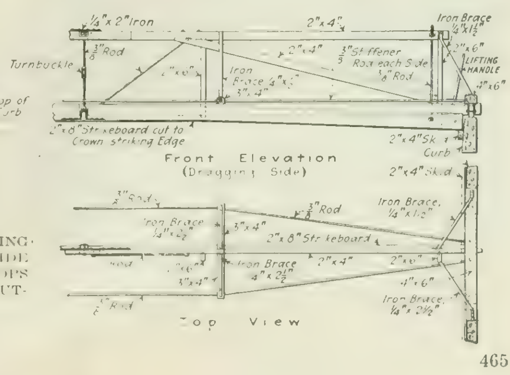
A TEMPLET with self-adjusting cutting edges has been developed for striking the warped surfaces of the pavements at the Langley Field Aëronautical Station near Hampton, Va. The level nature of the country makes it necessary to get drainage by dropping the gutters while the center line is held at a uniform elevation with respect to the curbs. This produces a warped surface which cannot be dragged longitudinally with the ordinary rigid templet. A complete description of the conditions surrounding the job at the experiment station and a picture of the templet in operation are given in an article on page 447 of this issue.

Other Articles in This Issue of Interest to Contractors:

Complete details for the construction of the templet are shown in the drawing. The distinctive feature is the strap-iron hinge, at the center, which allows the two sections of the cutting edge to be raised and lowered. Not being attached to the trussed frame, these edges may be easily raised and lowered by means of the two lifting handles. The center hinge is suspended from the truss by a rod and turnbuckle, allowing adjustment for changes in the elevation of the curb with respect to the center line of the street. The cutting edges must be in front of the frame as it moves forward, and the frame must be well trussed and braced laterally to prevent deflection.

In operation the truss, which is mounted on four wheels, rolls upon the top of the curbs, while the cutting edges slide upon skids which are bedded against the curbs at the proper gutter grade. The skids are made in short lengths which may be quickly removed after striking, so that the space which they occupy may be filled with concrete. Four men are required to operate the device. Two move it forward, while two raise and lower the cutting edges so as to tamp the concrete. After the first strike, the edges are raised, the templet is moved back, and the operation is repeated without tamping. This leaves a smooth surface for the finishers.





HINGED SELF-ADJUSTING EDGES OF TEMPLET RIDE ON SKIDS WHOSE TOPS ARE LAID TO THE GUTTER GRADE

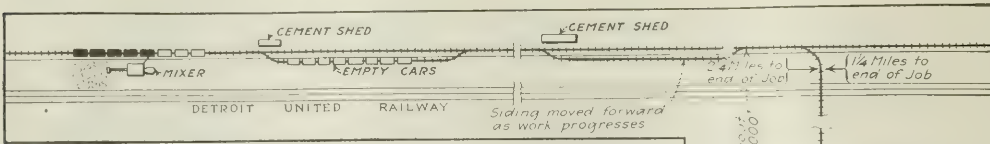
Every Step Mechanical in Materials Supply for Michigan Road

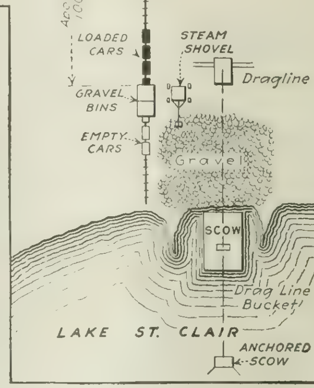
AGGREGATE handling is one hundred per cent. mechanical on the new shore road being built near Mount Clemens, Mich. The train of mechanical processes begins with the unloading of the barges which bring in the gravel, and is continuous to the charging of the mixer. Not a manual operation, except those for actuating the machines, intervenes. All-mechanical handling of aggregate means that six-sevenths of the volume of concrete materials are unloaded, reloaded, hauled and put into the mixer without being touched by hand. Only the cement is unloaded, reloaded and changed by hand.

The shore road is 3½ miles long and 18 ft. wide, and has a 5-in. base of 1:6 concrete with a 2-in. asphalt wearing surface. The volume of concrete per lineal foot of base is, therefore, 7½ cu.ft., or a little more than ¼ yd. About 400 lin.ft. is the average day's run, but as much as 512 lin.ft. have been laid in eight hours. At 400 ft. a day, about 112 cu.yd. of gravel and 450 bags of cement are consumed in a day's work.

Gravel barges, as indicated by the plan, arrive at a point about opposite the middle of the section of road being built. This location keeps at a minimum the length of haul. The service railing extends about 1000 ft. to the road, and then along the side of the road to the place of concreting. It is single-track, with two turnouts. As the work progresses the siding nearest the mixer is moved forward about ¼ mile at a move. The track is built in 15-ft. sections and is easily shifted by hand.

Arriving at the landing stage, the gravel barges are unloaded into a stockpile by a dragline cableway exca-





NOTHING BUT THE CEMENT IS TOUCHED BY HAND FROM POINT TO PLACE IN FINISHED CONCRETE BASE

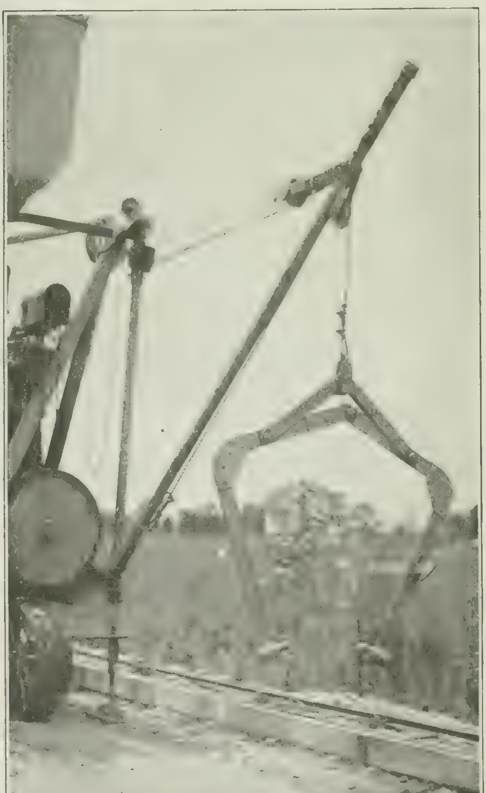
vator. From the stockpile a revolving steam shovel handles the material into bins under which runs an industrial railway. From the bins the gravel chutes into boxes on cars. To prevent spilling in loading cars the clearance under the bins was made so small that even if a careless gateman leaves his gate open no considerable amount of material can overflow the car sides.

Two men load a train of eight cars, each car carrying two 20-ft. mixer charging boxes, in six to eight minutes.

Four loaded cars are pulled oy a team of horses from the bins, up a slight grade, to the first siding on the road, as shown in the layout sketch. The team then returns for another string of four cars, and the train of eight loaded cars is ready to be hauled to the mixer by a gasoline locomotive which has brought back a string of empties.

Each car, as previously stated, carries two boxes, each holding 20 cu.ft. of gravel. The mixer is fitted with a batch transfer attachment from which a bail is hung, as one of the pictures shows. This bail is so balanced that it will stay open, thus permitting a train to move under it without the necessity of swinging the derrick. By means of this apparatus a box of gravel is lifted from the car and dumped into the loading hopper. Three bags of cement are then added, and the batch is ready to be mixed. Only five men are needed at the loading end of the mixer, three to discharge a box full of gravel into the hopper and two to handle the cement. The latter was stored in several sheds along the road. It was hauled from the sheds to the mixer in cars, each of which holds 60 bags of cement.

The contractor is Thomas E. Currie, Detroit, Mich. The track and the plant layout was planned by the engineering department of the Lakewood Engineering Co., Cleveland. The concrete work was started about July 18, and at the time of writing a little more than 1½ miles of concrete had been laid.

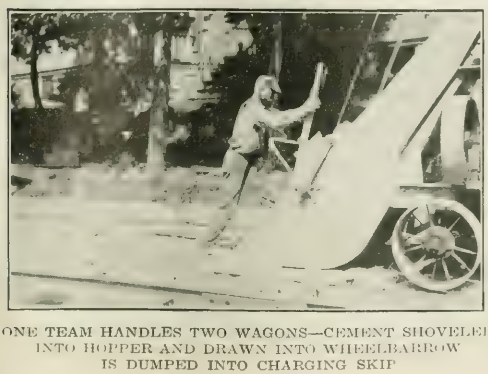


MIXER DUMPS BATCH BOX INTO ITS OWN HOPPER

SHOVEL LOADS HOPPERS OVER GAS

Wagon With Hopper Gate Handles Bulk Cement on Paving Job

BULK cement is carried in wagons that stand at the car to be loaded and at the mixer to be unloaded, is measured in a hopper attached to the wagon and is dumped into a wheelbarrow on a road contract in Milwaukee County, Wisconsin. The work is being done by Schoonmaker & Winding of Milwaukee. The road, 1⅓ miles long and 29 ft. wide, requires about 7500 barrels of cement. The work is one block from the railroad team track at the closest point, and a mile at the farthest. All materials are being hauled to the work by wagons or trucks.



ONE TEAM HANDLES TWO WAGONS—CEMENT SHOVELED INTO HOPPER AND DRAWN INTO WHEELBARROW IS DUMPED INTO CHARGING SKIP

The bulk cement is shoveled from box cars into ordinary wagons, the only preparation of which consists in nailing cloth over the cracks, where they occur, in the sides and bottom. Cement is measured in a combination hopper and measuring chute. This hopper is made of 16-gage sheet steel and weighs less than 100 lb. It has two slides, between which is measured 2 cu.ft. of cement. The hopper and the chute are filled by shoveling from the wagon with the bottom slide closed. When the hopper is filled the top slide is closed and the bottom one opened, filling the wheelbarrow.

More wagons than teams are required for this method, and of course the teams are unhooked when a loaded wagon reaches the job. A two-bag batch mixer is being used on the work, requiring the use of two wagons and one team. Three men, in addition to one teamster, are employed, one loading wagons at the car, one shoveling from the wagon to the hopper, and one wheeling from the hopper to the mixer. The wheelbarrow man operates the slides.

The contractors claim a saving of 27c. a barrel, including 15c. saving in the price of bulk cement. Not only is the work costing less, but labor, which is so scarce and difficult to get at the present time, is economized also.

Spare Plant Units Insurance Against Accidents

PLANT breakdowns can always be best forestalled by keeping equipment in good repair. A repair gang cannot, however, prevent accidents. A wrecked paving mixer was the first thing that caught the eye on a road job visited not long ago. The paver had been working up-hill. In some way a steel dump car load of concrete materials broke loose at the top of the hill and banged down into the mixer. Road pavers are not designed for bumping posts, and when the car had been disentangled neither it nor the mixer was fit for active service. In fact, the repair gang asserted that hospital leave for at least a week would be required to put the mixer back on the firing line. When a contractor is running 700 ft. a day on a rush concrete paving job, an enforced shutdown of six days is not pleasant to contemplate. The contractor for this job was, however, a disciple of preparedness. Two months before he had purchased a spare mixer which had been standing at job headquarters, covered, and with paint unscratched, waiting for just such a contingency as arose. Before the working day of the accident was over the gang had cleaned up the wreckage and restored the subgrade for concreting. By the next morning the spare mixer was on the grade, and the gang was unreeling its ribbon of concrete as if no accident had occurred.

The obvious moral of this tale does not end with the spare mixer. On this same job the contractor kept in stock spare cars so that he need not cut down his train lengths and reduce output if accident or breakdown put a number of cars out of service. Spare units of vital plant elements are first-class accident insurance.

C. S. H.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

College Heads Discuss War Educational Plans

Army Representative and Institution Leaders Consider Training Program for Students

Enthusiasm at the highest pitch marked the meetings of the three hundred college and university heads attending the conference of the Middle West region called to meet Aug. 30-31 at Fort Sheridan, Ill., by Col. Robert I. Rees, chairman of the committee on education and special training of the War Department. The object of the conference, which will be repeated for the Eastern schools at Plattsburg, N. Y., and Pacific Coast schools at the Presidio, San Francisco, is to acquaint the school authorities with the program of the Students' Army Training Camp. It was prolonged to two days, largely for the purpose of giving the presidents a chance to get into the spirit of the training camps. Many of their own students are in training at the place of conference.

Colonel Rees opened the meeting with a full explanation of the intensive training desired and the revised plans, as noted in these columns last week. Maj. W. R. Orton made a statement concerning the military program, which will take up 13 hours a week, and Dr. J. R. Angell, dean of the University of Chicago, outlined the courses which are to be followed, so far as the equipment and facilities of the various schools will permit. These are divided into two classes: Those of direct value to the army, such as engineering, chemistry and medicine, and those which will develop the practical judgment of the men for line officers. For the arts schools the latter only are possible, and of the following studies no doubt exists as to their value: English composition; French; Italian (perhaps); elementary physics and chemistry; American history; contemporary European history, with which should be combined a course on causes of the war ("Put teeth into this," said Dr. Angell); geology; geography; elementary economics; political science and civil government and international law. The colleges have an opportunity, in Dr. Angell's opinion, to prove to the country, now as never before, their real worth. They will attempt to do twice as much as usual in half the time.

C. R. Dooley discussed the vocational section, which will be merged with the collegiate section only so far as the military training is concerned. Grammar school graduates are eligible to these, and have an opportunity to advance from the vocational to collegiate grades. Some collegiate students will be put back into the vocational classes. It is a purely American and democratic arrangement.

Faculty status was warmly discussed, but Colonel Rees indicated that it was impossible to commission the professors, and that they should consider the instruction of these men as the greatest patriotic service possible.

Other topics discussed include treatment of technical students, relations of naval reserves, relations of military and college authorities, mess, athletics, supply and equipment, housing and the contract with the Government.

War Activities Will Dominate City Managers' Annual Convention

War activities of cities under the manager plan will dominate the program of the fifth annual convention of the City Managers' Association, to be held at Roanoke, Va., Nov. 6-8. The convention will mark the tenth anniversary of the establishment of the city manager plan, which had its birth in Virginia. The association states that of the 124 manager cities now in existence one-third are within 300 miles of Roanoke and more than two-thirds within 600 miles.

Heads of Aircraft and Munitions Appointed

Secretary of War Baker on Aug. 27 announced that he had that day selected John D. Ryan to act as second assistant secretary of war, in charge of the air service, and had designated Benedict C. Crowell, first assistant secretary of war, to have special responsibility for the munitions program. Mr. Ryan had been in charge of the Bureau of Aircraft Production, acting jointly with General Kenly, who is the head of the Bureau of Military Aëronautics. Mr. Ryan will now be in complete charge of the production and operation of all army aircraft. A new head of the Bureau of Aircraft Production will be selected by Mr. Ryan. The navy fleet will remain under the Secretary of the Navy. Mr. Ryan succeeds E. R. Stettinius as second assistant secretary of war and Mr. Stettinius remains in France, where he is now, as the special representative of the War Department, with full power to carry out special missions.

Mr. Crowell, who has been first assistant secretary of war for some time, has now the necessary power to see that the munitions required for our military operations are procured and furnished to the armies in the field.

Policy Defined on Use of Bituminous Materials

Highways Council Considers That Dust Laying Is Their Least Important Function

The enormous increase in the demand for fuel oil due to war activities made it necessary to regulate the supply of petroleum, asphalt, and tar products for highway work, says bulletin No. 2 of the United States Highways Council. Most of these materials are made from raw products which are either directly or indirectly available as fuel, and, while conserving this, the limited supply of petroleum, asphalt, and tar products should logically be used where it will be of greatest benefit.

Upon the assumption that the use of a certain amount of these products is absolutely necessary to the welfare of the country and to the successful prosecution of war measures, conservation of the present stock for the most necessary purposes releases, for the manufacture of fuel oil, crude materials which would otherwise be used in the manufacture of road materials. All grades and types of petroleum, asphalt, and tar products are, therefore, classed as potential fuel. Some of these products may be directly used as fuel, others may be made suitable for fuel by combination with light fluxes.

The relative importance of different classes of road work were explained in Bulletin No. 1 and reported in *Engineering News-Record* of Aug. 29, p. 423. Dust laying is considered the least important use of petroleum, asphalt, and tar products during the period of the war.

No hard-and-fast rules can be applied to the policy governing the release of petroleum, asphalt, and tar products for road purposes. Different and constantly changing production, storage and transportation conditions exist in various parts of the country, and every application must, therefore, be considered on its own merits.

No special permits are required for the release of fuel oil to be used in the operation of road or paving plants, if the project for which the fuel oil is desired has been approved by the United States Highways Council.

No applications for petroleum, asphalt, and tar products will be considered unless approved by the proper state highway departments, except that application for materials to be used directly in work for the Federal Government will not require the approval of any state highway department, but must have the approval of the United States Highways Council.

War Power Plant Bill in Committee Hearing

Hearings on the bill appropriating $200,000,000 for Governmental aid to power plants, noted in *Engineering News-Record* of last week, p. 420, have been held before the Committee on Interstate and Foreign Commerce of the House of Representatives. Before that committee appeared Secretary of War Baker, B. M. Baruch, chairman of the War Industries Board, and representatives of the power section of the War Industries Board. It was clearly brought out in the hearing that the measure is intended entirely as a means of meeting a war emergency. Secretary Baker, for instance, said: "This is not the place to settle the great policy of Federal ownership. What we want to do now is to get the power"; and Mr. Baruch said, "There is no desire, so far as I am concerned or so far as the men I have asked to draw the bill are concerned, either to accelerate or retard Government or municipal ownership. We want to keep that question out of it. This is a war emergency."

It is the intention of the Government officials so far as possible to utilize existing power stations by enlarging the individual stations or by consolidating several stations. Projects under way but halting on account of lack of funds will be taken over by the Government or will be assisted financially. On account of the need of early production, it is not expected that much hydro-electric power will be involved.

Government Registration Blank to Classify Engineers

A Government registration blank for classifying engineers has been issued by the division of engineering, United States Employment Service, at Chicago, as another step toward the registration of all members of the engineering profession under the jurisdiction of the employment service. Engineers are urged to call or write to the Director of Engineering, 29 So. La Salle St., Chicago, for blank classification forms to be filled in and returned.

The form first provides for a record of experience, by years, in various branches of engineering, as consulting, designing, contracting, construction, operation, valuation and scientific management, surveying and drafting. At the same time the registrant indicates his special classification as a civil, mechanical, electrical, mining or chemical engineer. Provision is made for the designation of other special subjects. The classification blank also includes provision for the listing of experience in subclassifications under the five main branches of engineering. Bridges, reinforced concrete, highways, railways, harbor work, dams and reservoirs, municipal, water-supply, etc., are included in the subclassifications. The blank also provides for indication of the age of the registrant, his draft classification and salary.

Swamp and Cut-Over Lands Investigation

Engineers Chosen for Three Districts Into Which Country Is Divided—Elwood Mead Aids

To carry out the investigation of the reclamation of swamp and cut-over lands recently authorized by Congress, outlined in *Engineering News-Record*, Aug. 22, p. 361, the Secretary of the Interior announces the division of the country into three districts. The entire work is placed under A. P. Davis, director and chief engineer of the United States Reclamation Service.

The Western district, including the whole arid region, is under the supervision of F. E. Weymouth, Denver, Colo., who is chief of construction of the Reclamation Service and is handling irrigation work in the same region. He has charge not only of irrigation work but of the drainage which is incidental to and related to the work of irrigation and which comprises practically all the drainage problems of the arid region.

The Northern district includes Missouri and the territory north of the Ohio River and east of the 98th meridian. This is in charge of F. W. Hanna, who constructed and operated the Boisé Canal system and was later supervising engineer of the Southern district of the United States Reclamation Service. Still later he was consulting engineer in that service. Mr. Hanna also has charge of the investigation of cut-over lands in the Northwest, this problem being closely related to similar problems in the region of the Great Lakes.

The Southern district, which contains the largest area of swamps, is in charge of H. T. Cory, consulting engineer, San Francisco, who has had wide experience on construction work with the Southern Pacific Ry., including the spectacular closure of the Colorado River when it was flowing into Salton Sink and threatened to submerge the Imperial Valley.

Prof. Elwood Mead, Berkeley, Cal., is engaged upon a study of the interests and requirements of the settler. Dr. Mead has been successively state engineer of Wyoming, chief of irrigation and drainage investigations in the United States Department of Agriculture, professor of irrigation institutions of the University of California, chairman of the State Rivers and Water-Supply Commission, Victoria, Australia, and is now professor of rural institutions, University of California, and chairman of the California Land Settlement Board.

Another Concrete Barge Launched

Concrete barge construction is under way at the Interocean Barge & Transport Co. at Seattle. On July 6 a deck barge 116 ft. long, 34 ft. wide and 9 ft. 6 in. deep was launched there. The boat draws 3 ft. 9 in. light and 8 ft. 9 in. with 600 tons of cargo. The concrete was poured between May 24 and 30. Launched endwise July 6, the boat was loaded July 16 with 520 tons of box shooks and started out for a 150-mile tow through rough water. It is stated that practically no leakage developed through the concrete. The company is developing a yard on the Duwamish waterway in Seattle.

Asks Postponement of Municipal Utility Extensions

Postponement of extensions to waterworks, pavements, street car systems, lighting service and any and all other municipal utilities, except those absolutely essential to the war, is urged in a letter dated Aug. 24 sent by the Capital Issues Committee to the Public Utilities Commissions of every state. The committee also urges that public service companies be freed from franchise obligations which can be dispensed with in the present emergency.

Opportunities for Commissions in the Signal Corps

Announcement has been made that the Signal Corps will establish at the cantonment at Camp Meade, Maryland, Oct. 1, a school for enlisted candidates for commissions in the corps. Sending 400 men to this school for a course of instruction lasting about three months is contemplated. Upon the conclusion of the course students who have successfully graduated will receive commissions as second lieutenants in the Signal Corps. The school is open to enlisted men who are more than 20 years and 9 months of age and who possess a fundamental knowledge of electricity. Men in the service who wish to enter will have to be taken into the service either by induction or enlistment, the latter, of course, not now being possible to men below 45 years of age. When the new draft law goes into effect other arrangements permitting men not yet in the Army to enter the camp will probably be made.

Reduction of Nonwar Work Relieving Labor Shortage

There is a noticeable relief of labor shortage in certain sections of the country, as a result of the reduction of nonwar work. Reports from Indiana, in the national labor survey of the United States Employment Service, for the week which ended Aug. 10, showed that a diminished output of passenger automobiles is releasing mechanics for employment in war work. In other sections, also, the survey has found, conservation of man-power as well as of fuel and material has been gained by the reduction of output of so-called nonessentials.

The survey shows, however, that the general skilled labor shortage is almost as serious as that of common labor. A dearth of machinists, boiler makers and molders can only be relieved by transfers from local nonwar industries.

Santa Ana River Flood Control and Water Conservation

Control of floods and conservation of water in the Santa Ana River in southern California, from the San Bernardino Mountains along the entire course of the river of about 90 miles, through San Bernardino, Riverside and Orange Counties, to its mouth in Newport Bay, is a project of such size and importance that it must be undertaken with the assistance of the Federal, state and county governments and individual and community interests, according to a report recently made by the board of engineers of the Tri-Counties Reforestation Committee of the three counties. Enough water could be saved to irrigate 40,000 acres additional, says the report.

About three years ago the river cut a new channel from a point about 10 miles from its mouth into Newport Bay. In the report of the board of engineers warning is given that the stream under flood conditions may return to its old channel and thus cause immense damage to lands and improvements between the old and the new channels. The report also points out that silt, instead of being deposited on lowlands as formerly, is now carried into the navigable waters of Newport Bay, and recommends that this be prevented. Methods that should be used. says the report, include reforestation, afforestation, storage reservoirs, retardation works, spreading of waters, channel rectification and bank protection.

The board of engineers was composed of John H. Quinton, Frank Olmsted, A. L. Sonderegger and W. K. Barnard, all of Los Angeles.

Seattle Power Project Approved by San Francisco Engineer

At the request of the Seattle municipal authorities M. M. O'Shaughnessy, city engineer of San Francisco, recently made an inspection of and report on the proposed hydro-electric development on the Skagit River in Washington. The City of Seattle plans a $5,500,000 bond issue to cover the cost of development at this site, as outlined in *Engineering News-Record* of Aug. 1, p. 248. Mr. O'Shaughnessy's report approves the plan as proposed by the city and, in general, confirms the findings on the basis of which the city is proceeding with the plans. "The securing of power rights on Skagit River is a wise measure," the report states, "and the early development of the cheapest power unit is a necessary enterprise for the city at the present time." As to power available, Mr. O'Shaughnessy reported that the Skagit River should furnish a field of development ample for the next fifty years of the city's growth.

The total cost of $5,213,000, as estimated by city officials to cover dam, tunnels, penstock, complete power house, transmission line and substation, was thought by Mr. O'Shaughnessy to be conservative. The use of cedar poles for the transmission line was suggested as effecting a saving of $4000 per mile, or $412,000 for the 103 miles. These poles should have a life of 15 years, which would defer the use of steel until that commodity becomes cheaper than at present. Detailed borings and studies of dam foundations are recommended, but from the indications observed, final results will be satisfactory, Mr. O'Shaughnessy believes. A power plant built as an initial development in the lower reaches of the river and fed by the natural flow of the stream will not during periods of lowest flow deliver its maximum efficiency until supplemented by storage on the higher levels. The plant should therefore be designed and located, the report points out, with the purpose of creating storage reservoirs at higher levels.

Contractors to Organize September 30

Executive Committee to Perfect National Association—Meeting Called at New York

Contractors throughout the country are expected to perfect the machinery of a national organization at a meeting of the executive committee formed for that purpose as a result of the convention of building industries held July 15 and 16 at Atlantic City. The members of the committee, announced in *Engineering News-Record* of Aug. 1, p. 245, have been requested to meet at 51 Chambers St., New York City, on Monday, Sept. 30.

It is stated that much interest has been shown in the proposed form of constitution submitted to the committee members for discussion, and in consequence, those engaged in the movement expect the committee to develop comprehensive plans which will lay the foundation for an organization that can be of the greatest service to contractors and to the country, both now and after the war.

Baltimore Paving Commission Disbands

The paving commission of the city of Baltimore, organized under act of the state legislature in May, 1911, and authorized to spent an amount estimated at $10,000,000 to repave the streets, disbanded on Sept. 1, for the period of the war. To the present time $7,000,000 has been spent, but because of the high cost of material and the difficulty of getting contractors it was decided to discontinue work. During its régime the commission has removed 2,450,000 sq.yd., or 138 miles, of old cobblestone pavement; approximately 2,500,000 sq.yd. still remain in the city. In place of the cobblestone pavements, the commission has laid 1,640,000 sq.yd. of sheet asphalt, 490,000 sq.yd. of granite block, 562,000 sq.yd. of vitrified brick, 92,000 sq.yd. of bituminous concrete and about 72,000 sq.yd. of paving of wood block, cement concrete and other modern materials. The average cost, including the overhead charges, was $2.40 per square yard. Based on a street width of 30 ft. from curb to curb, this represents 161 miles of improved paving at an average cost of $43,300 per mile. The overhead charge amounted to only 5% of the total expenditure. The commission consisted of Maj. R. Keith Compton, chairman and chief engineer, Douglas H. Thomas, Samuel C. Rowland, Leonidas G. Turner, William S. Thomas and the late Gen. A. E. Booth. Mayor Preston is a member ex officio. Upon the resignation of Major Compton, Frank K. Duncan, one of the commission's engineers, was made acting chief engineer.

To Conserve Oakland Water-Supply for War Industries

An order issued Aug. 21 by California officials of the United States Shipping Board forbids the sprinkling of lawns and gardens and calls for a general conservation of water in Oakland, Alameda and Berkeley. These communities are served by the East Bay Water Co., which has recently had to meet the demand for 6,000,000 gal. of water more daily for use of shipyards and other war industries. The conservation order is expected to reduce consumption from 22,000,000 to 17,000,000 gal. daily. If this is found to be an inadequate reduction, a water ration of 15 gal. per person per day may be put into effect. Water storage in Lake Chabot, the company's main source of supply, is far below normal this season. The lake is now 40 ft. below the usual water level and the company has had to resort to well supplies. It was expected that new wells would be in service by Sept. 1, which would furnish 4,000,000 gal. more. It was planned then to cut off the Lake Chabot supply for a week in order to remedy the present muddy condition of the water, caused by pumping from the low levels. When the lake is cleared, and with the new well supply and the savings ordered, the situation will be relieved somewhat. However, no material improvement in the general situation is expected by the company until the winter rains come.

Akron Votes $2,000,000 Water Bonds

Considerably more than the necessary two-thirds vote was cast at Akron, Ohio, Aug. 13 for $2,000,000 water bonds. The Capital Issues Committee has approved marketing $1,315,000 of these bonds in 1919. The city will advertise at once for laying 8 or 10 miles of distribution pipe already in hand. Later this year contracts will be let for other parts of the 1918 program, including a 48-in. force main from the reservoir and pumping plant to the city. H. S. Morse is director of public service.

Ask Study of Water Waste in Railroad Yards

Because the railways entering Jersey City use nearly a third of the water-supply there, and because of the serious water shortage of last winter, the Chamber of Commerce of Jersey City has requested the regional director of the Railroad Administration to make a study of water consumption and possible waste through leaks or otherwise in the Jersey City yards. The chamber, through Fred Van Zandt Lane, manager, states that the per capita water consumption of 160 gal. a day in Jersey City is believed to be excessive, notwithstanding the large use of water by railways.

Concrete Boats Being Built for Four Branches of Government

Concrete ships, barges and lighters to the number of 102 are now under contract by four separate branches of the United States Government. The names of the companies holding the contracts, the types of boats and the situations of the yards are given in the accompanying table.

TABLE SHOWING GOVERNMENT CONCRETE BOATS UNDER CONTRACT

Government Agency	Type of Boat	No.	Name of Contractor	Location of Yard.
Emergency Fleet Corporation..	3500-ton Freighter.........	1	Fougner Concrete Shipbuilding Co........................	Astoria, L. I.
	3000-ton Freighter.........	1	Liberty Shipbuilding Co.......	Brunswick, Ga.
	3500-ton Freighter.........	2	Liberty Shipbuilding Co.......	Wilmington, N. C.
	7500-ton Tanker...........	6	LibertyShipbuilding Co.......	Wilmington, N. C.
	7500 - ton Tankers and Freighters...............	8	San Francisco Shipbuilding Co.	Oakland, Calif.
	7500 - ton Tankers and Freighters...............	8	F. T. Ley & Co...............	Mobile, Ala.
	7500 - ton Tankers and Freighters	8	A. Bentley Sons..............	Jacksonville, Fla.
	7500 - ton Tankers and Freighters..............	8	Schofield Eng. Co............	San Diego, Calif.
Navy Department	500-ton Harbor Lighters....	4	Ambursen Consn. Co..........	Little Ferry, N. J.
	500-ton Habor Lighters.....	4	L. L. Brown Co..............	Peekskill, N. Y.
Railroad Administration (Construction Supervised by E. F. C.).....	500-ton N. Y. Barge Canal Barges	8	Holler-Davis & Flood Co ...	Fort Edward, N. Y
	500-ton N. Y. Barge Canal Barges	4	Caldwell-Marshall Co........	Tonawanda, N. Y.
	500-ton N. Y. Barge Canal Barges.................	5	Thomas & Currie............	Detroit, Mich.
	500-ton N. Y. Barge Canal Barges............	4	Cummings Concrete Constructional Eng. Co.............	Ithaca, N. Y.
War Transport Branch, War Dept.	130-ft. River Boats...	14	West Coast Sbldg. Co........	Wilmington, N. C. & Everett, Wash.
	100-ft. Water Tankers......	5	Gt. Northern Sbldg. Co.......	Portland, Ore.
	225-ft. Car Floats..........	6	Liberty Sbldg. & Transp. Co...	Cleveland, O.
		6	L. B. Harrison Co............	Athens, N. Y

Mouth-of-Mine Power Plant Near Pittsburgh

In order to help out the power situation in the Pittsburgh district, the West Penn Power Co. has agreed to build a 40,000-kw. station at the mouth of a coal mine in the Alleghany valley and connect it up by an appropriate transmission system with the distribution system of the city of Pittsburgh. The estimated cost of the plant and transmission lines is $5,000,000. The Ordnance Department, United States Army, will advance $2,000,000 of this amount and the company will provide the remaining $3,000,000. Three years after the end of the war the reproduction cost of the plant is to be determined by three disinterested appraisers, one chosen by the Secretary of War, one by the company and the third by agreement of the first two, and their finding is to be subject to review and revision by the Secretary of War. The company undertakes to repay to the Government such part of the advance made by the Government as represents the excess of the appraised value over the $3,000,000 originally put up by the company.

Motor Transport Corps Formed by War Department

Creation of a motor transport corps, which will consist eventually of approximately 5000 officers and 200,000 men, to have charge of all motor vehicle transport in the Army, has been announced by the War Department. It is hoped that such an organization will expedite the movement of troops and supplies for the American Expeditionary Forces in France.

Heretofore all motor transport was under the control of the Quartermaster Corps, but it has grown to such proportions that it was deemed advisable to organize a separate corps and take further steps for its rapid expansion. All forms of motor transportation, with the exception of tanks and caterpillar tractors which are used to haul artillery, are transferred to the new corps. The tanks and tractors will remain under the supervision of the artillery and ordnance branches.

In combining transportation facilities, one of the advantages sought is the better standardization of equipment, resulting in greater efficiency and economy of operation and permitting a more general interchange of parts. The problem of supplying parts and making repairs is extensive; there are many repair stations in France which are operated by from 500 to 1500 mechanics each.

The new corps is in charge of Col. Charles B. Drake.

Empire Engineering Company Elects Officers

The Empire Engineering Co., Inc. of New York elected the following officers and directors at a recent meeting: President and chairman, J. H. McClement; vice-president and general manager, J. Rulon Miller, Jr.; vice-president, Beverly R. Value; secretary, treasurer and comptroller, C. A. Nicklas; directors, J. H. McClement, Alfred Skitt, Franklin Nevius, Beverly R. Value, J. Rulon Miller, Jr., and C. A. Nicklas. The Empire Engineering Co. is the name which was adopted when the name of H. S. Kerbaugh, Inc., was changed in 1917.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

NEW ENGLAND WATER-WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 11-12, Boston.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

Personal Notes

J. G. SULLIVAN, until recently chief engineer of the Canadian Pacific Railway Co., announces that he has opened a consulting engineer's office in Winnipeg, Man. Mr. Sullivan is a member of the American Society of Civil Engineers, Engineering Institute of Canada, and the American Railway Engineering Association.

LINCOLN BUSH, consulting engineer, New York City, has been commissioned as colonel in the construction division, Quartermaster Corps.

H. R. SAFFORD, recently chief engineer of the Grand Trunk Ry., has been appointed engineering assistant for the Central Western Region, United States Railroad Administration, with office in Chicago. Mr. Safford, who was graduated from Purdue University in 1895, entered the service of the Illinois Central R.R., that year, and was successively rodman, assistant engineer,

roadmaster, principal assistant engineer, assistant chief engineer and chief engineer maintenance of way. Subsequently he left the Illinois Central to become chief engineer of the George B. Swift Co., general contractors, of Chicago, and in 1911 he was called to the Grand Trunk as chief engineer.

GEORGE F. WIEGHARDT has been appointed highway engineer of Baltimore, Md. As such he will be a member of the Board of Estimate. Mr. Wieghardt was born in Baltimore in 1887 and received his early education in the public schools of that city, and was graduated with honors from the Polytechnic and Maryland Institute. He was graduated from Cornell University with the degree of civil engineer in 1909, receiving the Fuertes medal for the best standing in his class for three years. He has had a varied experience, mostly in Baltimore, on sewage and water-works construction, and in 1914 was appointed assistant to the chief engineer of the Pennsylvania Water Supply Commission. In 1916 he was appointed principal assistant engineer of the water department of Baltimore, which position he held until his present appointment. He succeeds Maj. R. M. Cooksey, who resigned to enter the army.

CHARLES H. HIGGINS has been commissioned a major in the Ordnance Department. Mr. Higgins was born in Southington, Conn., in 1879, and was graduated from Princeton University in 1903 with the degree of civil engineer. From 1903 to 1911 he was connected with the S. M. Stillman Co., general contractors, Jersey City, N. J., as draftsman, superintendent of construction and engineer, and had supervision of a number of important engineering structures for the Pennsylvania R.R., the Jersey City Stockyards Co., the Magnus Metal Co., the Lister branch of the American Agricultural Chemical Co., Newark, N. J., the Brooklyn Union and New York Mutual Gas Companies, the Pintsch Compressing Co., Jersey City, Central R.R. of New Jersey, and also of a number of municipal structures. Since 1911 Mr. Higgins has been conducting a general consulting engineering business with offices in New York City, recently forming the new firm known as the Delano & Aldrich and Charles H. Higgins Co., which firm will carry through the various engineering projects under way for both companies.

WILLIAM I. VAN ARNUM has been appointed superintendent of the water purification plant at Youngstown, Ohio. For seven years Mr. Van Arnum was superintendent in charge of the water purification plant at Cohoes, N. Y., and later was connected with the Bridgeport Hydraulic Co., Bridgeport, Conn., from which activities he goes to the superintendency of the plant at Youngstown, Ohio. Mr. Van Arnum will assume his new duties on Sept. 9.

JOHN D. GARVER has been commissioned lieutenant in the navy and made instructor in the United States Naval Steam Engineering School, Hoboken, N. J.

WALTER CHARNLEY, who was engaged on port and harbor and other works in Brazil, and before that was in Mexico on railroad and harbor construction and survey, has been commissioned as first lieutenant and is in training at Camp Humphreys, Virginia.

F. T. HATCH, formerly chief engineer maintenance of way of the St. Louis system of the Pennsylvania Lines, has been made consulting engineer to the corporation and will have charge of valuation, with office in St. Louis.

H. P. BOARDMAN, professor and civil engineer and acting dean of engineering at the University of Nevada, Reno, has returned to his university duties after a leave of absence to engage in Government work. Since the first of March Professor Boardman has been engaged as engineer on the construction of the United States Explosives Plant "C" at Nitro, W. Va.

R. B. SHEPARD, JR., office engineer in the valuation department of the Atlantic Coast Line R.R., has been appointed valuation engineer. He succeeds D. W. Gross, who has resigned to enter the service of the corporation.

C. N. BAINBRIDGE has been appointed assistant engineer in charge of bridge inspection and bridge erection on the lines of the Chicago, Milwaukee & St. Paul Ry., east of Mobridge, S. D., succeeding E. S. Meloy, deceased.

C. A. FORTER has received a commission as first lieutenant in the sanitary corps. Mr. Forter has been representing the John Baker, Jr. Company of Kansas City and was for many years office engineer in the city engineer's office at Topeka, Kan.

MAURICE COBURN, principal assistant engineer of the Pennsylvania Lines West, with office in St. Louis, has been transferred to Indianapolis as supervising engineer.

RAYMOND BURNHAM, designer of coal tipples for Fairbanks, Morse & Co., has been commissioned captain in the Engineer Officers' Reserve Corps. After graduation from Sheffield Scientific School, Yale University, in 1903, he was with the Mexican International Ry. for one year on topography, and for two years in Panama on an exploration survey. For the next six years he was a mining engineer on various projects in California, Idaho and Mexico, returning again to civil engineering work in 1912 with C. W. Humphrey, consulting engineer, Chicago.

W. A. CLARK, chief engineer of the Duluth & Iron Range R.R., has been appointed chief engineer also of the Duluth, Missabe & Northern Railway.

A. R. COOK, principal assistant engineer of the Northern Pacific Ry., with office in Tacoma, Wash., has been appointed engineer maintenance of way for the line west of Paradise. He succeeds L. M. Perkins, transferred.

OBITUARY

LIEUT. ROBERT E. A. MACBETH was killed in an aviation accident at a training camp near Birmingham, Eng., on Aug. 19. He was a graduate of the School of Practical Science, Toronto, and prior to his enlistment was assistant city engineer of Toronto. He completed a course in aviation in December, 1915, and was sent to England, where he saw considerable service and was latterly engaged in passing upon airplanes before their acceptance by the Imperial Government.

MAJ. FREDERICK WILLIAM WATKINS, with the Department of Water Supply, Gas and Electricity, New York City, until 1914, when he was retired, died at his home in White Plains, N. Y. He was 75 years old and a veteran of the Civil War, which he entered as a private in the Union army. He served in the First New York Volunteer Engineers, also in the artillery and infantry, and was brevetted at the close of the war major of volunteers after winning successive promotions. Major Watkins was graduated as a civil engineer from New York University in 1868 and was employed on railroad construction work for fifteen years before entering the service of the aqueduct commission as assistant engineer in 1884.

MORLEY DONALDSON, formerly vice-president and general manager of the Grand Trunk Pacific Ry. at Winnipeg, died at Ottawa on Aug. 27 at the age of 65. He was born in Edinburgh, Scotland, coming to America as a young man. He entered the service of the Canada Atlantic Ry. in 1881 as chief draughtsman and rose to the position of general superintendent. When that road was merged with the Grand Trunk in 1905 Mr. Donaldson became general superintendent of the Ottawa division of the system, and in 1912 was appointed vice-president and general manager of the Grand Trunk Pacific at Winnipeg, from which position he resigned about a year ago. He was a member of the Canadian Society of Civil Engineers.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

War Industries Threatened by Steel Shortage

Nonwar Plants May Be Entirely Shut Off—Labor and Fuel Chief Factors in Serious Situation

Reports that the output of certain important war industries was seriously threatened by the steel shortage were responsible for a meeting in Washington between representatives of the steel industries and the War Industries Board, followed by a meeting in New York of the heads of steel producing companies throughout the United States. Owing to the greatly increased tonnage required by our European allies, and to the labor and fuel shortage, the supply of steel in the United States will be entirely restricted to the needs of the War and Navy departments, the railroads and the shipyards.

Late last May indications were that the steel producers would reach 100% production, having averaged up to that time 93%. Basing calculations on the 1917 output, and the plant extensions placed in service in 1918, it was predicted that steel production would pass the 50,000,000-ton mark this year. Now, however, with a reduced instead of an increased output, the requirements for the last half of the year call for upward of 23,000,000 tons, and may reach 25,000,000 tons. At the present rate of output the capacity is but 17,000,000 tons of rolled steel.

Estimates in the early part of the year were also based on the probability, as indicated at that time, that both the fuel production and the shipping facilities would meet the situation. Although, as pointed out by the Fuel and Railroad Administrations, great strides have been made and progress effected, the labor situation, the difficulty in which was not apparent in the early months of the year, has become so acute that it entirely upsets the predictions made. Instead of a 100% capacity output, as indicated, today the report is of but 92% output. It was 93% at the time the estimate was made.

To formulate measures to meet this situation the conferences held in Washington and New York were called. At these meetings greater conversion of mills to steel production was decided upon, as well as an increase in the coal supply and the further curtailment of supplies for lesser essential industries.

Steel for the manufacture of passenger automobiles has been almost entirely shut off, and the recommendations of the War Industries Board to the various automobile manufacturers to effect a 100% conversion war production by Jan. 1, 1919, indicates to what extent the restriction of steel will be carried by that time. Those factories which have stocks of steel on hand were notified that in case of necessity they would have to share them with factories producing war essentials. On the other hand, it was pointed out that the Emergency Fleet Corporation had a reserve supply on hand of 1,200,000 tons of steel, which with the 66,000-ton reserve to be shipped in October and the 50,000-ton weekly deliveries now being made, will furnish stock on hand for 4,000,000 tons of shipping. This is more tonnage, some believe, than both the wood and steel shipyards will be able to produce this year. From this it is argued by some industries which feel the shortage that the Emergency Fleet Corporation is stocking up at the

(Concluded on page 474)

Storage of Coal by Industries To Be Strictly Limited

A limit to the amount of coal that industrial plants will be allowed to accumulate and carry on hand, and a fixed uniform amount for each state, were established at a meeting of all the state fuel administrators east of the Mississippi Aug. 20. This action was brought about by the increasing demand for coal for special war purposes in the East, particularly for the navy and transport service.

The announcement states that "coal in excess of that required for current operations shall be delivered to plants not on the preference list of the War Industries Board only when it is not in demand for use before Apr. 1, 1919, by consumers on said list; namely, railroads, the Federal Government, states, counties, public utilities, retail dealers or manufacturing plants on the preference list."

The notice further states that these limits are mandatory, and each fuel administrator is expected to see that different classes of consumers are not allowed to exceed the established limits. In particular cases, however, which may require special action by the granting of greater stocks of coal, the state and fuel administrators are permitted to grant special licenses under certain restrictions and limitations. Those companies which have reserve stocks of coal on hand at the effective date of the notice are permitted to retain them only on condition that they shall thereafter use screenings or mine run only, and shall obtain such screenings or mine run for current use only from certain specified fields.

Listing Industries for the Fourth Liberty Loan

Trade Chairman Named and 120,000 Firms Lined Up and Rated, for Use in New York City Drive

Canvassing for the Fourth Liberty Loan in New York City will be facilitated by a master list containing 120,000 names and ratings of firms listed according to industries. Trade chairmen have been named by Benjamin Strong, governor of the Federal Reserve Bank, to conduct the campaign, 40 of those named having already accepted the appointment.

There are 90 committees, representing all the industries of the metropolis, and the chairman states that the division will be in a position to begin active work a month sooner than in any of the previous drives. While the trades have set no quota for their shares in obtaining subscriptions for the new loan, which is to be floated Sept. 28, it is anticipated that they will raise about half the total of the city. In the previous drive the trades totaled $550,000,000.

Each committee chairman will have from 10 to 20 associates, and will captain a canvassing force of from 100 to 500 workers. The task of selecting this army has been going on for several weeks. The necessity for a master list was realized by trade leaders when it was announced from Washington that the Fourth Liberty Loan would call for a greater sum of money than had ever been raised by the issue of bonds. The trades will be listed according to their estimated wealth under three classifications: 1. Firms capable of rasing $10,000,000 or more; 2, firms raising from $2,000,000 to $10,000,000 and firms raising less than $2,000,000.

The trades are being formed into committees and war industries are organized under one committee. The majority of the chairmen of all the larger canvassing organizations will remain the same as for the previous loans, and the committee reports that the work has already gotten under way with a rush.

Among the committees organized are those covering the building and allied trades; electrical, paper and rubber industries; coal trade; mining industry, and import and export shipping. The master list of trades will be supplied to each subcommittee and it is stated that not a single business concern will be overlooked when subscriptions are solicited.

The Advisory Trades Committee has decided to adopt a National Community Honor Flag for firms 60% of the employees of which have subscribed.

Steel Shortage

(Concluded from page 473)

expense of other industries almost as essential.

Recent actions by the authorities at Washington regarding the coal supply also indicate measures under way to assist the steel manufacturers in this respect. Hoarding, or even the apparent overstocking of coal by any industry, is to be stopped, and those industries which have a larger supply on hand than is necessary will be forced to share with industries not so favorably situated. Although these steel producers have assured the Government authorities that they will do everything in their power to increase their output, they point out that it is no use to expand unless they have adequate raw materials with which to operate their larger plants.

The representatives of the steel industries and Government officials therefore point out that more serious and far-reaching economies must be practiced. Sheet steel, tin plate and wire mills will probably be cut down 50% and pig and gray iron are available only for munitions or particular war requirements.

The automobile manufacturers are the first to receive notice of curtailment from Washington. This notice will be followed by others to all the other industries using iron and steel. They will receive direct warnings of and concrete rules for the effective saving of steel to the plants supplying direct war needs. Refrigerator manufacturers as well as motorcycle and bicycle plants have received first warnings, and stove manufacturers have been notified that there will be large inroads on their allotments. Electric manufacturers and dealers have also been notified of reductions.

Jobbers will be permitted to hold stocks for Government use and for civilian orders against essential needs but strict supervision of sales by means of pledge, etc., will be maintained.

Record Cement Production 1917—Output Now Restricted

A record production of cement for 1917 is shown in the statistics recently produced by the cement industry in the United States. The output for the United States, however, has been restricted to 75% of the average annual production, by order of the United States Fuel Administration limiting the allotment of fuel to the various industries.

Certain exceptions are made in the order to cover urgent Government needs for cement or for the purpose of such building operations as have urgent public necessity, or where the industry is able to obtain wood or peat for fuel without depriving the railroads of the use of wood or putting a burden on them for the hauling of fuel.

Although the production of cement broke the record in 1917, the actual shipments show a small decrease from 1916, but the increase in value of the cement, from the higher prices, resulted in an advance in value of 17.8% over 1916.

Centrifugal Stucco Gun Used on Large Construction Work

A centrifugal stucco gun, invented as a result of the many difficulties encountered on the incasing in concrete of the Eastern Hills tanks, Cincinnati, described in *Engineering News-Record* of Aug. 16, 1917, p. 305, is shown herewith. It consists of a small machine driven by a ⅛-hp. motor which has four blades to throw the mortar by centrifugal force. The machine including the motor weighs 32 lb. and is carried by a strap slung around the operator's shoulders, leaving both hands free to operate the machine. It is operated by one man with a helper to feed the mortar into the receiving hopper. The gun was also used in waterproofing the interior surface of a pit 50 ft. long, 15 ft. wide and 32 ft. deep, built for the Pollak Steel Co., of Cincinnati.

The machine, it is stated, will apply from 400 to 450 ft. of stucco per hour on brick or concrete surfaces, and it is asserted that the work is superior in both quality and appearance to hand work. It is asserted also that for exterior work where metal lath or expanded metal is used no plastering is required, as this device applies the entire coat monolithically. It applies pebble dash, it is stated, of any finish desired. It also applies cement mortar to certain self-centering forms.

APPLYING STUCCO WITH NEW GUN

The machine is patented by Jesse Hodges of the Ferro-Concrete Construction Co., Cincinnati.

BUSINESS NOTES

G. Ed. Ross, secretary and auditor of the Oregon State Highway Commission at Salem, Ore., has resigned his position to enter the service of the War Department at Washington as supervising acccuntant on the Kinney Construction Division.

The corporate interest of the Union Pacific System, together with 35 subsidiary and associate corporations, will maintain headquarters in the Gas Co. Building in Portland, Ore., during the remaining period of Federal control, according to J. D. Farrell, who is president of the auxiliary corporation and of the railway units of the parent system.

TRADE PUBLICATIONS

"Pile Pulling" is the subject of a 7-p. pamphlet issued by the McKiernan-Perry Drill Co., which announces that the pamphlet is published for the benefit of the users of their pile hammers. It contains brief information as to the best means of rigging them to pull piling.

The Mead-Morrison Mfg. Co., of Boston, has issued a pamphlet, No. 121 B, covering the Mead - Morrison truck winches. It is illustrated with numerous halftones showing the truck with the winch attached and parts of the winch, as well as line cuts showing the application of the machinery.

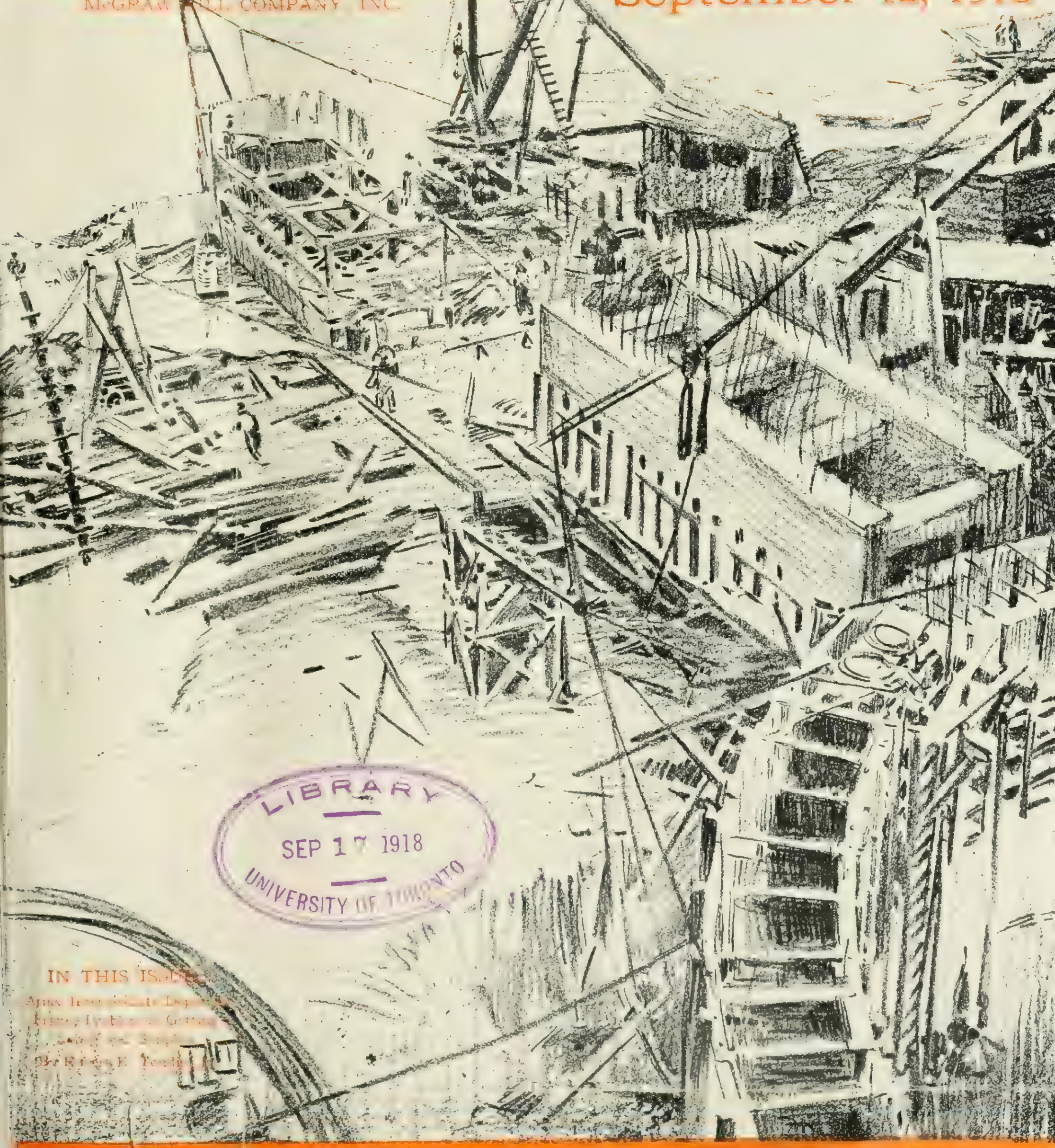
From the Sprague Electric Works of the General Electric Co. has been received bulletin No. 48,-938, superseding bulletin No. 902, covering the electric grab-bucket hoist. It is a 23-p. bulletin, illustrated with halftones and tables of engineering data.

The Advance Felt Specialty & Cutting Co. has issued an 18-page pamphlet illustrating the Widney Resiliometer, an appliance that measures the thickness, hardness and resiliency of any resilient material.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

September 12, 1918



IN THIS ISSUE

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There Is No Light Like Daylight

FEDERAL CEMENT TILE

Here is shown the interior of a building full of daylight projecting through Federal Glass Tile—the famous "Daylight Roof."

This roof is built of reinforced concrete units, some of which contain inserts of quarter-inch wire glass of approximately five square feet in each eight square-foot unit. This glass is firmly imbedded in reinforced concrete, free to come and go with vibration, contraction and expansion, but eliminating all metal work and putty which, of course, is subject to wear and disintegration. These glass tile units interlock with standard units and can be changed or distributed at will and shafts of light projected on any important operation on manufacturing or storage floors.

By the proper spacing of these glass tile, daylight fills all parts and corners of the building. More hours of daylight are obtained because of this direct overhead illumination, always free from obstructions and surrounding buildings, the net result being less artificial light, reducing light bills, increasing the efficiency of help, and improving Hygienic conditions.

"Make your work lighter" by Using Federal Glass Tile.

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, SEPTEMBER 12, 1918 — Number 11

A Red Letter Day

MILLIONS of men are registering today for the final drive against Germany. The flower of the manhood of the country will place itself on the service roll to fight abroad or work at home as the highest need may dictate. Engineers will do their part. They are fortunate, for working or fighting they are a most necessary factor in winning the war.

Preparation

ENTHUSIASM and united action will make the Fourth Liberty Loan Campaign a success. Suggestions for win-the-war meetings in every engineering and industrial organization before the drive begins will be sent to all who mail us the coupon printed on advertising p. 85. Do *your* bit!

Power Will Help Win the War

BEHIND all of the things that bill-poster slogans tell us will win the war lies power. Ships cannot be launched, food cannot be produced, airplanes cannot be built, munitions cannot be forged, without the all-moving power that drives the war plant. But this power for many months has been sadly deficient. Economies of operation have been practiced, and non-essentials have been reduced, but the basic fact remains; more power must be produced. Government authorities who realized this months ago have at last openly recognized that private interests can no longer command the necessary capital and the Sims Bill, appropriating $200,000,000 to acquire, enlarge and develop power, is the result. Properly safeguarded against permanent Government ownership—which is a question to be left to calmer days—this bill should pass and pass quickly. Even now it is too late to initiate new schemes which will become effective within the year. But there is still ample time to assist financially projects already under way and to insure a coöperation or consolidation possibly not feasible under existing laws. Power may not win the war, but without it the war is surely lost.

Acquiring Utilities for Condemnation Proceedings

MUNICIPAL acquisition of public utilities by condemnation is so unusual that attention may well be called to the short article on p. 483 which tells of the decision of a California court which upholds the right of cities in that state to acquire utilities in that way. Unless the decision hangs on some state constitutional provision peculiar to California it merits the attention of those interested in public utilities on both the municipal and the private ownership sides.

Philadelphia Bank Urges Water Meters

PLEADING for the great army of industrial workers, the Corn Exchange National Bank of Philadelphia in its August bulletin urges the universal water meter system for Philadelphia as a means toward insuring an ample supply of pure water. It is quite unusual for a bank to join in a campaign for water meters. The Philadelphia Bureau of Municipal Research is continuing its work for meters by the publication of leaflets. The Philadelphia *Evening Ledger* has recently come out unreservedly for water meters for the first time. Altogether the outlook for the universal meter system at Philadelphia is most encouraging. Water saving will help win the war and help greatly in the reconstruction period also. It is time that Chicago, Buffalo and other water-wasting cities besides these and Philadelphia began to cut water waste, at the same time saving coal and labor greatly needed for other purposes.

Help Study Reconstruction

BREADTH of vision is shown by the definition of reconstruction and plans for the study of its problems given in the official announcement of the Reconstruction Committee of the National Council of Research on p. 511. The committee desires suggestions of possible reconstruction fields and agencies. Such an opportunity for service should be seized.

Regulate Traffic by Zone Systems

SEGREGATING street traffic by zones is quite out of the ordinary. An order, which will go into effect in New York City, Sept. 16, sets aside for the use of passenger vehicles only, ten north-and-south avenues through the central portion of lower Manhattan. The remaining twelve avenues, bordering the zone on either side, together with one in the midst of the zone, are assigned to commercial vehicles. Each type of vehicle can enter the district of the other only by the intersection nearest to its destination and must leave by the nearest intersection. This innovation is noteworthy on account of the size of the zones established, but more particularly because light traffic is forbidden in the heavy-traffic zones—an uncommon restriction. By separating high- and low-speed traffic the plan will doubt-

less aid passenger vehicles and may help ordinary trucks but the high-speed commercial vehicle, which runs as fast as is allowed by law, may be held up by the concentration of more slowly moving trucks. The experiment will be watched with interest throughout the country.

Does the Railroad Need the Motor Truck?

ADVOCATES of road building and more extensive use of motor trucks to relieve the railroads in a measure will learn with surprise and dismay that Theodore H. Price, speaking for the Railroad Administration in a defense of it against a newspaper charge of inefficiency, declares that he doubts whether shippers are sending their goods in unusual quantities by motor truck, and asserts that if they are it is not because of lack of railway transportation. On the contrary, he says, the administration has been urging merchants to take advantage of the present carrying ability of the railways to stock up against their winter's needs, when weather conditions make train operation more difficult. Whether or not the total ton-mileage of motor-truck transportation is much or little compared with the total of rail transportation, there seems to be more than one instance where the motor truck has saved the situation for an industry or a considerable part of a community. It is difficult to predict what the future demands for transportation are going to be. It seems reasonable to expect that at some if not many points motor-truck transportation will continue to be a valuable auxiliary to rail and water transportation and that roads should be built and maintained accordingly. But in the present emergency it is more important than ever that each case be given thorough and intelligent engineering study.

Common Sense and Essential Industries

BY FAR the most important action taken by the War Industries Board since its initiation is the common-sense classification of essential industries which that board announced Sept. 9 for the immediate purpose of guiding exemption officials in making the second draft. Not of first importance is it that at last the Government has undertaken to say what is essential—the word for which industry has waited fifteen months; not of greatest moment is it that a comprehensive list of industries has been issued, to which, with minor exceptions, everyone will agree. Of chief import is the single statement in the explanation accompanying the instructions, "All priority is relative, and implies purposeful discrimination." It summarizes the present point of view of Washington with reference to war-time activity—a point of view which is a great advance over the confused ideas bred by the first few months of conflict. The great thing is, that now a selection of the sheep from the goats has at last been made, the Government has stated in no uncertain terms that the new classification is never to be arbitrary, but is to be a living, growing thing, keeping pace at every step with the needs of war and of the country at large. Some things most essential in themselves are not to receive blind preference, because an oversupply is being produced, and we can afford to cut down on them. Other things, far less directly essential, but of such a nature that a shortage at the present time would react seriously on the war, receive the coveted priority until such time as increased production has placed us out of danger. With such a common sense administration of priorities in man-power and materials, we need have no fear. Our strength will not be impaired by killing non-essential activity under such a program, but rather will be conserved by converting non-essential production to immediate war uses, and by continuing the conversion in a never-ending adjustment to keep pace with changing needs.

The First Final Railroad Valuation

SCARCELY more nourishment is afforded the railroad corporations by the first final valuation report of the Interstate Commerce Commission, that on the Texas Midland R.R. (see p. 488), than they had from the first tentative valuations of two years ago. Certain unit prices have been increased, the Bureau of Valuation itself being convinced that the tentative figures were too low. Original cost, which the tentative report said could not be found, has nevertheless been found, but the companies were less interested in this than were the state commissions. In most other respects the findings of the bureau in the tentative valuation are sustained by the commission.

Several new reasons are advanced for the old conclusions. One of the least satisfactory of these from the companies' point of view is the justification of the deduction of depreciation. No answer is made to the railroads' contention that the value lies in the use made of the property, and that where there is 100% efficiency of use it matters not that half the service life is gone. Instead the commission contents itself with discussing what courts and other commissions have meant by depreciation. Manifestly the commission must report what the law prescribes (which it does not seem to have done in the case of land), but if the law is incompatible with justice, or if the figures the law calls for are likely to be wrongly applied, that fact or those facts could well be recorded by the commission.

In reporting "present value" of land instead of the reproduction cost the valuation act calls for the commission begs the question. Reproduction cost of the railroad is not reproduction cost of the railroad unless it includes land. The carriers were ready with plenty of evidence that railroad land does cost much more than the market value of contiguous land; and the commission was admittedly aware that it does. Inability to determine whether such market value should be tripled or quadrupled is no excuse for evading the whole issue. It is unfortunate, however, that the railroads did not rest their case on a simple argument for a multiple.

Failure to record "other values or elements of value," as the act also prescribed, does not come in the same category. The bureau did not find any, and the carrier, though invited to do so, did not submit any convincing evidence of what they amounted to. Considerable testimony along these lines was presented in the

Kansas City Southern case (see *Engineering News-Record* of Aug. 8, p. 277), and it remains to be seen whether this road will fare any better. As its witnesses all agreed that the sum of these other values could be found only by subtracting the sum of the tangible values from a total value based on sheer judgment—in other words, that reproduction cost itself has little or no bearing on final value, and that there is no such thing as building up a valuation on cost figures and estimated intangibles—*Engineering News-Record* suspects that it will not

Contingencies, working capital, appreciation—all of these the commission admits to be realities for a railroad to be built, but all of them it explains out of the valuation; they could be avoided in reproduction, or they are operating expenses. The logic is no more convincing than when first put forth. In the cases of engineering and general expenditures the commission leans the other way in its determination not to concede too much. By its own studies it shows averages for these items of 3.6 and 1.9% respectively—and then it allows 2.15 and 1.5 per cent.

Altogether the first final valuation gives little encouragement that the valuation will go far toward solving the manifold problems that prompted Congress to pass the valuation act. Only part of the property is on record, and that is not all in the same terms. It is to be hoped that the commission will yet, when some of the more important roads come before it, revise its views and at least record all the facts.

Contractors and War Service

UNDOUBTEDLY the most important reason for the immediate formation of a national association of contractors is the opportunity, and indeed the necessity, for war service. From more than one Government source has come the intimation that not merely the contractors, but also the war work of the country was suffering because there was no war service committee of contractors. There is little doubt that the formation of such a committee would be looked on with favor in most quarters at Washington. Neither is there any doubt that no representative committee of this sort can be called into existence unless contractors themselves take the initiative.

Yet, while the War Industries Board is maturing comprehensive priority machinery for converting every industrial activity that can serve, now or later, to carry on the war or to sustain the life of the country, while the essential character of motion pictures and fiction magazines is being put on an unquestioned footing, it would almost seem that Government agencies are engaged in stamping out construction work as men stamp out a conflagration, turning a fresh stream of cold water on every project that shows its head. Certainly the effect could hardly be worse were there deliberate intention behind acts such as that of the local capital issues committee which stopped, just because it was construction, projects considered necessary by other officials, or that which recently threatened to end all concrete construction in an important state by ordering mills to stop all cement shipments at once, leaving owners and contractors no recourse but to disband construction forces and resort to a long fight to have the order modified in single cases.

The apparent feeling that construction work is about the most useless of all activities has had the practical effect, whether intended or not, of a crusade against all projects involving new building, before which nothing could stand except work defended vigorously by the War Department, the Navy or the Shipping Board. The big contractors, being in the nature of things engaged on work under the protection of these powerful agencies, have not felt the pinch, and remain indifferent to the need for a real analysis of the situation.

All will admit that there is much construction work which can and should be postponed till after the war. All will admit, too, that there is much construction work not directly required by the Government agencies mentioned which must be done, unless the country wants to face in the near future the certainty of having its war efforts cramped by the wearing out without replacement of our national plant, including transportation, housing, industrial and municipal facilities of every sort. No one, however, is now giving the necessary thought to the problem of where to draw the line. As a result, when the immediate needs of the Government for mushroom building are satisfied, contracting faces the danger of extinction. Of course, when peace comes, new organizations will spring up, and many old ones will get back into the game, at least as names. But for the most part, the men and organizations will have to be replaced and rebuilt from top to bottom. And the work that should have gone on, which would have served to preserve the industry, and for lack of which the entire nation will be a heavy loser, will have gone into the discard.

These are no theories. Contractors and the country will suffer just these consequences unless someone able to pick out the new construction which is really necessary shall step to the front in time to avert them. No one can do more toward establishing the correct policy toward new work than a really representative war service committee of contractors. They could point out to our Treasury Department that Canada is now rushing construction on one of the world's largest hydroelectric plants; and wisely, though that plant cannot develop one kilowatt of power for years to come. They could contrast this policy with that which put the ban on all such developments in the United States because the war will be over, in the opinion of some officials, before the plants could be finished. They could show in what districts the deterioration of roads would have a serious effect on crop yields. They could champion the cases of industries able to pay in short order for new building through increased production efficiency. They could at least establish the mechanism for collecting information on such subjects, and supply the agency for investigating questions of this sort, which cannot be settled in the present out-of-hand manner without evil consequences sure to affect the war and to persist for a long time afterward.

How soon will contractors act to give the Government this help and this information? No one but themselves can be blamed for the consequences to the industry and the public if they do not step into the breach at once in an organized effort to render constructive war service.

Army Intermediate Depot in France Problem in Getting Labor and Supplies

Project Covers Site Six Miles Long—Three Types of Warehouse Are Being Built—Chinese Labor Used on Railway Grading—Installation Completed for Storing 5000 Tons of Beef at Zero Temperature

BY ROBERT K. TOMLIN, JR.
War Correspondent of Engineering News-Record

Photographs not otherwise indicated are from Committee on Public Information.

TO PROVIDE storage and railroad yard facilities at a point midway betwen the front line trenches and the United States Army seacoast bases in France where supplies and equipment are unloaded, engineer troops, assisted by labor units of several nationalities and German prisoners, have partially completed the construction of what will be, eventually, the largest of the so-called "depots" for the American Expeditionary Forces. This is the intermediate depot, where reserve stores for the engineer, quartermaster, medical, signal, ordnance and the various other special services of the Army are delivered, held until needed, and then shipped to points of use.

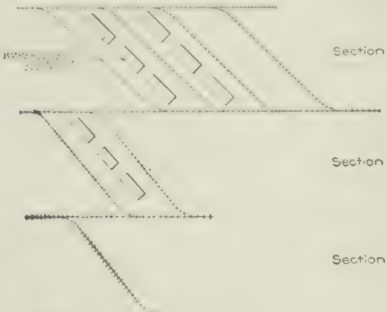


FIG. 1. SKETCH SHOWS TYPICAL LAYOUT OF WAREHOUSE SECTION OF ARMY INTERMEDIATE DEPOT

In previous articles, on the advance depot and the docks, storage and railroad yards at one of our base sections, I have outlined the general purpose and relation to one another of the several "depots" for our overseas supplies. It is, therefore, unnecessary to go into details as to the function of the intermediate depot. Suffice it to say that it is, in effect, a vast storage and regulating reservoir of materials of all sorts upon which the draft from day to day varies, depending upon the needs at the front and at other places in France where American army activities are under way.

The intermediate depot must be equipped to meet hurry calls for almost anything in the form of food or supplies. On the heels of a requisition for canned beans in car-load lots may come a demand for a shipment of cast-iron pipe, specials, and valves for a water-supply project. To meet such demands involves the provision of millions of square feet of covered and open storage and the creation of railway yard facilities for delivering and taking away the almost endless variety of products called for by the war program upon which we are engaged. Aside from its tremendous size the intermediate depot is unique in that it contains the largest refrigerating plant in France—a plant with a capacity of storing at a temperature of 0° F. 5000 tons of fresh beef.

Even over here in France it is hard to visualize the vast extent of the construction program which our engineers have laid out, and of which the intermediate depot, though a big project, is only a part. One journeys from place to place between the seacoast and the front, and all along the line the work of the engineer is in evidence. I have covered by railway, motor car and "hiking" a good many thousand miles since I landed in France, and even to-day there are many sites where construction is in full swing which I have not visited. There are others, too, I will venture to say, of whose very existence I am ignorant—and this in spite of fairly steady contact for six months with engineer officers grading in rank from second lieutenant to major general. The thing is appallingly big to "cover" in any comprehensive way. We can pick out jobs here and there for description, in an attempt to give our engineers in America some idea of the main types of construction which our technical troops in France are doing, but under present conditions it would take a sizable staff of men to record in adequate fashion the engineering work which is being done for the American Expeditionary Forces.

FIG. 2. WOOD-FRAME WAREHOUSE HAS HOLLOW TILE WALLS

Take for example the single project of the intermediate depot. In plan it is a diamond-shaped layout 6½ miles long and 1¼ miles wide. The plans provide for more than 200 warehouse buildings, each about 500 ft. long and 50 ft. wide. These dimensions are only approximate, for there are buildings of several different types, but, on the average, they are of about the size indicated. Coupled with the building construction is the matter of laying about 225 miles of railway track to serve the warehouses.

With the exception of the refrigerating plant, however, the depot problem presents nothing difficult in the matter of engineering design. The wooden buildings

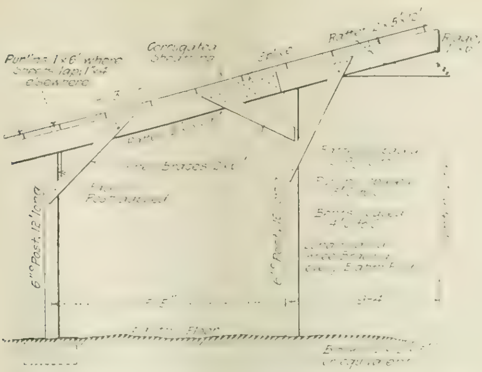


FIG. 3. TYPICAL CROSS-SECTION OF WAREHOUSE SHED

are of extremely simple types, and the railroad yard grading and track laying has been principally a job of obtaining materials and handling labor, rather than one of elaborate technical detail. This does not mean that the work has proceeded in any haphazard way, but rather that it has been studied with a view to eliminating anything savoring of "fancy" engineering or construction. The main large-scale map of the yard layout, for example, is one on which all unnecessary draftsmanship has been omitted. It is a straight "working" drawing. Tacked down upon the rough plank table in the shack which serves as the headquarters of the commanding officer of the engineer troops and his principal assistants, the paper has been worn through in spots by the elbows of the men who have to consult it regularly and mark up progress. No one has had time to make a new drawing. The holes in the old one are patched up with adhesive tape as they develop, and the work goes on.

As to the layout of the warehouses and the tracks the plan shows the work divided into five sections, four of these being parallel bands running in an east and west direction, and the fifth extending diagonally along the western ends of the others. In addition, there is a special yard for the storage of engineer material. Between pairs of parallel east and west track the warehouses, generally in groups of three, are placed end to end as shown in the accompanying sketch (Fig. 1). At the time of my visit early in June there had been laid about 60 miles of track, and 80 warehouse buildings were finished. During the early stages of the job about 15 miles of rail had to be obtained from the French, but at the present writing 80-lb. steel rail from the states is being employed exclusively. The same situation existed in the case of wooden ties but now, with the work of our forestry service speeding up the production of lumber from local sources, the tie shortage is being relieved.

The grading of the railway yards has been done both with small hand tools, pick, shovel and wheelbarrow, and with the aid of heavier plant such as locomotive cranes and clamshell buckets, and road graders hauled by caterpillar tractors. The labor represents many nationalities. In addition to our own service battalions there are large gangs of Chinese on the job. While the site of the yards is fairly flat, large areas were originally covered with brush and small trees, necessitating a considerable amount of grubbing. On this work of clearing and grubbing, as well as that of digging drainage ditches and grading the earth floors of the warehouses, the Chinese were used. Labor of higher grade, both negro and white, was reserved for the more difficult jobs of track laying and ballasting. However, a few of the Chinamen were employed on tasks demanding some degree of mechanical skill; for example, in assembling a few road graders and concrete

FIG. 4. ENDS OF WOOD-FRAME WAREHOUSES ARE SHEATHED WITH CORRUGATED IRON BUT SIDES HAVE ONLY CANVAS COVERS

FIG. 5. STEEL FRAME WAREHOUSES ARE SIMPLE IN APPEARANCE

mixers. The major of engineers who made this experiment told me that the Orientals became intensely interested in putting together the parts of American machinery, and often they worked hours overtime tinkering with the equipment which had been entrusted to them.

The track layout of the yard involves the provision of two humps and two separate groups of receiving, classification and departure yards, one for east-bound and the other for west-bound traffic. The hump starts with a 4-per cent grade which is eased off in 100-ft. stretches to 1 per cent. Among the accessory structures for the railway yard are engine sheds, coaling stations, inspection and repair pits.

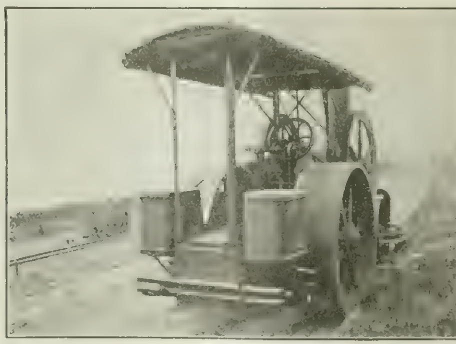
For the warehouses there are three different types of structure: (1) wood frame with open sides and corrugated iron roofing; (2) steel frame entirely sheathed with corrugated iron; (3) wood frame with walls of hollow clay tile or cement blocks. The steel and the clay-tile warehouses are used to store supplies which would be damaged by wetting, such as flour and sugar in sacks. The open wood-frame houses, on the other hand, are suitable for the storage of canned or boxed goods. The steel-frame structures serve as fire-stops, being interposed here and there between the wooden structures.

The wood-frame warehouse is merely a shed formed by timber bents and corrugated roofing, as shown in Fig. 3. Most of the posts are young pine trees, 6 in. or less in diameter, obtained on the site during the clearing operations and stripped of their bark. The ends of each warehouse are sheathed with corrugated iron sheets, as shown in Fig. 4. The sides are not sheathed. As a means of protection for the material placed beneath this form of shelter large sheets of canvas are hung from a point beneath the eaves and extend down to the ground level, as shown in the picture. On this job, as on all others which have been undertaken by our engineer troops in France, scarcity of materials was one of the conditions which we had to face. As one of the majors of an engineer regiment at the intermediate depot expressed it to me, "Our principal difficulty has been to put the job through using only about one-half the original bill of material."

FIG. 6. ONE OF THE VERY LARGE STEEL FRAME WAREHOUSES SHEATHED WITH CORRUGATED IRON

In the sketch showing a typical cross-section of a warehouse shed (Fig. 3), it will be noted that the sizes of the various members are given. This means that such sizes are used when they are available, which is not always the case. In this type of warehouse no roof truss is employed. The rafters, 2 x 5 in. in section, are kneebraced to the vertical posts. It is practically impossible to obtain in France to-day long timber, and in the case of the warehouse rafters a splice is introduced as shown. The purlins are spaced on 3 ft. centers and are usually of very light material. The corrugated roofing is nailed to them.

Many of the storage warehouses at the other depots of the American Expeditionary Forces in France are raised above the ground level on posts, or are provided with depressed railroad track along both the incoming



Photographs by Engineering News-Record

FIG. 7. GRADING DONE BY AMERICAN ROAD GRADER HAULED BY CATERPILLAR, SHOWN ON LEFT, AND ROAD ROLLED BY AMERICAN MACHINE, IN VIEW AT RIGHT

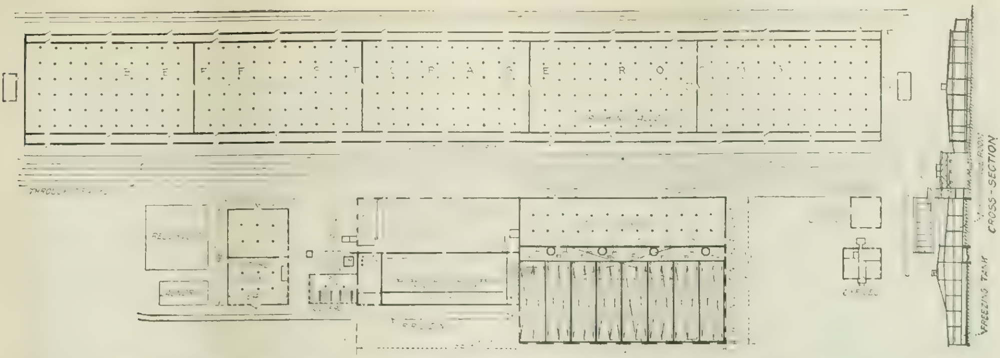


FIG. 8. LAYOUT OF THE HUGE REFRIGERATING PLANT BUILT BY AMERICAN SOLDIERS IN HEART OF FRANCE

and outgoing platforms, thus making the warehouse floor level the same as that of the freight car. In the case of the present wood-frame warehouses at the intermediate depot this practice has not been followed; as a general rule, there is no flooring other than the earth at the original ground level. In some cases, logs are placed on the earth floor in parallel rows to raise cases of goods a few inches above the ground.

More substantial types of warehouse are shown in Figs. 5 and 6. Those of the hollow-tile type were built for us by French contractors. In the steel-frame type of warehouse all connections are bolted rather than riveted, and the structure is sheathed on roof, ends and sides with corrugated iron.

The first lumber for the warehouse construction came from the United States, but since these early shipments a certain quantity has been secured from Swiss and French sources and from American forestry regiments. As a general rule, about five warehouses of the wood-frame type are under construction at one time, and to each building a gang of 60 or 70 men is assigned. Portable saw-rigs have been used for the framing work and have proved decidedly useful. Very little concrete is used on this job, the principal demand for it being at the refrigerating plant, in the footings for the columns of the steel-frame warehouses and for the inspection and engine pits for the railroad yard.

At the time of my visit to the intermediate depot, warehouses of the three different types, wood-frame, steel-frame and wood-frame with hollow-tile walls, had been built and were in service. About 25 locomotives were being used on the railway yard operation and construction, and shipments in large volume were being received, stored or routed for the front. One of the depot's biggest days occurred on June 13, when 520 cars were loaded and hauled out.

A very large labor force has been required on the depot construction work. I was told that the force, at times, has exceeded 10,000 men. Of course, this number does not remain constant. The situation over here is one that is characterized by shifting, sometimes sudden, of units from one place to another. For example, the work at the intermediate depot was begun by one of the regiments of railway engineers which were among the first to arrive in France a year ago. A few of them, principally officers serving in administrative capacities or as superintendents of big labor gangs, are still on the job. The rank and file, however have left for other parts. While a great deal of the grading work for the railroad yards has been done by hand labor, mechanical plant is to be seen at work here and there. For example, in one section the roadbed for the track is

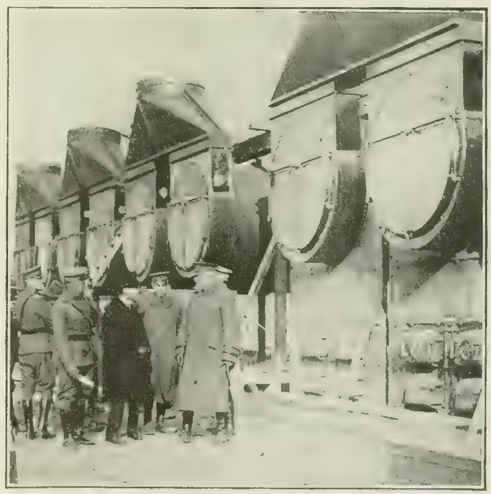


FIG. 9. SECRETARY BAKER AND GENERAL PERSHING IN FRONT OF BOILERS OF REFRIGERATING PLANT

being formed with a road grader hauled by a caterpillar tractor (Fig. 7). The method is to make two cuts, one on either side of the center line, thus forming ditches, and at the same time throwing the material into subgrade where it is levelled off by hand prior to the placing of the ties. A certain amount of road building is required at the intermediate depot. One of the views in Fig. 7 shows a gasoline roller which was put to work as soon as it had been received from the United States.

One of the features of the intermediate depot is the big refrigerating and ice-making plant which has been in operation since May 2. It serves as a cold-storage house for meat and other perishable products required

FIG. 10. REFRIGERATING PLANT UNDER CONSTRUCTION LAST WINTER

by the Army, and was designed originally to have a capacity of 5000 tons of frozen meat at a temperature of 12° F., in addition to the production of 500 tons of ice daily. The first plans have been altered to some extent as regards the temperature in the cold-storage rooms. In order to obviate the necessity of icing the railway cars in which the meat is transported from the refrigerating plant to the front, a lower temperature than that originally contemplated is being maintained in the cold-storage rooms. During my visit to the plant the thermometer indicated 1° below zero. By maintaining this zero temperature—which is the present operating practice—meat can be delivered to points of consumption without the use of iced cars.

The refrigerating plant consists of a group of 12 principal buildings, some of which are of the following sizes: beef storage, 112 x 896 ft.; ice-making, 100 x 218 ft.; ice storage, 68 x 218 ft.; engine room, 60 x 170 ft.; boiler room, 53 x 170 ft.; pump room, 25 x 38 ft.; machine shop and store room, 64 x 96 ft.; laundry, 24 x 50 ft. In addition there are a few miscellaneous buildings and a concrete reservoir 65 x 65 ft. in plan. For its operation the refrigerating plant requires 4,000,000 gal. of water daily, which is obtained from a river ⅜ of a mile distant, by means of a 16-in. pipe line and a pumping station. A general layout is shown in Fig. 8.

The engine, boiler and pump-room equipment includes eight 225-hp. boilers (Fig. 9), four refrigerating machines with a total capacity of 1100 tons refrigeration, equivalent to the cooling effect obtained from the melting of 1100 tons of ice daily. There are two 150 kva. electric generators and three turbine-driven centrifugal pumps, each with a capacity of 1800 gal. per minute, or a total capacity of 5400 gal. per minute.

Refrigeration is by direct expansion of ammonia circulating in coils hung from the ceiling of the refrigerator building, which is divided into five rooms, each with a capacity of about 1000 tons of meat. Means are also provided for storing vegetables and other products at a somewhat higher temperature than the zero degrees maintained in the meat-storage rooms. As an indication of the immense size of this plant, it may be noted that for the refrigerating coils alone 30 miles of 2-in. pipe were required.

While the original plans for the manufacture of ice, as distinguished from the provision of refrigeration in the meat-storage rooms, have been modified for a smaller output, the plant is nevertheless equipped to produce ice. In the ice-making building, there are six freezing tanks, each with a capacity of 62½ tons of ice daily. The freezing tanks contain a solution of brine cooled by 26 miles of 1¼-in. iron pipe.

Into the construction of the refrigerating plant 4,000,000 ft. b.m. of lumber, equivalent to about 6000 tons, have entered. Insulation for the cold-storage rooms, roofing paper, insulating paper, and brick for boiler settings, represented a tonnage of 2600, while 2000 tons is the weight of the mechanical equipment for the plant. Then, too, there are items of 400 tons of salt and 200 tons of ammonia, including the weight of the drums in which it is shipped. Summing up, the refrigerating plant represents a tonnage of 11,200. This figure is important when it is recalled that practically everything which entered into the construction of the plant had to be shipped from the United States. In addition, concrete for footings, walls, engine foundations, etc., was required, most of the cement for this purpose having been obtained from Europe. Exclusive of the cost of transportation from the United States—itself an item of no mean size under present conditions—the refrigerating plant represents an outlay of more than $2,000,000.

Obviously, such work as that required for the installation of a large plant of this kind could have been handled only by specialists. This fact was appreciated last year, and while the designs were being prepared at Washington there was organized a so-called ice plant company of engineers of about 350 men, most of whom were recruited from the personnel of the large packing companies of the Middle West. Actual work on the refrigerating plant was started in France in December, 1917, but the promise by those in charge of the installation that operation could be begun in five months was regarded with skepticism in some quarters. Never-

theless, in spite of all the difficulties which surround construction work in France these days, this promise was fulfilled ahead of schedule, and the placing of the works in operation on May 2 of this year is a splendid tribute to the men of the ice plant company.

In explaining to me the plans for the refrigerating plant, which were prepared under the direction of the cantonment division of the Quartermaster Department —now known as the construction division—a major of the Quartermaster Corps who is an expert on refrigeration mentioned a few of the outstanding features of the design. Great pains have been taken to insure flexibility in the layout of the piping. A break would be serious, especially over here where ammonia losses cannot be so easily replaced as in the United States. Horizontal return-tube boilers were selected on the grounds of ease of installation and ease of shipment. On the liquid ammonia lines ample provision is made for expansion and—a very important point—these lines are sectionalized by the introduction of valves at frequent points; in case of a break a section of piping may be at once cut out of the system and ammonia losses thereby greatly reduced.

Provision is made for the use of exhaust steam for distilled-water ice which may be needed for special purposes, as, for example, in hospitals. In the manufacture of ice which, in the case of the plant at the intermediate depot, is accomplished by suspending cans of water in a brine solution, the impurities in the water are forced toward the center of the block as the freezing operation progresses from the outside inward. To offset this trouble pipe lines are introduced which, when the block is partially frozen, suck out the impure water at the core, and replace it with clean water. A clear block of ice is the result.

By maintaining a zero temperature in the freezing rooms, and allowing meat to remain there four days before shipment, it will be possible to dispense with special refrigerating cars and to forward the frozen meat in plain box-cars. This feature of the plant operation is an exceedingly important one in view of the present car shortage in France and the undesirability of introducing special cars for special purposes.

Provision is also made in the operation of the plant for salvaging oil. Judged by many other engineering structures which have been built by our engineers in France, the plant occupies an almost unique position. I was told that it had been built exactly in accordance with the drawings.

A view of the refrigerating building (Fig. 11) from the roof of the ammonia condenser shows that the feature of our plant, so far as the layout of this building is concerned, is the use of a long, low, single-story structure, rather than a more compact building of several stories as is common elsewhere. The advantage of the layout adopted is that long trains can be quickly loaded and unloaded. The main refrigerating building, measuring 896 x 112 ft., will accommodate 25 freight cars on each side.

The successful completion of the refrigerating plant is due in no small measure to the precautions taken in America in the crating, marking and shipping of the multitude of mechanical parts required. At Washington the delivery of the material ready for shipment

Photograph by Engineering News-Record

FIG. 11. HOW CARS ARE HANDLED AT THE BEEF STORAGE BUILDING

abroad was controlled by charts, and shipments were well coördinated, and as a result the machinery arrived in France when and as needed—a most remarkable performance when one considers the unprecedented volume of transatlantic freight now being carried and the difficulties involved in avoiding mistakes and delays.

May Acquire Utilities by Condemnation

A decision was recently handed down by the supreme court of the State of California upholding the Railroad Commission and sustaining the right of a municipality to condemn public utility properties. The suit was entered by the Marin Water & Power Co. and the North Coast Water Co. against the Marin Municipal Water District after the Railroad Commission had passed upon the matter in 1915. The supreme court holds that it was bound by law to take the valuation put on the properties by the Railroad Commission; that the company was not entitled to any increase in value accruing after the assessment of the property and prior to the completion of the transaction, and that the law under which the condemnation proceedings were brought was constitutional. The decision of the commission, now confirmed by the court, authorized the district to take over the properties on a payment of $1,200,500 to the Marin Water & Power Co. and $289,200 to the North Coast Water Company.

This case has been followed with great interest by other water districts because it is the first to be fought out since the passage of the California law putting under the jurisdiction of the Railroad Commission the condemnation of public utilities. This decision is taken to mean that there may be no appeal on the question of valuation as set by the Railroad Commission, although a case may be taken into higher courts on other grounds.

Engineering Methods Solve New Haven's Man-Power Problem

Tap New Sources of Local Supply by Organized Publicity—Attract 247 Women a Week, 54 Per Cent. Increase, to War Factories

By Charlton L. Edholm
Executive Secretary, Committee on Man-Power Engineering, National Americanization Committee, New York City

APPEALS to the American spirit of the citizens of New Haven, Conn., proved successful in increasing the supply of war workers after engineering analysis of the situation had shown that the only unexhausted source of new labor was to be found among residents who could change their occupation or put forth extra efforts, in addition to discharging home duties, for the purpose of increasing the country's supply of munitions. The immediate response increased the weekly supply of new women workers by first 50, then 100 per cent.

The men who direct the big plants of that city canvassed the various sources of labor supply, when the draft threatened to deplete their factories, and found that there were six, namely: (1) to transfer workers from an essential industry in another community, or, (2) from the same community; (3) to transfer from a nonessential industry in another community, or, (4) from the same community; (5) the employment of idlers, who were designated "industrial slackers" and included well-to-do shirkers as well as vagrants, and (6) the development of latent industrial forces within the community.

It was recognized that the transfer of labor from one essential industry to another was merely movement in a circle and could produce no good results. The transfer from nonessential industries was made difficult by the fact that in many cases it is impossible to determine just which industries are nonessential. Some goods that are regarded as luxuries serve a valuable purpose, when the question is analyzed, and luxuries designed for export are especially "essential" in maintaining a favorable trade balance and thus protecting the nation's gold reserve.

There remained the employment of the industrial slacker and the development of the latent forces within the community, and it was upon these sources that the employers decided to draw.

A publicity campaign was undertaken through the newspapers and a number of meetings were held, some of them by women's clubs and some for the general public. It was found by investigation among the women's clubs that a large number of girls and young women were available for certain kinds of work in the factories requiring quick wits and nimble fingers rather than great muscular strength. The tending of machines and feeding them with raw material, inspecting, finishing and various other processes, could be handled by women as well as by men, if not better.

But the difficulty was to overcome the class prejudice that kept these women out of factories. The patriotic appeal was brought out in the newspaper advertising, and of the series of half-page displays that were carried the circular shown at the top of the next column is typical.

> **TO THE WOMEN OF NEW HAVEN!**
>
> **New Haven needs your individual help for national service.**
>
> **The United States Government has called upon the manufacturers of New Haven to furnish immense quantities of a great variety of products. A large number of industrial workers are needed for this purpose.**
>
> **The industrial work of New Haven, which is clean, honorable and well paid, offers an opportunity for national service.**
>
> **The more people who work in a family, the less is the burden upon the individual. The more people who work in a community, the better is the distribution of the burden of support.**
>
> **To decrease the number of the unproductive and increase the number of workers is a war measure that will both serve the Government and New Haven, offset the high cost of living, and stimulate business in general.**
>
> **Many of the women in England and France who do not require their wages for support are investing their earnings in Government bonds or distributing them in wartime charities. New Haven is not far behind England in this respect. Already we have many women who are rendering unselfish service of this character. This is a double service, as they are not only giving their time to increase production, but are devoting their earnings to charitable and patriotic purposes.**
>
> **Further information as to the opportunities to do industrial work can be obtained by applying to the Industrial Recruiting Station at 673 Chapel St.**
>
> **THE EMPLOYERS OF NEW HAVEN.**

The press coöperated with much free publicity, giving space to articles describing the efforts made by French and English women to sustain their governments by work in the munitions plants. Editorials were printed along the same lines. Through the women's clubs, the seal of social approval was set upon this movement, and in New Haven it became the correct thing to engage in war work, including industrial employment.

A centrally located bureau was established, where volunteers could enroll for work in factories, and women's organizations were canvassed to secure names. Thousands of women signified their desire to enter factories, either munitions works or others.

Prior to the inauguration of this campaign the Winchester Repeating Arms Co. had been obtaining about 160 new women workers a week. During the first two weeks this average was increased 50 per cent., while for the first four weeks an increase of 100 per cent. was netted. From this point on, the gain in the company's plant was less spectacular, dropping to an average of 54 per cent., more because the demand for workers had been filled than for lack of applicants. A large number applying to this plant and distributed to other war industries is not included in these figures.

The wages offered to women were the same as those offered to men for similar work, and care was taken to protect the women factory workers from injury, excessive fatigue and undue discomfort.

It was found that many women were available for only part-time work, so the plan was adopted of pairing, one woman agreeing to work in the forenoon and the other in the afternoon. This arrangement was sometimes extended to allow neighbors who "paired" to take

over each other's home duties, so that while one woman was in the factory the other would look after the children and "keep an eye on the house" of the other.

In order to facilitate the patriotic impulse to work for the nation, the Winchester Repeating Arms Co. issues service flags and bronze badges for the munitions workers. The badge shows an American soldier charging, and in the background a huge munitions plant; it was designed by George T. Brewster, a sculptor of distinction. Each Winchester employee received a badge free. A service flag was issued to each employee and is designed for display in the window like the Red Cross service flag. It bears a reproduction of the badge, and the white field has space for stars, each representing a member of the household engaged in munitions work. Both men and women wear the badges with pride, and the windows of New Haven are bright with the service flags, showing the fine spirit that animates the industrial workers who are helping win the war by their daily toil.

There are two chief reasons why the New Haven plan is superior to the old competitive method of bidding for labor from other cities. In the first place, an influx of workers from the outside means a derangement of living conditions in the city. To obtain 10,000 workers, it would be necessary to absorb about 40,000 new inhabitants. The difficulty of obtaining housing for that number is a staggering problem in these war times, and the facilities of schools, street cars, railroads and all public service are taxed by the shifting of population. By developing the latent labor resources of the community all this waste is avoided.

The second reason is that the use of women in industry is certain to increase with a long war. The time to get women accustomed to the idea is now, for the overcoming of prejudice is a long, slow task. The addition of thousands of skilled workers to American industries is going to be a big help in winning the war, and as long as women receive equal pay with men for the same service, there is no injustice to labor in employing them.

Discretion must be used in placing the women workers at tasks that are not too strenuous. Hours of labor, working conditions, living conditions and wages should be adjusted to make the industrial work attractive, profitable and safe for the newcomers. If it is entered into in a spirit of greed and labor exploitation, the employment of women will meet deserved opposition and will surely fail. If it is entered into in a spirit of genuine (not camouflaged) patriotism, it will be a mighty blow in the cause for which our soldiers are fighting.

Drop Shafts Sunk Through Buried Tree Trunks by Dredging

Tunnels, Foundation Piers and 82-Foot Wells Constructed by Sinking Concrete Caissons — Derricks and Aerial Chutes Handle 100,000 Yards of Foundation Materials for Large Kansas City Power Station

DERRICKS and overhead chute distribution of concrete overcame the obstacle of a railway embankment which ran directly across the construction site of the new power station for the Kansas City Light and Power Co. The chuting system provided an aërial line for handling of concrete, and the derricks, by lifting and passing loads from one to another, eliminated the necessity of surface tracks for handling other materials. It was possible also, by means of the derricks and overhead chutes, to skip over portions of the work obstructed by the embankment and return to these portions later when the obstruction had been removed. This satisfied a condition which made a pre-scheduled order of construction work impracticable.

CENTRAL MIXING PLANT AND TOWER CHUTING FROM TWO HEIGHTS DISTRIBUTED CONCRETE OVER ENTIRE AREA—QUADRUPLE BOOM TRAVELING DERRICK CONSTRUCTED FOUR PIER CAISSONS AT ONCE

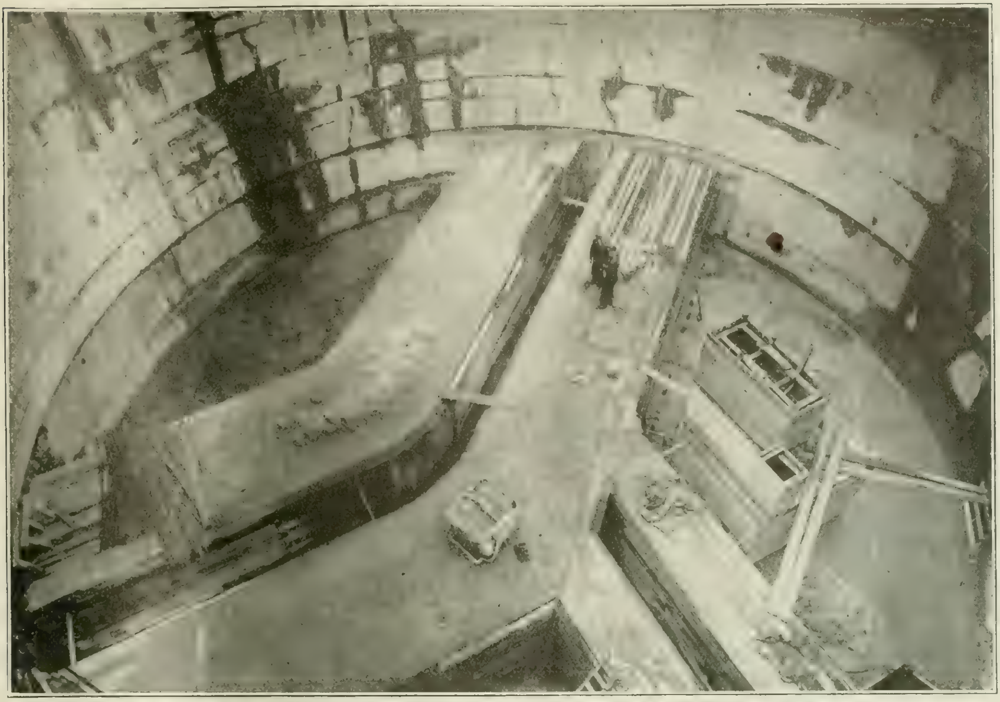
The foundations for the new station involved 50,000 cu.yd. of excavation and 45,000 cu.yd. of concrete work, distributed between two large diameter drop-shafts for intake and condenser wells, an intake tunnel, a discharge tunnel and numerous piers and footings. Construction plant and methods, therefore, had to be adapted to the execution of a number of independent, scattered pieces of work. Another complicating factor was a main-line double-track railway in operation on an 8-ft. embankment which ran directly across the construction site. This railway embankment covered part of the work planned and interposed an effectual surface barrier between the other two parts. Removal of the railway was of course planned, but when work on the foundations was commenced the date of removal was undetermined. Indeed, time passed, and several dates for removal were set and then postponed. When, finally, the embankment was out of the way, foundation construction was well advanced.

No inter-job surface track system was possible so long as the railway remained in service. Also, it was not practicable to pre-schedule the order of construction, because until the railway was removed portions of the site were inaccessible, and work here had to be postponed and undertaken as occasion offered. The logical plan, for example, would have been to commence the boiler-house foundations early, but as the railway embankment covered the sites for these foundations access was prevented until quite late in the construction schedule. Plant selection and layout had, therefore, to provide inter-job transportation without surface roads, and to permit of shifting construction operations as conditions required.

Excavation and concrete placing constituted the bulk of the construction work. The governing operation was excavation, comprised largely in the two large wells and their tunnel connections to the river, but also scattered among many separate wells for piers and pits for footings. The use of derricks and cranes promised the best solution of the excavation-plant problem, under the conditions. They required no means outside themselves for inter-job handling of materials; they could be shifted as the order of construction changed; they could be operated one at a time or in any combination of numbers. Also, as the material excavated could be consumed in a required raising of the ground level at the construction site, derricks met well enough the problem of spoil disposal. In the matter of placing concrete the conditions of scattered and frequently shifting points of disposal were perfectly met by the use of a central mixing plant with a tower and chute distribution.

For depths of 10 to 15 ft. the site was made ground, consisting of loam, silt and various decomposed vegetable matters in small quantities. Below this top layer to another 20 ft. in depth was fine sand, which changed into coarse sand and a fine gravel. This gravel layer was made the foundation bed for all the principal foundation structures. Two conditions complicated the excavation problem. The sand stratum contained many

DOUBLE-TRACK MAIN LINE, BISECTING JOB AND NOT REMOVED TILL LATE IN WORK, CONDITIONED LAYOUT



TUNNEL FORMS READY FOR CONCRETE AT THE BOTTOM OF THE BIG CONDENSER WELL

large tree trunks which had to be cut and dug out. Also, depending on the stage of the river, some 25 to 30 ft. of the work was below water level.

Drop-shaft methods, as employed on this work, are represented by the sinking of the 82-ft. diameter shafts for the intake and condenser wells. A pit some seven or eight feet deep down to about water level was excavated with a derrick and clamshell and brought to a level around the edges for setting up the steel cutting edge, the cutting edge forms, and the first lift of the shell forms. After these forms were filled the second lift of the shell forms was set and concreted. Sinking was then begun by excavating inside with derrick and clamshell. As the caisson sank the shell was built up by placing and concreting successive tiers of forms. When the cutting edge reached the required depth the bottom of the pit was dished, and a concrete seal was placed, using submarine concrete buckets handled by derricks. After the seal had set the well was pumped out and all the other work was done in the dry. Exactly similar methods were followed in sinking the small wells for piers.

The tunnels were constructed by sinking end to end a series of rectangular concrete caissons. Each caisson was sunk by methods similar to those used in sinking the wells. The caissons, however, had temporary bulkhead ends, so that after they were sunk connection could be made from one to the other. In making a connection sheet piles were driven on each side to close the ends of the space between the caissons, and the earth between was removed by derrick and clamshell; the bottom was then sealed, the bulkheads were removed and the walls were concreted. The tops of the tunnels were then put in place.

Two portions of the work, the river ends of the tunnels, being under water, required different methods. Here crib caissons of 12 x 12-in. timbers were floated into position and gradually sunk by excavating inside and building up the walls. When down to grade the concrete seal was placed and the crib was pumped out. The remainder of the concreting was done in the dry.

Excavation was the governing operation. Efforts, therefore, were concentrated on making the greatest progress possible in this task. A plant of 12 derricks and a locomotive crane was employed. These operated clamshell and orangepeel buckets and handled the sectional forms. Most of the derricks were stiff-legs operated by three-drum engines and separated swinging engines. For sinking groups of small piers effective use was made of a four-boom traveling derrick, each boom operated by a two-drum hoist and a separate swinging engine and counterweight. The four booms of this derrick would handle the work for four piers at one time.

Difficulties in excavation were confined largely to the removal of the buried tree trunks. Where these obstructions occurred in the larger pits and were clear of the caisson cutting edges, excavation was made around them and they were lifted out by the clamshells. With practice, the clamshell operators become very

skillful in searching out under water and in getting a lifting hold on these logs. In one case the operator took out in one piece a log 51 ft. long which was encountered 30 ft. deep in the intake well. A curious find was a length of 14-in. cast-iron pipe buried 25 ft. deep. The difficulties of log removal were greater in the small wells, as here the obstructions came under the cutting edges of the caissons and had to be broken up. Sometimes a sharpened railway rail churned up and down endwise by a derrick would cut and split the log into fragments, which could be dredged out by the clamshell. In more difficult cases a diver was sent down to place a blast which broke up the timber. Often a chain hitched around the end by the diver made possible the snaking out of the log with a derrick.

Disposal of the excavation was generally a simple task. The original ground level of the site was 10 ft. lower than the planned finished level, so that a large part of the excavation could be handled quite directly into fill. Sluiceways were employed in two instances to handle the spoil to fills a little distance away, and in one case across the railway tracks. The sluices were carried on trestle inclines and had at the upper end a tray into which the clamshell dumped. A pipe line and a hose nozzle washed the dirt from the tray down the chute to the place of fill, where it spread out over the ground.

Concrete for sealing the caissons was placed by derricks and submarine buckets. All the concrete was chuted to place from a timber tower 133 ft. high at the central mixing plant. This mixing plant had overhead sand and stone bins feeding two 1-cu.yd. mixers. Stone and sand delivered by railway were unloaded by clamshell into the bins or, when the bins were full, into stockpiles. Cement was stored in a house at the rear of the bins. From the cement house sacks were taken to the mixers on a push car hauled by a small hoisting engine. Two tower delivery hoppers, one about midheight for chuting to nearby work, and one near the top for reaching more distant work, were used.

Forms were generally built in panels which could be assembled and used repeatedly. The lumber for these was prepared largely in a field sawmill. A machine shop with a forge, an emery wheel, a lathe, a drill press and pipe cutting and threading machines completed the field shop equipment.

Open caisson work as a general construction method for subsurface structures of various kinds is the outstanding construction engineering feature of the work described. Caisson methods were employed for the great 82-ft. intake and condenser wells and for the small 8 to 15-ft. piers for columns, and they were employed for several hundred feet of tunnel construction, for work started in the open air and on the river bottom. Similar large diameter wells were constructed, however, for the power station for the Union Gas and Electric Co., Cincinnati, Ohio, by the same firm. The work was described in *Engineering News-Record* of Sept. 27, 1917, p. 593. At Kansas City, as at Cincinnati a year ago, difficulty expected in keeping the big cylinders level and on center was not realized. Care had to be exercised, but no serious trouble was experienced. Allowance was made in planning the work for a reasonable off-center shift, but the full allowance was never taken up.

The power plant was designed by Sargent & Lundy, Chicago, consulting engineers. The contractor was the Foundation Co., and the contract was handled by this company's Chicago office, of which Frederick W. Adgate is manager. G. B. Mitchell was superintendent of construction for the contractors.

Commerce Commission Makes First Final Valuation Report in Texas Midland Case

Gives No Single Final Value, but Will Later—Shows No Reproduction Cost of Land, but Lists Present Value Separately—Deducts Depreciation, Disallows "Other Values," Appreciation, Contingencies

RULINGS that may be interpreted as establishing general principles are made by the Interstate Commerce Commission in its first final valuation, that of the Texas Midland R.R., the report on which has just been made public. No single sum is indicated as final value. The commission interprets the valuation act as authorizing it to find such a sum and it will do so in due course, the facts meanwhile being available. In most respects the commission's findings accord with those of the Bureau of Valuation. There have been some upward adjustments of unit prices. No allowance, however, is made for "other values or elements of value," for appreciation, for materials and supplies, for working capital or for contingencies, while accrued depreciation is deducted in accordance with the bureau's interpretation. Property used by the Texas Midland but owned by other carriers is listed only, the cost figures to be included only in the inventories of the carrier companies. Industrial tracks and their rights-of-way are allowed only on the basis of actual ownership. No attempt is made to show the reproduction cost of land; the present value is listed separately, and is not included in the reproduction-cost totals for the property. The allowances for engineering and for general expenses other than interest during construction are 2½ and 1½%, respectively. A statement of original cost, not given in the tentative valuation, is included in the final report.

The original cost, including $67,493.44 for land, is given as $2,892,361. Exclusive of land, the totals for reproduction cost new and reproduction cost less depreciation are respectively $3,461,356 and $2,597,442, each of the latter two figures being about 2½% higher than the corresponding figures in the tentative valuation. (See *Engineering Record* of Nov. 11, 1916, p. 598.) The differences are due to the substitution of higher unit prices for certain tie, ballast and track-laying items, the admission of telegraph and telephone lines excluded from the tentative valuation, and slight revisions of the allowances for engineering and for general expenditures. The present value of the company's land is given as $254,479.98, which, added to the repro-

duction totals would bring them up to $3,715,836 and $2,851,922, respectively. Compared with these figures, the capitalization is $2,112,000.

Single Sum for Final Value

Regarding the much discussed question of whether or not the valuation act requires the finding of a single sum as the value of the property, the commission states that it is of the opinion that it authorizes the finding of such value, and the commission intends ultimately to make such finding as to each property. "Under the circumstances of the instant case," states the report, "full justice will be done if the findings made as to underlying facts stand, with leave to the carrier and other parties to apply to be heard upon the undetermined question as to what sum shall be stated."

In the tentative valuation it was stated that original cost could not be found. Figures purporting to show original cost of equipment and land were, however, reported, and the commission has found that from the tentative valuation it is possible to ascertain the amount of money which has been expended on the property as accurately as the records of the carrier permit. The figure given in this case is asserted by the commission to represent "within reasonably close limits of accuracy the maximum amount of money which the carrier, its predecessor or any other person or persons invested in the property."

Realizing that original cost to date is in many cases difficult to ascertain, the commission says: "Original cost to date will be reported as fully as it can be ascertained from the best evidence which is practically available . . . If it is not possible to show original cost to date for all of the carrier property, but it can be ascertained for a portion of the property, that fact will be reported . . . Whenever the original cost of the greater portion of the property can be ascertained, and as to minor parts cannot be ascertained from records, we shall within comparatively narrow limits estimate the original cost of such minor portions so as to show original cost of the whole property as closely as may be."

Conditions Assumed for Reproduction Cost

Cost of reproduction new is assumed by the commission to imply "that a railroad being operated is conceived of as nonexistent and then theoretically brought into existence by a succession of steps well known to competent engineers." Clearing and grubbing are not allowed except where forests now exist adjoining the right-of-way; in other words, present-day and not original topographic conditions are assumed. Historical conditions are assumed, however, with respect to materials used in construction; that is, reproduction new is interpreted to mean reproduction as built, so that where second-hand material was used second-hand material is figured.

Because assessments for public improvements are assumed to have carried their benefit with them through increased land values, no allowance is made for them except where they are so closely connected with the railroad that they would be wiped out if the railroad were removed.

Consideration has been given to the protest of the carrier in the matter of quantities and unit prices, and in some cases the carrier's contention has been allowed wholly or in part. For example, the unit price of 56c. for burnettized pine ties has been raised to the carrier's claim of 69c. A dollar a yard is allowed for burnt-clay ballast, as compared with 80c. in the tentative valuation and $1.60 claimed by the carrier. A figure of $900 per mile of road for tracklaying is substituted for the earlier figure of $780. No concession is made on the items of grading, bridges, trestles and culverts, and several smaller items of road and equipment. The carrier's contention, however, that allowance be made for telegraph and telephone lines on the right-of-way is sustained.

Contingencies and Engineering

Nothing is allowed for contingencies, except certain additions to the quantities of such items as spikes, to take care of wastage and other inevitable losses. The commission contends that while on a new road to be built contingencies will inevitably be encountered, the situation is different when the railroad has been built, and the engineer has it before his eyes.

The commission states that it arrived at its figure for engineering by both the synthetical and the historical method. A study was made of 121 railroad construction projects of all sizes, and the amount charged to engineers was found to vary from less than 1% to nearly 10%. The weighted average showed approximately 3.6%, in view of which the engineers were instructed to include an amount not less than 2% nor more than 5% of the investment in the road, exclusive of engineering and land. In the instant case the estimate was first made by the synthetical method, and 2.15% was the figure reached. The commission concluded that this represented a sufficient amount, but increased it slightly to take care of additions made to the tentative valuation.

General Expenditures

Asserting that a railroad with good credit has no difficulty during normal times in borrowing money at 4½%, the commission felt that the rate of 6% would be ample to cover all incidental items of expense during the construction period, as compared with 8% contended for by the carrier. "The construction period, as determined by our engineers," states the report, "does not represent the shortest period in which a railroad could be constructed, but rather that period within which the work might be economically done." Considering that the carrier is crossed by several different roads, the commission believes that in this as in other instances the period allowed for reproduction would be materially less than originally required for construction. As to the proper interest period, the commission assumes that a railroad company would have a sufficient amount of money on hand at the beginning of each six months to cover construction expenditures for that period. It states also that a study of the construction of certain roads shows that when expenditures begin they continue at about an even rate to the end of the construction period. The assumption is therefore made that the time for which interest should be allowed

is one-half the construction period, plus three months. An allowance of three months is made for money expended for equipment.

As to all general expenditures other than interest during construction, the commission believes a percentage method to be preferable to the synthetical method used by the member of the engineering board. A study of general expenditures for the same 121 railroad projects previously referred to indicated an average of 1.93% of all road accounts, exclusive of land. A figure almost identical, 1.889%, was found for the Virginian Ry., which the bureau thought was illustrative. After careful deliberation, the bureau concluded that 1½% was a proper allowance, and the commission agrees with this figure. The total of $40,064 allowed compares with $31,091 in the tentative valuation and $146,650 claimed by the carrier.

Both materials and supplies and cash on hand, while inventoried in the accounting report, are excluded from the final valuation. The commission differentiates between the plant itself and its operating assets. "By the plant," it states, "is meant the roadway, equipment and other physical parts. Operating assets include materials and supplies and cash on hand. . . . In cost of reproduction new the property to be theoretically reproduced is the railroad itself. It does not contemplate inclusion of materials and supplies and cash on hand, which are so-called liquid assets, and change from day to day."

Only Present Value of Land

The contention of the carrier with respect to land is rejected. Acknowledging testimony that in the acquisition of a railroad right-of-way a carrier must pay more than the market value for its land, the commission perceives "a marked difference between assuming in advance the total cost of acquisition, whether as the result of condemnation and damages paid or of purchase, in excess of the present value of similar lands in the vicinity, when no railroad has been constructed or is in operation, and the attempt to ascertain and state the cost of reproducing or reacquiring, at the present time, lands which actually have been severed from the adjacent property, have been converted into a railroad and are being occupied by an operating rail carrier." The commission finds itself unable to see any difference between the theory advocated by the carrier and that rejected by the Supreme Court in the Minnesota rate cases. "Before we can report figures as ascertained," it states, "we must have a reasonable foundation for our estimate, and when, as here, the estimate can be made only upon assumptions, and upon impossible hypotheses, such as those pointed out by the Supreme Court in the opinion quoted, our duty to abstain from reporting as an ascertained fact that which is incapable of rational ascertainment is clear."

As an added reason for rejecting the carrier's theory in this case, the commission feels that there is no certainty as to what land the carrier would have to pay for in case of reproduction. The railroad, it says, was built comparatively recently, and more than 25% of its right-of-way was donated. Nothing in the records shows the commission that reproduction of the road would be regarded in any less friendly spirit by the community as a whole and individual owners in particular than when the right-of-way and terminals in question were acquired but a few years ago. The commission does not feel, therefore, that all such donated lands would necessarily have to be bought or condemned and paid for at the full amount which a jury would award on condemnation.

In the matter of streets and highways occupied, the commission holds that such occupation should be regarded as franchise rights, and not as acreage owned. It would allow the carrier for streets or alleys vacated as such and used exclusively for common-carrier purposes, but not for streets or alleys used jointly by the public and the carrier. Outside of a municipality land jointly used by public and carrier would be allowed the carrier unless it affirmatively appeared that the carrier did not own it.

Depreciation, Appreciation and "Other Values"

In the case of depreciation, also, the contention of the carrier is disallowed. The commission holds that at the time the valuation act was passed depreciation was understood to rest entirely on the basis of service life spent and remaining, and not at all on that of efficiency of present use. The commission holds, further, that this definition is supported by the courts and doubts whether any case can be found where it has been deliberately assumed that depreciation and deferred maintenance were synonymous.

Appreciation is disallowed by the commission. The valuation act, the commission states, nowhere refers to appreciation, which it regards as the antithesis of depreciation, but which it states cannot be estimated as depreciation can. Conceding that certain items of maintenance are higher on a new railroad than on an older one, it believes that others, such as tie renewals, are lower, and "that the net result seems to be that the total cost of maintenance during the early years is less than afterward." Furthermore, "the attempt to measure the value of appreciation by its cost," the commission says, "is not consistent with our prescribed rules of accounting, under which the expenses of operation are chargeable to operation." The conclusion, therefore, is that no separate value can be placed upon appreciation.

No "other values or elements of value" are reported. None were reported in the tentative valuation, and the carrier asserted that the valuation act had not been complied with. Invited to put in testimony as to such other values, the carrier did not, asserts the commission, offer any such testimony. The commission holds that no substantial evidence of other values has been presented to it. Conceding that going value, described as "the value of an assembled and established plant doing business over one not thus advanced," is recognized by the decision in the Des Moines gas case, the commission asserts that "there has been urged upon us a going value which is said to exist in addition to that here referred to, which apparently runs into sums of great magnitude, but which, in spite of its magnitude, is incapable of more than the most metaphysical and conjectural description on the part of those who advocate its inclusion as an element of value. It has been urged upon us on many successive occasions, but from the beginning it has been nothing but a vague claim."

Sixty-One-Foot Hydraulic-Fill Dam Rests on Earth Foundation

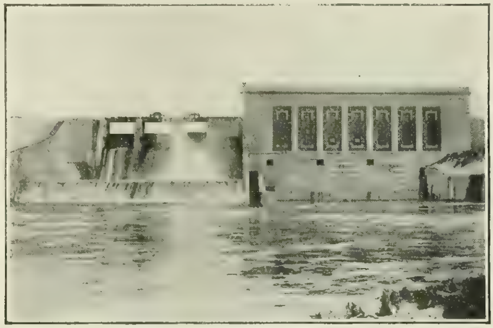
Junction Hydro-Electric Development in Southern Michigan Notable for Winter Placing of Earth Fill and for Extreme Height of Concrete Retaining Walls, Which Hold 90 Feet of Fill

By William G. Fargo
Fargo Engineering Co., Jackson, Mich.

An EARTH-FILL dam 61 ft. high, founded on clay hardpan and built by the sluicing process through an exceptionally severe winter, is the main structural feature of the new Junction development of the Consumers' Power Co. in southern Michigan. The earth fill, in addition, is retained at the side nearest the spillway by a reinforced-concrete retaining wall of a maximum height of 90 feet.

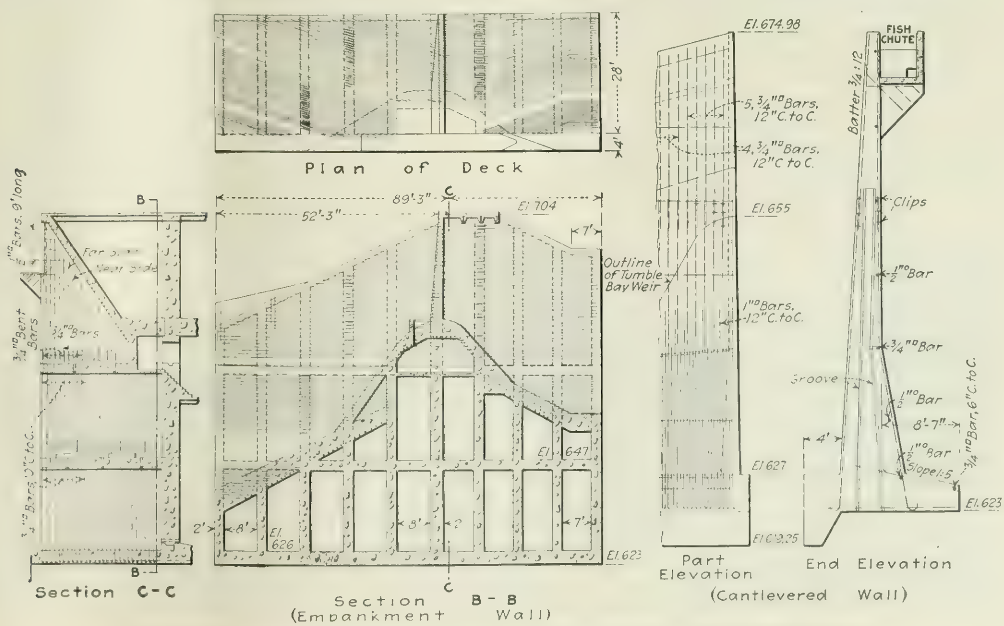
The new development is part of a chain of hydro-electric plants operated by the same company in the lower peninsula of Michigan. It is located 3½ miles from Wellston, on the Manistee River, about 25 miles above its mouth. The station has a total generating capacity of 16,500 kw. and is equipped with three single-runner vertical-type units, each rated at 5500 kw. at 90% power factor, speed being 100 r.p.m. The generators are three-phase, 30-cycle, 7500-volt machines. A new and independent 140,000-volt transmission line more than 100 miles long has been built to conduct the energy from this plant to Grand Rapids.

The site of this dam is in the heavy glacial drift region of the north central portion of the lower peninsula of Michigan. The nearest rock stratum is about 800 ft. below the river surface. A compact clay hardpan is found 15 to 30 ft. below the river surface at the site, and on this the dam and power house have been built. The owners and designing engineers of this development have within the past 14 years built seven other success-

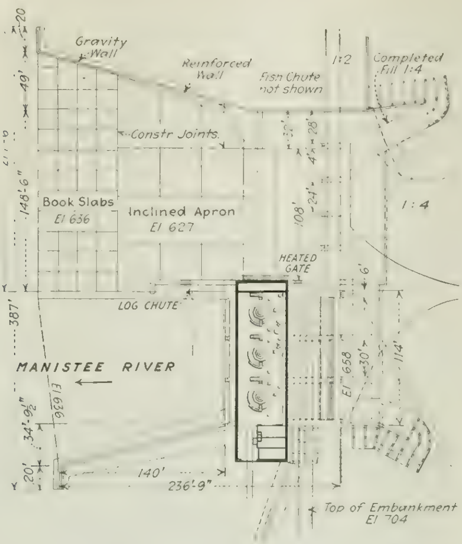


LOOKING UPSTREAM TOWARD POWER HOUSE AND SPILLWAY

ful dams, with heads ranging from 26 to 40 ft. (three being 40 ft.) on the Au Sable, Muskegon and Grand Rivers in Michigan, placing the structures upon similar clay hardpan foundations. Where the hardpan is com-



REINFORCED-CONCRETE RETAINING WALL WHICH HOLDS FILL AWAY FROM SPILLWAY

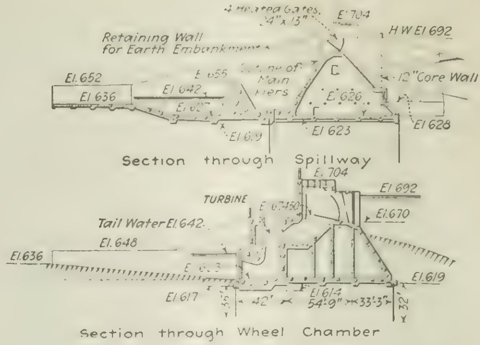


DETAILS OF THE JUNCTION DAM AND HYDRO-ELECTRIC PLANT AT WELLSTON, MICHIGAN

pact and continuous no round or sheetpiling has been used. At Junction Dam a line of sheetpiling extends across the valley and to a depth of about 40 ft. below the normal river surface.

The drainage above Junction Dam is 1451 square miles. The Junction pond at El. 692 has an area of 1560 acres. This dam backs up the water in the main river about eight miles, and up the South Branch, which enters 1½ miles above the dam, a total distance of about 4½ miles to the Stronach development built in 1912 by the same owners. This development has 18-ft. head and was built primarily to furnish power for the construction of the larger dam.

The width of the valley at the top of the embankments, El. 704, is about 800 ft. On the south side the sand bluff rises to a height of 140 ft. above the river surface. The bank on the opposite side, into which the



embankment is tied, is 76 ft. above the river surface. The power house and spillway are placed immediately in the old river channel, the river having been diverted during construction. These structures and the adjacent embankments form a straight line across the river valley and at right angles to its general direction. The power house adjoining the south bank is 145½ ft. in length and 40 ft. in width. Beyond this is the spillway, consisting of four 24 x 13-ft., steel tainter gates, motor-operated, surmounting a hollow concrete structure.

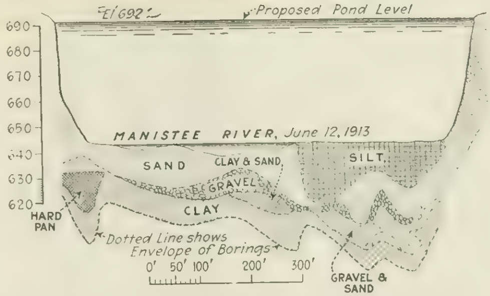
The ordinary flood is about 5000 c.f.s., and the maximum flood of record in the past 20 years is 7500 c.f.s. Two of these gates will, therefore, safely discharge the maximum flood of record without rise of headwater. The freeboard on the embankment is 12 ft., to provide for the possible failure of any future dam upstream.

Water passing through the tainter gates is received in a tumble bay 24 ft. deep bounded by a solid concrete weir of this height across the spilling channel, the crest of this weir being 13 ft. above tailwater. The spillway operates successfully to deliver the water at low velocity. In passing 5000 c.f.s. through the spillway, sand lies undisturbed on the last 50 ft. of concrete apron.

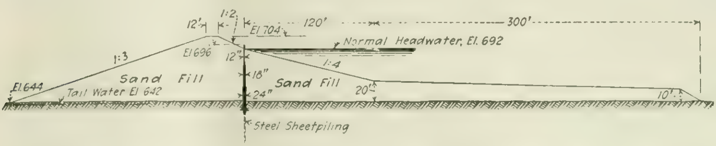
The principal embankment to the right of the spillway is 430 ft. long on top, and has a maximum height of 61 ft. in the land section. The top width is 12 ft.; the upstream slope beginning at the core wall is 1 on 4 and the

JUNCTION DAM UNDER CONSTRUCTION SAND AND CLAY FILL BEING TAKEN FROM RIVER BANK AT RIGHT

downstream slope 1 on 3. The total volume of the embankment and blanket fills is about 452,500 cu.yd. The south or left-hand embankment is a wedge 100 ft. long on top and zero at base. Both embankments have a reinforced-concrete core wall intersecting the upstream slope at the water line and carried 4 ft. above the normal head-water level. The core walls are 2 ft. thick in the lower section, 1½ ft. in the middle section, and 1 ft. thick in the top section. Underneath the core walls is a continuous line of steel sheetpiling driven to a general depth of 40 ft. below the tailwater level. Under the power-house section the hard clay is continuous and of considerable depth, but in the spillway section and northward are some sand seams, and under the north embankment the clay beds dip sharply to the north, so that sheetpiling was required to effect a tight cut-off. Since raising the headwater, the seepage from the north embankment has been collected and measured through a V-notch weir and has remained practically constant at 0.46 c.f.s., this seepage nearly all coming from the north bluff, where springs originally existed. This very satisfactory tightness of embankment is due to the character of the material of which the embankment is composed, to the manner of deposit by the hydraulic method,



NO ROCK WAS FOUND BELOW JUNCTION DAM SITE



A THIN BLANKET FILL EXTENDED 300 FEET UPSTREAM OF EARTH DAM

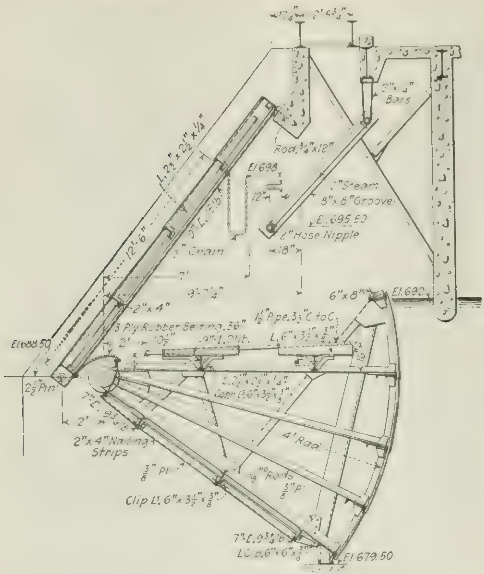
and the care taken with the sheetpiling and core wall.

The embankment material was for the most part sluiced from the 140-ft. sand bluff on the south. This sand contained a small amount of fine gravel and thin seams of clay. By the hydraulic process this clay was rather intimately mixed with the sand, and although some of the clay by reason of its fineness was deposited in the toes of the embankment, for the most part it was mingled well with the sand, and accounts largely for the water-tightness of the embankment and blanket fills extending upstream a total distance of more than 400 ft. from the core wall. At a point 120 ft. upstream from the core wall the embankment is 20 to 25 ft. in thickness and the blanket fill in the next 300 ft. slopes down to a thickness of about 12 ft. A large part of this blanket fill was placed by ground sluicing, and it is consequently thicker at the sides of the valley. The areas covered by embankment contain but little muck or humus and, except to burn off the surface vegetation, brush and logs, no attempt was made to strip the embankment areas. In joining the embankments to the natural bluffs the slopes where necessary were stripped and stepped, but in general the bluffs were free from vegetation, and but little work of this kind was necessary.

Drains were laid downstream from the core wall at the foot of the bluffs on both sides of the river. Short lines of 4-in. tile were laid at intervals under the embankment toes and connected to a main intercepting drain. These drains are of socket pipe laid with loose joints and surrounded by gravel. Marsh hay was used to keep the fine sand out of the joints. The tile drains are performing their functions properly.

In designing the concrete construction of a multiple-unit power house the question of construction and contraction joints is a vital one. The joints must be so designed and constructed as to prevent leakage from

AND SLUICED INTO 61-FOOT EARTH DAM AT LEFT. SPILLWAY AND POWER HOUSE IN CENTER OF VIEW



TAINTER GATE IS HEATED FOR WINTER OPERATION

water, in this case under a total head at the wheelpit floor of 42 ft. Below this level the greater thickness of concrete and absence of necessary joints made the problem simpler, although the water was under a higher head. The construction joints in the penstocks have been made as few as possible, and where necessary have been made water-tight by specially bent copper, or corrugated ingot iron strips galvanized, these strips crossing the joints and permitting by their special corrugations movements at the joint. With sufficient care to prevent injury to the strips during construction this type of joint has proved quite satisfactory after use for a number of years in heads up to 60 ft. This type of joint is also used at intervals in the embankment core walls, and the water-tightness of these embankments is in a great measure due to the care taken with the joints.

Construction plans were prepared in detail to indicate exactly where joints were allowed, and no departure from this joint program was permitted without thorough consideration by the designing engineers. The result has been a very satisfactory water-tightness throughout the penstock and power-house section. The maximum length cast without joints was 114 ft. for the downstream wall of the three penstocks. Continuous pouring of concrete was practiced wherever necessary, and some of the runs took nearly a week, with stops at no time exceeding six hours.

The north embankment wall forming the spillway abutment was built as a cellular reinforced-concrete wall in the high part, where it had a maximum height in places of 90-ft. from base of foundation, and a 51-ft. maximum height for the cantilevered T-wall. In the high cellular section the top third was designed with a batter of 8½ in 12, to reduce the moment of earth pressure. All of the cells or pockets in this wall were sluiced full of sand.

The maximum soil pressure assumed at the toe of this wall was 7500 lb. per square foot. No piles were driven, as the foundation soil was a very tough and compact clay hardpan. Under full load for several months no settlement has occurred. The maximum soil pressure on the downstream side of penstocks is 8000 lb. per square foot. Test loads of 12,000 lb. per square foot of soil were supported without appreciable settlement.

Bracketed to the back of this retaining wall is a reinforced-concrete Cail fish chute on a slope approximately 1 on 4, the section of the chute being 4 ft. wide and 5 ft. high.

Aside from greater height, the spillway at Junction Dam differs in no essential feature from numerous similar spillways built in various parts of America. It has already been proved that in discharging the ordinary floods of the river the velocity on the downstream 50 ft. length of the concrete apron is sufficiently low not to disturb the sand lying on this part of the apron.

During that portion of the construction period after the spillway had been completed and while the main or north embankment was being placed, the river was diverted through temporary openings in this spillway, closed by wooden flap gates. There were eight of these gates, in size 12 x 10 ft., with their sills at El. 640, the actual size of the openings being 10 x 6 feet.

In the spillway section, 12 ft. in depth of sand and clay were sluiced through these temporary openings onto the floor of the dam to increase the weight and give greater stability. During the four-months' period when the river was being passed through these temporary openings, this sand fill inside the dam was covered with a plank floor which remained safely in place.

The severe winter conditions of this district require that one of the spillway gates be provided with a heating system so that in case of emergency there will be no delay in opening a gate. One of these gates will very nearly discharge the ordinary flood of the river. It is also found that when one of the gates has been opened and the water allowed to flow for a few hours the circulation thaws the ice on the remaining gates successively. The scheme of heating is to warm an inclosed chamber, between the gate piers, having such shape and size as to permit the opening of the gate within it. The radiators are supported on the upper radial struts of the gate and swing with it, the connection to the steam main being by a 2-in. flexible hose. Steam is supplied from the low-pressure boiler of the power plant heating system. This scheme of heating has the advantage of applying heat directly to the surface of the headwater about 2 ft. in width between the curtain wall and the gate itself. The details used would not be applicable to a dam at which the headwater was allowed to rise above a fixed elevation. The uniform flow of the Manistee River permits the operation of this plant with headwater maintained at a constant elevation of 692.

Each of the three wheel chambers is closed by a steel tainter headgate 30 ft. wide by 22 ft. vertical height. These headgates, like the spillway tainter gates, are hoisted directly by motor-driven worm-geared hoists without the aid of any counterweights. The headgates are trunnioned on 12-in. steel pins, each of which is stressed in bending with a load of 240,000 lb. The motor-driven hoists are operated from the power-house

switchboard, and tell-tales in sight of the operator indicate the position of the gate. The large size of these headgates permits the water to pass at a velocity of 2.57 ft. per second. The form of the water passages from racks to turbine is such that the water moves in very smoothly, and in making an efficiency test of the turbine, current meters were used very successfully as the range of velocities, both across the penstock and in each vertical, was quite uniform. The current meter section was taken 4 ft. downstream from the racks at the headwater level, the vertical being 10 ft. from the racks at the bottom.

The Consumers' Power Co., which owns Junction Dam, built it with its own forces and equipment. J. B. Foote, chief engineer of the company, was in general charge of the design and construction of this plant.

G. S. Cochran was general construction superintendent, and the resident superintendent was Fred B. Taylor.

George F. Stecker was in charge of the electrical design and construction. The hydraulic and structural design and engineering supervision of construction, except the electrical features, were in charge of the Fargo Engineering Co. of Jackson, Mich. H. N. Tuley was its resident engineer.

Construction Methods Used on the Junction Dam

Excavating, Concreting and Winter Earth Sluicing Features Requiring Careful Attention on Hydro-Electric Project

CONSTRUCTION through the winter months caused most of the problems in building the Junction Dam described in the preceding article, but the excavating and concreting methods have some further points of interest.

The main part of the excavation for the power house and spillway was located in the old river bed, and as a considerable part of the excavation was required in the blanket fill upstream from the dam, it was decided to make use of slack-line cableway excavators operating in an up- and down-stream direction. Two cableway excavators were provided, each of them having a wooden head mast 90 ft. high, located upstream from the area to be excavated. The main cables were of 1⅜-in. diameter and 600-ft. span and were anchored to concrete anchor blocks located downstream from the tailrace. Scraper buckets of 1½-cu.yd. capacity and of the rear gate discharge type were used. Each cableway was operated by one 10 x 12-in. two-drum hoisting engine. Excavated material was dumped around the wooden head masts, as shown in one of the accompanying photographs. These piles of earth were later sluiced into position to form a part of the upstream blanket fill. On account of a large number of sunken logs and old trees encountered in the excavation, which are clearly shown in the view, considerable difficulty was encountered in handling the excavated material, but it is probable that any other kind of excavating plant would have encountered the same difficulty.

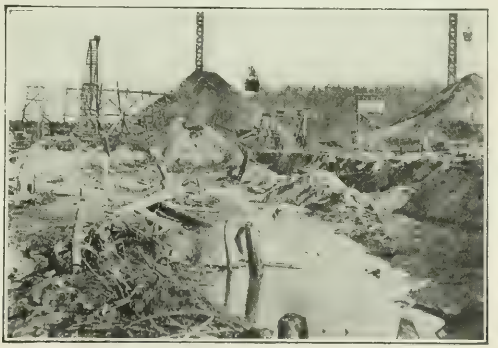
Revolving drag-line excavators were used to excavate the diversion channel for turning the river during the construction period and also for other miscellaneous work.

All sand and gravel for concrete were obtained from a pit about five miles from the site of the dam, and were hauled from the pit in 6-yd. dump cars, the motive power being furnished by a two-motor electric work car.

The gravel was excavated at the pit by means of a drag-line excavator and was screened by means of rotary screens on top of a portable screening plant. The bank gravel contained a large amount of excess sand, which was disposed of behind the screening plant as it was moved along in the pit. The gravel and sand were dumped from the cars directly into storage bins of the concrete-mixing plant; the bins were placed near the top of the high bluff adjacent to the power house structure. Concrete mixers were used, one of 33 cu.ft. capacity and one of 28 cu.ft. capacity. Cement was purchased in cloth sacks which were piled in a cement storage house of 10,000 bbl. capacity.

All sand, gravel and cement were proportioned by weight, the cement being dumped from the sacks into a loose cement compartment above the mixers. This method of weighing, which was described in *Engineering News-Record* of Aug. 29, p. 393, gave excellent results and made it possible to change the proportions easily as occasion demanded.

Electric power was used for the screening and mixing plants and for operating all pumps. A transformer station was provided near the site of the power house and was served by a transmission line from Stronach dam. A motor generator set was used for providing the



CABLEWAY EXCAVATORS DIG FOUNDATIONS FOR SPILLWAY AND POWER HOUSE IN GROUND FULL OF LOGS

direct current required for the operation of the trolley line to the gravel pit.

All freight was delivered on the Pere Marquette R.R. at a switch about three miles from the dam and was hauled to the site of the work by means of the trolley car.

No round piling was used on the job; but a large amount of steel sheet-piling was driven. Under the power house and spillway it was necessary to penetrate a layer of hard clay before reaching the sand, and in some places it was found impossible to drive the piling by ordinary means. A steam-operated channeling machine was used to good advantage in these places, a channel being cut in the hard clay to a depth of about

10 ft., and the steel piling was driven in this channel. Under the core wall the steel piling penetrated a number of veins of coarse gravel and also thin clay layers, and use was made of water jets operating under a pressure of about 100 lb. per square inch at the nozzle of the jet. It was found that if a ½-in. air pipe was introduced into the jet pipe, the combination of high-pressure air and water tended to displace the sand and gravel much more readily than by the use of water alone. A large amount of the steel piling was driven by means of double-acting steam hammers, but in some parts of the work it was found advisable to utilize drop-hammers.

In driving the steel piling through the clay under the power house and spillway, an artesian flow of water was encountered which forced its way to the surface along the line where the piling penetrated the clay. The piles were capped and the flow was stopped by grouting, as described in *Engineering News-Record* of July 18, p. 147.

The greater part of the earth fill was made by means of the sluicing method, work being carried on throughout the extremely cold winter. The quantities of earth sluiced, with the temperatures during each of the winter months, are shown in the accompanying table:

	Cu Yd Sluiced	Temperature Deg Maximum	Fahr. Minimum	Average
1917				
November	74,900	+68	+ 5	+35 8
December	98,000	+40	18	+18 1
1918				
January	51,100	+26	—30	+ 8 6
February	48,300	+38	29	+14 9
March	21,800	+50	6	+31 [illegible]

Most of the earth was obtained from the high bluff near the power-house side of the dam, being transported to place in the earth embankment by means of sluicing troughs carried on wooden trestles. These sluicing troughs were for the most part made from No. 10-gage steel plates, and were approximately semicircular in shape, with a diameter of 30 in. The troughs were 10 ft. long and were so placed on the trestle that they overlapped each other a few inches. They are shown in two of the views. The sluicing grade was from 6% to 8%, and in ordinary weather no trouble from leakage was noted. However, in extremely cold weather it was found that there was a tendency for the slight back leakage through the joints between the troughs to form ice which gradually built up, lifting the lower end of each trough so that the effective sluicing grade was materially flattened. This made it necessary to remove the ice from the joints at frequent intervals, so that the sluiced material could be transported on the proper grade.

SLUICING EARTH INTO JUNCTION DAM DURING THE BELOW-ZERO WEATHER OF JANUARY, 1918

Centrifugal sluicing pumps were utilized, all of them being motor-driven. All the pumps were housed in, and no especial trouble from freezing was encountered on account of the very cold weather. As long as the water was kept in motion through the sluicing pipes there was not much delay from freezing, but if for any reason the flow was stopped it became necessary to thaw the pipes. The construction organization became so proficient in the use of the plant, however, that comparatively little delay was caused during the winter on account of freezing of the water-supply. Constant at-

LAPPED TROUGH SECTIONS CARRY SLUICED EARTH FILL

tention was required to keep the ice removed from the sluicing troughs in order to prevent obstruction to the flow of the sluiced material, but it was found that with a reasonable amount of attention very little ice was deposited in the embankment and there was no tendency for the sluiced fill to freeze so long as water was allowed to run over the surface.

When the temperature remained below 15° F. for more than a few hours sluicing was stopped. The embankment surfaces under construction were cleared of snow and ice when starting anew. In some cases, where it was not possible to make a continuous fill, the ground froze, and it became necessary to utilize steam jets for thawing the frozen material before sluicing was resumed in that particular location. These steam jets gave very satisfactory results and it was found possible to thaw a surface of considerable area by means of one pipe left in place for several hours.

In order to provide suitable accommodations for a working force of about 600 men, many of whom had families, considerable care was expended in the layout of the camp. Single men were housed in bunk-houses, each of a capacity of about 30 double-deck iron beds. The married men were provided with shacks 16 x 16 ft., which were constructed by the company at a cost of \$60 to \$70 each and rented at \$3 per month. A sewer system was installed throughout the camp, discharging into the main river below the site of the dam, and drinking water from springs was pumped throughout the grounds. One combined wash room, toilet room and bath room was provided for each two bunk houses, and sanitary toilet facilities were also provided for the shacks in the camp. The unmarried foremen, engineers and office men lived in a 10-room staff house, most of the rooms being provided with double-deck steel bunks. Because the plant was some distance from a town, it was considered advisable to provide to some degree for the entertainment of the men, and accordingly a moving picture theater and a pool room were installed. A well equipped general store and a barber shop were operated by private persons. The dining hall was operated by a commissary contractor, who was required to maintain a specified standard of service.

Concrete Lined Pit Built Without Shifting Bracing

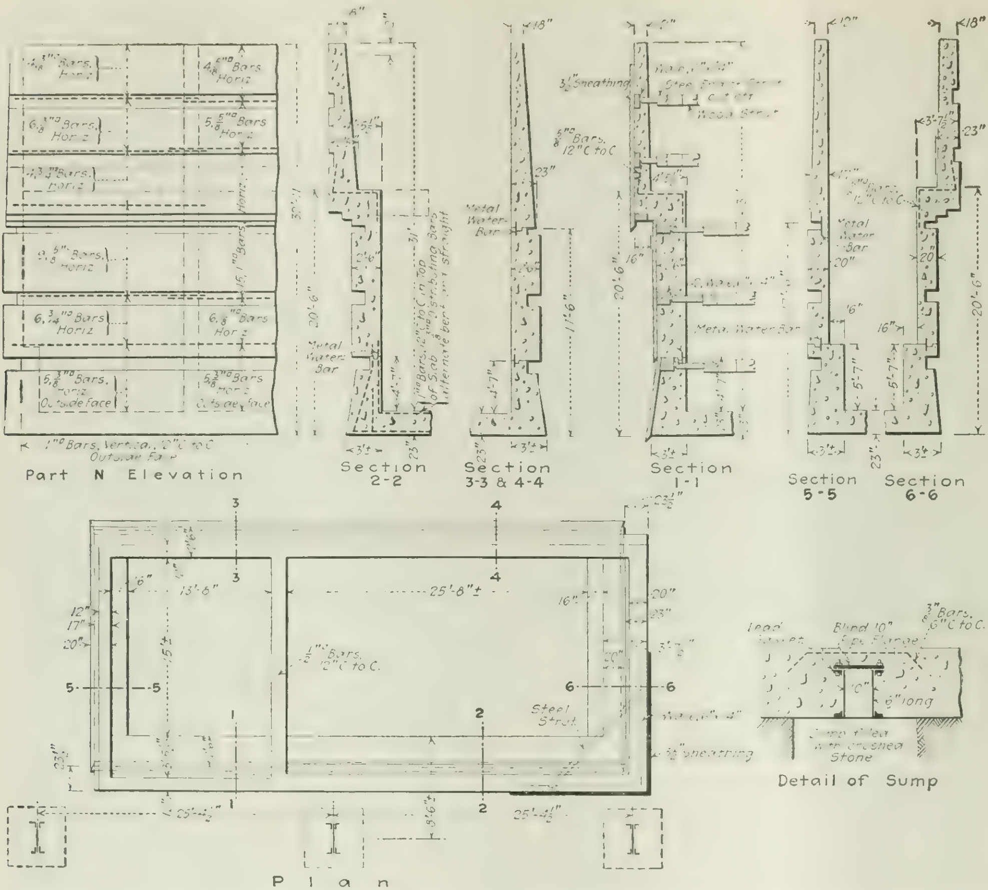
Concrete Sides Embed Sheeting, Wales and Brace Ends — Relief Sump Permits Placing Bottom Against Heavy Head of Water

By H. D. Loring
Chief Engineer Ferro-Concrete Construction Company

CONSTRUCTION speed was materially increased by sacrificing salvage of sheeting in building a concrete lined pit for the new heat treatment furnace of the Pollak Steel Co., Carthage, O. By leaving the sheeting in place as a back form for the concrete walls, and using braces with steel beam ends, the concrete was placed without shifting a single timber and without leaving any holes to be plugged. It was possible also to make the concreting a continuous operation, which helped further to insure water-tight construction. All the work was done against a heavy head of water, and in placing the concrete bottom a relief sump kept the pressure down until the concrete had hardened to sufficient strength to resist the upward thrust of nearly 1700 lb. per square foot.

Necessity of completing the pit, which was emergency construction for war work, in great haste, was the contractor's main reason for the construction methods and the lining design adopted. As the plan indicates, the north side of the pit was located as close as possible to a line of existing steel columns, each of which carries a dead load of about 30 tons to a concrete footing 5 ft. square at a depth of 5 ft. A bed of gravel from 12 to 14 ft. deep overlying stiff blue clay was to be penetrated. The gravel to within 5 ft. of the surface was saturated. This necessitated designing the walls and the pit timbering for water pressure, which, as stated, amounted at the pit bottom to 1700 lb. per square foot. This was slightly less than the weight of the concrete structure. The contractor's original instructions were to carry the pit to a depth of 27 ft.; the design was prepared on this understanding and the sheeting, bracing and excavation were completed. Then it was decided to increase the depth by 5 ft., and the plans had to be enlarged. The drawings show the design and construction as they were finally worked out.

Speed of construction was the controlling factor. The temporary bracing had necessarily to be heavy, and it was important that it should be so designed that it could be maintained during wall construction with the least possible hindrance to concreting. Usually temporary bracing is handled in one of two ways. By one method it is necessary to (1) form and concrete the wall



SHEETING USED AS BACK FORM AND STEEL ENDS OF BRACES CUT OFF AND LEFT IN WALLS OF FURNACE PIT

to the bottom of the first wale, and when the concrete has hardened slightly (2) to place another wale against the inside form at the level of the completed concrete; (3) cut off the horizontal struts and move them down against the new wale; (4) remove the second wale; (5) build forms to the bottom of the next wale, and repeat the cycle. The alternative is to build forms for the entire wall, using an outside form within the wales and boxing around the struts, which, with the wales and sheeting, are removed after the concrete has set. Both methods permit salvage of the wales and struts; the second method facilities salvage of the sheeting, but the difficulty of plugging the holes left for the struts makes it inadvisable for water-tight work.

The contractor decided to save time at the expense of salvage and use the sheeting as the outside form; then to form the inside of the wall completely; concrete the wales and struts in place, and afterward cut off the ends of the struts. This method permitted pouring the entire pit in one operation. Accordingly, the wall between the wales was designed to carry the pressure from center to center of wales, and a minimum of 6 in. of concrete was allowed over the wales. The ends of the struts which passed through the walls were made of steel sections protected with paint, and the projecting ends were burned off after the concrete was hard. No wood passed through the wall.

The walls above the original bottom were designed as continuous slabs, and the details are sufficiently indicated by the drawing. When the additional depth was ordered, it was necessary to drive a third stage of sheeting within the area already sheeted, which made it impossible to design the lowest walls like the others, on account of the limitation imposed on the thickness. Accordingly, they were designed to cantilever off the bottom, the increased thickness necessary at the junction with the floor being obtained by driving the sheeting at an angle. The bottom is a slab 23 in. thick reinforced for upward pressure. The wall between the furnace and oil tank spaces was originally designed as a partition and strut only, but after the pit was completed it was strengthened to carry liquid pressure.

The sheeting and bracing were constructed of materials immediately available. For sheeting 4 x 6-in.

yellow pine dressed and matched planks were used, and the wales were made of one or two sticks of 6 x 14-in. oak spaced 5 to 6 ft. apart. The horizontal struts were 8 x 8-in. timbers with ends of steel, as shown by the drawing.

Placing of the Struts

They were located so as to clear the ¾-cu.yd. clamshell used for excavating, and to miss the form work for the dividing wall, as well as to provide extra strength opposite the steel columns. The only provision for taking care of these columns was to sheet tightly and brace strongly, leaving the sheeting in place and pouring the wall against it. As the sheeting below the footing is under water, no trouble is anticipated from its rotting.

The 4 x 6-in. sheeting used was available in 12- and 14-ft. lengths, so that two stages were sufficient for the depth originally planned. On the south side, the location of the outer face of the wall was determined by the position of the lower stage of sheeting, so two forms were used for the upper portion and the top sheeting was removed and the wall back filled. On the north side this could not be done on account of the columns, and the upper portion of the wall was offset so as to come directly against the sheeting.

The contract was awarded Apr. 16, 1918, and the site was turned over to the contracting firm Apr. 26, the necessary plant having been assembled in the interval. Excavation was started with a stiff-leg derrick and a ¾-cu.yd. clamshell, which was used as a bucket when the stiff clay was reached. Sheeting was started by hand, and when the driving became hard a steam hammer was used.

Provision of Pumping Capacity

Plenty of pumping capacity was provided by a 7 x 7 x 10-in. duplex pump with 5-in. discharge operating at 90-lb. pressure of steam obtained from the boiler which ran the concrete mixer. Another boiler was used for the derrick. The original depth specified was reached May 15 and the final depth of 32 ft. below the surface May 21. At that time the great pressure on the bottom made it necessary to handle a large volume of water to keep the hole from flooding. A sump hole was dug in the middle of the pit and an 8-in. pipe was run through the bottom to act as a suction well for pumping until the bottom was strong enough to sustain the pressure, when the pipe was capped. The details of this well are shown on the drawing.

No particular trouble was encountered during the excavating. The steel ends for the struts and the diagonal steel struts used at the corners were not originally made heavy enough to take care of the eccentricity developed by the necessarily rough work of erecting temporary bracing, and were reinforced on the job. Liberal factors of safety are considered advisable to meet such conditions.

Concrete was started May 25 and finished May 29, and forms were removed June 3. A few troublesome leaks developed where the concrete was imperfect; they were dealt with and stopped by the usual methods of bleeding and calking.

Norfolk & Western Electric Operation Found Highly Satisfactory

FREIGHT movement by electricity during October, 1917, cost 26% less on the Norfolk & Western Ry. than if steam had been used, according to the latest annual report of that company. This statement and numerous other data assembled by the *Electric Railway Journal* are cited by that publication in a recent issue as evidence that the electrification of a mountain section of the Norfolk & Western in 1915 has proved an excellent investment.

One of the chief points argued for the electrification is that last winter, when unusually severe weather conditions hampered the steam roads so greatly, the Norfolk & Western was able to maintain a normal flow of traffic. This traffic is mainly in coal, and it is estimated that during the winter 50% more coal was shipped than could have been transported under steam operation.

An important factor in the situation is the rapid increase of traffic on the Norfolk & Western. Since electrification the tonnage handled without additional locomotives has increased 50%. Before electrification it was possible to haul eastbound a maximum of about 40,000 tons daily, with trains of 3300 tons, while on May 4, 1918, 61,200 tons of coal were so handled. On the heavy grades the steam locomotives averaged about 7 miles per hour, while in the Elkhorn tunnel the speed was as low as three or four miles. The electric locomotives maintain a constant speed of 14 miles. Steam trains formerly left Bluefield with two Mallet engines for trains of empties, and a Mallet pusher was added at the steepest grade on the return trip for 3300-ton trains. Now one electric locomotive starts out the same number of empties, and a pusher is added for 3300-ton loads up the heavy return grade.

An element of superiority noted for electric operation is the decrease in standing time. An electric engine is allowed 45 min. terminal turning time, for change of brakeshoes, journal inspection and the like; Mallet locomotives averaged 10 hours.

The average loss of engine-hours is only one-half of one per cent., despite the fact that certain new departures were made in the design of the locomotives, and that the large volume of traffic has made long shoppings impossible. The locomotives are overhauled once a year.

Bulletin Gives Physical Tests of Road Stone

Bulletin No. 670, recently issued by the United States Department of Agriculture, gives the results of the more common physical tests of approximately 3650 road-building rocks of the United States. The bulletin contains a complete record of all crushing strength tests made prior to Jan. 1, 1916. The tests show that the average crushing strength of granites and gneisses lies between 20,000 and 21,000 lb. per square inch, and that the average for limestones and dolomites lies between 18,000 and 19,000 lb. per square inch. The bulletin states that granites, gneisses, schists, sandstones and quartzites should not, in general, be used in the wearing course of water-bound macadam roads, and that shales and slates should never be so used. This is on account of the low cementing qualities of these materials.

June Floods Cause Damage to Bridges in Iowa

Serious Interference with Highway Traffic Results from Undermining of Piers, Fall of Spans and Washouts in Roads

TYPICAL FLOOD DAMAGE ON ROAD BETWEEN AMES AND STORY, IOWA

DAMAGE to roads and highway bridges in Iowa by the June floods is estimated to involve about $250,000 for repairs and reconstruction. This damage seems to have been most serious in Story County, where it was under the direct observation of the engineers of the State Highway Commission and the Iowa State College at Ames. Results of these observations, as given below, are taken from the July *Service Bulletin* of the State Highway Commission.

"Rain began on Sunday morning, June 2, and on Monday night there was a storm which resembled a cloudburst in its effect. High water and washouts isolated the state college until Tuesday noon, when the repair of a culvert made it possible to get from Ames to the college by a 14-mile route, the direct distance being only two miles. On Wednesday the repair to a steel bridge made a 9-mile route practicable. Similar conditions existed elsewhere. A pile trestle was built across a washout in the road between Ames and the college, but on June 28 a more serious break was caused by the failure of the concrete bridge over Squaw Creek, having three 45-ft. arch spans. While an express wagon was crossing the driver was alarmed by a crushing sound. He reported this and the bridge was partly barricaded.

"The city engineer from Ames and men from the Highway Commission made an examination and soundings. Cracks had opened in the arch rings and the spandrel walls, and one pier showed considerable settlement, but instruments kept on the bridge for several hours showed no further settlement. City engineers placed red lanterns as a warning, but traffic continued to use the bridge. Any detour possible at this time meant several miles of travel between the two points. At about 9:45 p.m., while an automobile was in the middle of the first span, the span gave way and slowly

SETTLEMENT AND CRACKING OF SQUAW CREEK BRIDGE RESULTED FROM UNDERMINING OF PIER IN FLOOD

sank, carrying the car with it. The span was not over the bed of the stream but a considerable hole had been scoured out to a depth of 5 to 7 ft. The car upset, but the three occupants were not precipitated into the water. The second span went down almost at once, but the third span remained standing for nearly a quarter of an hour.

"The bridge had been built in 1908, with a concrete floor in the stream bed. This floor had broken up and disintegrated and the reinforcing had rusted badly. The bridge was built over the protest of the engineers from the engineering department of the Iowa State College and of the State Highway Commission which, at that time, had no authority to enforce standards or supervision of construction, but was in the position of giving advice only when advice was asked. The claim of the engineers was that the bridge was not of good

SQUAW CREEK BRIDGE COLLAPSED ON DAY AFTER SETTLEMENT AND CRACKING WERE OBSERVED

design, that reinforcing metal was insufficient, improperly placed and overstressed, and that the concrete was also stressed beyond the point of safety, according to best standards in bridge design. The bridge was built at a cost of $6500, a saving of some $1500 over bids on a concrete-arch design submitted by the Commission engineers. It will probably cost $15,000 to construct an adequate bridge at the old site and under conditions as they are at the present time."

The bridge wreck with the overturned automobile, is shown in one of the accompanying views. Design features of the bridge are noted in the *Bulletin* as follows: "Computations showed stresses in reinforcement metal reached 33,000 lb. Good practice limits such stresses to 16,000 lb. The elastic limit of the steel approximates 32,000 to 33,000 lb. The breaking point is 45,000 lb. The concrete had a maximum stress of 805 lb. per square inch, where it should not have had more than 500 lb. The pavement floor in the stream bed was badly broken up in 1911. The bridge was built in 1908."

Undermining of foundations by deep scour was a leading cause of bridge failures in these floods. At the two-span concrete arch bridge over Skunk River, near Ames, the torrent scoured out the bed to a depth of 15 ft. below the normal level, and although the center

DISCHARGE OF 48-IN. BOX CULVERT IN JUNE FLOOD

pier was carried on piling it failed and caused the collapse of the spans. At the Chelsea bridge, in Tama County, with two 50-ft. pony-truss spans, the pier was undermined to a depth of 9 ft. beneath the footing, while one abutment was undermined 6 ft. The pier settled 2 ft. but piling prevented collapse of the bridge.

The damaged steel span on tubular piers shown in one of the views is on the Skunk River. One of the tubes settled about 2 ft., but piling was driven and the bridge shored up. In the condition as illustrated it formed for several days the only crossing of the river for a considerable distance. The cases mentioned are typical of many others, and there was also extensive loss in culverts and small wooden bridges. Concrete box culverts of the highway commissioner's standard design are mentioned in the report as having stood up well. A 48-in. culvert of this type, discharging 200 cu.ft. per second, is shown in one of the illustrations printed herewith.

Highways suffered severely from washouts, as shown by the accompanying view of damage to the road be-

TUBULAR PIER SETTLES TWO FEET AND NEARLY DROPS BRIDGE INTO RIVER

tween Ames and Story. For miles the roads were under water, and even when this became shallow it concealed holes and washouts so that it was dangerous for traffic to pass.

Organization of Government Railroad Administration

Chart and Explanatory Data Showing Branches and Their Functions Which Have To Do with Construction and Other Engineering Matters

SINCE the organization of the United States Railroad Commission, set forth by text and chart in *Engineering News-Record* of Apr. 11, p. 723 (the matter published being taken from a report of the railroad committee of the Chamber of Commerce of the United States), the organization has expanded beyond the point where it can be shown within the compass of this journal. A new 31-page report and diagram have been prepared by the committee as of Aug. 10. The diagram here shown, and the explanation of the functions of the various departments, are based on this report, but departments with which the engineering profession has little to do are eliminated.

Central Administration

Passings of the functions of the Director General, the Assistant Director General and the Division of Law, which it is not necessary to explain here, the purpose of the Division of Finance and Purchases is to coördinate and supervise railroad purchases of materials and supplies, and to develop plans for meeting the financial requirements of the railroads, whether their needs relate to the taking up and renewal of obligations and the issuance of new securities, or to financial provision for betterments and additions. The Finance and Purchasing Sections Advisory Committees assist the director respectively in the financial work of the division and in the coördination and supervision of railroad purchases of equipment, materials and supplies. The function of the Procurement Section is to follow up and expedite the delivery of equipment ordered by the Railroad Administration, by keeping in close touch with the progress of the work at the different plants and by rendering such assistance as is possible in the procurement and delivery of materials needed. That of the Forest Products Section is to procure forest products used in railway work, such as ties, timbers, etc. The function of the Advisory Committee on Insurance and Fire Protection is explained by its title.

Division of Operation

Several sections of the Division of Operation having no direct bearing on engineering are omitted from the diagram. The Car Service Section deals with all matters relating to car service, including (a) the relocation of freight cars; (b) provision through the regional director, on application of proper Government authorities, for preference in car supply and movement where more than ten cars are involved, and (c) the recommendation of embargo policies and exemptions as the needs of the Government, seasonal requirements or other governing circumstances may demand. The Car Record Office records the movement of carload shipments of United States Government freight.

The Mechanical Department exercises supervision over all rolling stock and over the shops where repairs to this equipment are made; prepares plans and specifications for new equipment, and equalizes the distribution of repair work to different shops and the distribution of motive power among the railroads.

The Committee on Standards follows up standard plans for the purpose (1) of recommending changes which may be found necessary in standards already adopted as to cars, locomotives and the specialties used thereon; or (2) of developing additional standards.

To standardize operating statistics and to keep the Railroad Administration currently informed as to results of railway operation as revealed by the statistics is the function of the Operating Statistics Section.

The Marine Section supervises the operation of shipping under the control of the Director General, and aims to coördinate all other shipping (including that on the Great Lakes) and the railroads.

The Washington and Cincinnati Freight Traffic Control Committees exist for the respective purposes of controlling freight at the gateways of Potomac Yard, Hagerstown, Md., and Hampton Roads, and the Ohio River gateways at Cincinnati, Louisville, Cairo, Evansville, Paducah and Portsmouth. Each may decide upon embargoes affecting traffic through its gateways.

While the Division of Traffic has many sections, they are not of direct concern to the engineer.

Capital Expenditures, Labor, Accounting

To receive and pass upon the reports made by the railroads as to their budgets of necessary expenditures for improvements, and to exercise supervision over capital expenditures, are the function of the Division of Capital Expenditures.

The Division of Labor exists to deal with problems of railway wages and conditions of employment, and to aid in bringing about a better understanding between railroad officers and employees.

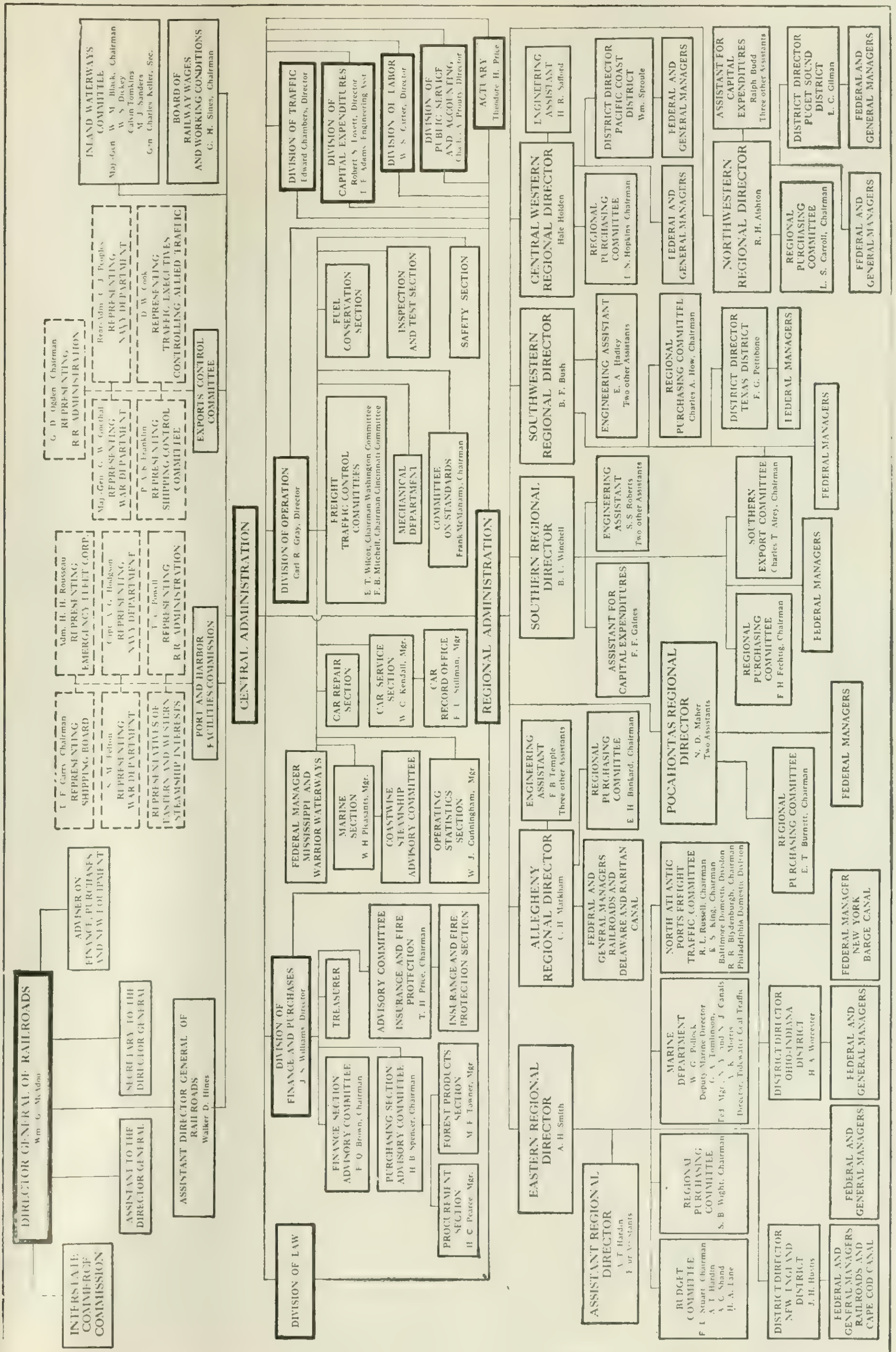
The Division of Public Service and Accounting supervises inventories of the railroad properties of which the Government has control, together with receipts and expenditures of their operations, and deals with all questions raised by any portion of the public as to the adequacy of the service rendered to shippers and consignees.

The Actuary's function is to compile and analyze statistics and make reports concerning various economic problems connected with the functions of the Railroad Administration; also to direct the work of the Bureau for Suggestions and Complaints, to which the public has been invited to address criticisms, commendations or suggestions.

Regional Administration

Seven regions now exist in place of the three defined in *Engineering News-Record* of Apr. 11. Their approximate boundaries are shown by the accompanying map (page 504).

More or less difference is found in the general staffs of the different regional directors. In the Eastern Region there is the Budget Committee (which was formed before the Eastern Region was subdivided, and so has jurisdiction over the three regions). Its function is to study the plans for additions and betterments

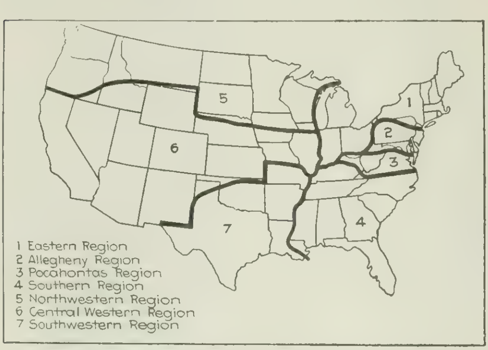


ORGANIZATION OF THOSE BRANCHES OF THE UNITED STATES RAILROAD ADMINISTRATION THAT DEAL WITH THE PROBLEMS OF THE ENGINEER

(including equipment) and for road extensions proposed by railroads in the Eastern Region, and to report from time to time on the needs for additional facilities. A. T. Hardin, a member of that committee, is assistant regional director. In most of the other regions similar duties fall upon the engineering assistant or the assistant for capital expenditures.

Each region has a Regional Purchasing Committee, whose function is to standardize and consolidate purchases of every kind that may admit of such treatment, and to submit to other regional committees and to the Director of Purchases in Washington, as information and for criticism, full statistics as to cost prices of materials used in railroad operation, so that these prices can be carefully prepared and checked.

In the Eastern Region the Marine Department has been created to coördinate the work of the Marine Section of the United States Railroad Administration



KEY MAP OF THE SEVEN REGIONAL DISTRICTS

with related activities of the United States Fuel Administration and of the port authorities of New York harbor.

The North Atlantic Ports Freight Traffic Committee controls carload domestic freight (except freight consigned to an official of the United States Government) for coastwise vessels via the ports of New York, Philadelphia and Baltimore; and makes effective when necessary embargoes issued by the several lines reaching those ports; and, when conditions warrant, issues railroad shipping permits as exceptions to embargoes. The Baltimore and Philadelphia Domestic Divisions control the movement of domestic freight into their respective ports.

Serving both the Southern Region and the Southwestern Region, the Southern Export Committee exists to issue permits covering all export business through South Atlantic and Gulf ports, and to see that freight originating in Southern territory is sent through those ports and distributed among them in such a way as to prevent congestion and obtain the greatest possible efficiency.

Advisory Commissions

Of the advisory commissions and coöperating agencies on which the Railroad Administration is represented or with which it is directly concerned, the function of the Committee on Inland Waterways is to make a prompt investigation, and report as soon as possible a definite plan describing the extent to which and the manner in which additional use may be made of internal waterways for the economical and expeditious movement of the traffic of the country, so as to relieve or supplement the railroads under existing war conditions. On the basis of reports this committee has submitted recommending steps to relieve the railroad of freight that can better be carried by water, managers have been appointed for the Cape Cod Canal, the New York and New Jersey canals (the New York Barge Canal and the Delaware & Raritan Canal) and the Mississippi and Warrior River waterways. It has also effected the operation by the Lehigh Valley Transportation Co. of the lake-line service between Chicago, Milwaukee and Buffalo in order to relieve the car situation as much as possible.

The function of the Board of Railway Wages and Working Conditions is to hear and investigate matters presented by railroad employees and their representatives affecting (1) inequalities as to wages and working conditions, whether as to individual employees or classes of employees; (2) conditions arising from competition with employees in other industries, and (3) rules and working conditions for the several classes of employees, either for the country as a whole or for different parts of the country; and to give hearings upon and investigate other matters affecting wages and conditions of employment referred to it by the Director General. This board is solely an advisory body.

Port and Harbor Facilities Commission

The function of the Port and Harbor Facilities Commission is to take charge of and be responsible for the construction of new port facilities and the extension of existing facilities which the Shipping Board or the Emergency Fleet Corporation may authorize and make appropriations for; the commission being authorized in carrying out such work to arrange and negotiate contracts and to utilize such agencies of the Shipping Board or the Emergency Fleet Corporation as may be available, and where practicable to utilize any Government agencies that will be helpful in the situation.

The Exports Control Committee is authorized (1) to inform itself as to (a) the probable amount of freight which may be exported for the prosecution of the war; (b) how this war freight can best be routed to the various ports; (c) how much of other essential traffic has to be handled, and (d) the amount of local traffic necessary for each port; (2) to select the port to which specified freight shall be transported for shipment overseas for use of the War and Navy Departments, the Allied governments and others; (3) to decide the distribution of the combined amount of all exports between the various ports so as to facilitate its handling at and avoid congestion in any common port.

All of the powers conferred upon the Interstate Commerce Commission by the act to regulate commerce and acts supplementary thereto are retained by the commission, except the power to suspend rates initiated by the President. Among the various bureaus under the commission is that of valuation, whose function continues to be to value the property of common carriers under the valuation act.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Data Wanted on Experiences with Gauntleted Railroad Tracks

Sir—If any of your readers is able to furnish the writer, either to him direct or through the medium of your columns, with data concerning actual experience with railroad tracks gauntleted, he will be very much indebted for the same. Such data as relate to gauntleted steam railroads with electric railway tracks, especially covering advantages and disadvantages in operation, would be particularly appreciated.

F. H. Frankland,
Consulting Engineer.
New York.

Commission Control and Credit Hazard

Sir—I have read with interest the editorial entitled "Does Commission Control Remove the Hazard of Investment?" in your issue of Aug. 8, p. 255. I agree entirely with your trend of thought. The point raised is so nearly like a question under discussion by our own commission during the Indianapolis Water Co. hearing I am inclined to believe it may be that hearing you have in mind.

The closing sentence of the opening paragraph of the editorial reads: "At the same hearing one of the commissioners expressed himself as not interested in the question of dividends, but as being very much interested in the maintenance of service by the company." If this reference is to the Indiana commission the words "service by the company" should have read "the credit of the company," which would of course change all that follows in the editorial.

This commission is not concerned greatly in the question of dividends, but it is tremendously concerned in the maintenance of credit of utilities, and to its credit, I believe, is the fact that, in the period through which we have been passing and are now in, that is trying every weak financial link, we have not had a public utility go into the hands of receivers. We are making a most strenuous effort to keep them in such financial condition that they will be able to meet obligations which are falling with increasing weight on them.

Whether your comment does have in mind the Indiana commission or not, I am certain you will be pleased to have this letter of comment on your editorial expression.

I believe as you do that commissions are now passing through the most crucial period of their existence. They are on trial. It is therefore unfair to the commissions, in such ordeal, to have any misinterpretation or misunderstanding of their attitude, especially when it seems to be in direct line with the thoughts expressed by yourself. You must certainly know that not all companies that appear before commissions come with legitimate claims, and I am inclined to think that some public utility representatives have been more or less unfair to commissions in reporting to papers such as your own attitudes or expressions which are not correct.

E. I. Lewis,
Chairman Public Service Commission of Indiana.
Indianapolis.

Should Combine Breadth with Intensity of Engineering Education

Sir—Your editorial in *Engineering News-Record* of Aug. 22, entitled "Engineering Education for War-Time and Reconstruction Periods," and the articles referred to therein, were read with great interest by the writer. He agrees with you that "engineers are needed as never before," that "their qualifications must be higher," and that "to meet conditions we must have more and better engineers." The best way to obtain such is another matter, and with the tone of your editorial on this question he does not quite agree.

After the war, questions and projects of national and international importance will arise and the problems involved will be big and complex. If engineers are to have their say and play their part and are to be the leaders they assert they should be, then they must be ready to meet the test. They must be engineers of wide vision and generous training, not mere technicians. "Better engineers" must be broader and bigger thinkers than in the past. The big place will be for the big man, and not the narrow specialist

Will the suggestions as set forth, and seemingly indorsed, in your editorial secure the desired results? Will not the concentrating of engineering courses into three years have the effect of narrowing the perspective of the embryo engineer? In the program outlined by Mr. Silcock nothing but technical studies is proposed. His idea of "articled apprenticeship" is, of course, essentially British and probably would never find much favor in this country, and we need not therefore consider very seriously this aspect of the question. "Intensive training" and "concentration" in engineering education are well enough to meet a war emergency, but if persisted in will they not tend to produce the "old school" engineer? Surely we want to get away from the type which prided itself on its aloofness and self-sufficiency.

Both *Engineering News* and *Engineering Record* have been staunch advocates of the "broad" engineer, and in looking through their columns one is forcibly struck by the fact that recent thought in the matter of engineering education has been along the line of lengthening, rather than shortening, the courses. More time was to be devoted to cultural subjects and to the study of modern business science. The idea of increasing the hours of work and cutting vacations is good, but in order to secure the best results the scheme should be worked out in such a way as to make a substantial net gain in hours. If this were done, then these cultural and economic subjects could be added. Perhaps the ideal method is the "coöperative system" which has been so successfully used by the University of Cincinnati. Rutgers does well to pattern after it. But why should *Engineering News-Record* approve decreasing the benefits by shortening the course?

Another factor in the making of "better engineers" is membership in engineering societies, both national

and local. The value of this to young engineers has never been sufficiently emphasized. Local societies are particularly valuable in this respect. The writer's experience with the Brooklyn Engineers' Club was very interesting. There, opportunities to meet and become acquainted with engineers of mature judgment, as well as with younger engineers, in various lines of work, were afforded. Instructive talks and lectures were given every week; a good engineering library was available, and periodic Saturday afternoon inspection trips were made. This is merely typical of the opportunities offered by local societies all over the country, and young engineers and students should be urged to take advantage of them.

Does it not seem, therefore, that the tendency to intensify training should be viewed simply as a war measure, and that any other view is fraught with danger? If engineers are to become "leaders of men" they must be not only intensively, but broadly, trained.

EDGAR A. VAN DEUSEN,

Charlotte, N. C. Southern Power Company.

[We gladly give space to this plea for continued breadth of engineering training, although we did not intend to suggest anything to the contrary—especially not after a return to normal times.—EDITOR.]

Continuity Undesirable in Some Bridges

Sir—Referring to the editorial remarks on "Continuous Bridges" in *Engineering News-Record* of Aug. 22, p. 346, there is a very practical phase of this question which you fail to mention. Where spans are connected across piers, any damage to one usually affects the adjacent span, possibly with disastrous results. Thus, a freshet, a derailed train, an undermined pier or any one of a hundred and one things in practical railroad life may work havoc to a continuous *bridge;* whereas, if the spans were separated, not the *bridge* but a *span* only would be in trouble. This is handled with comparative ease.

It is an open question whether adjacent spans should be upon a common pedestal; and it is very safe practice to make separate pedestals with a thick unbroken bedplate under both.

The question over and above simplicity and accuracy of design is one of keeping the line open, where the delay of even a fraction of a day costs untold annoyance and expense—enough to blot out the figured saving upon hundreds of continuous spans.

New York City. MASON R. STRONG.

Were the Former Days Better Than These?

Sir—The article "Looking Back Half a Century," in your issue of Aug. 8, though interesting, has a tendency to put the engineering profession of that day and earlier in a wrong light to the younger practitioners of today. I gather this from remarks made to me by some of the younger members of the profession.

There are several points in the article to which the writer begs to take exception. He has been a practitioner for fifty years and knew personally some of the prominent engineers of those early days and was assistant to others—such men as the elder Trautwine, Benjamin Latrobe, C. Shaler Smith, William R. Hutton, Charles P. Manning, John Murdoch, Col. William P. Craighill and others.

I do not know what the practice on municipal work may have been in Philadelphia, but I do know that there was not any such bad practice in sewer construction in Baltimore and other cities as was indicated by that article. Again, on railroad and other works at that time the resident engineer had a better chance to become familiar with the practical part of engineering than he has today, as he was generally engaged from the location to the completion of the road. He had often to prepare the plans for the small bridges, culverts and other works on his residency. The chief engineer, before the advent of bridge companies, planned all the bridges and railroad buildings, and on completion of the road often was made general superintendent.

I believe the ethics of the engineers of a half century ago were far better than those of the majority of the younger members of the profession today.

Pueblo, Colo. NORVAL W. WALL.

Engineers' and Bartenders' Salaries

Sir—I have read with interest the articles that have appeared in *Engineering News-Record* of late on the salaries paid to engineers, draftsmen and transit men, and have noted also the salaries offered in the advertisements in your "Positions Vacant" columns.

In western Wyoming the following prices for services in the various occupations here mentioned have prevailed since last winter and are in vogue at present: Bartenders, \$130 per month; teamsters, \$4 per day; common laborers, \$4 per day (and they are scarce at that); men working in the hay field, \$4 per day and board; sheep herders, paid \$100 per month and board, and sleep in the sheep wagons; coal miners, anywhere from \$175 to \$275 per month, with an average of about \$225. I have just finished quite an extensive survey and paid the "green" men \$4 per day and was lucky to get them at that.

Compare these prices with those offered for engineering services, including positions in technical schools and colleges, as advertised in your "Positions Vacant" columns. W. NEWBROUGH.

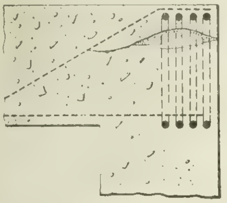
Kemmerer, Wyo.

How Much Does Concrete Shrink in a Building Column?

Sir—The writer has been in charge of a five-story reinforced-concrete building of the beam-and-girder type of construction. The floor slabs, beams, girders and exterior columns are a 1:2:4 mixture, and a 1:1½:3 mixture is used for the interior columns. The contractor must necessarily pour the interior columns separately on account of the richer mixture, but there has been considerable discussion as to the amount of time, if any, which should elapse between the time of pouring the exterior columns and the floor slab. It costs a contractor considerably more to pour the concrete in two operations, and the writer has insisted that at least two hours elapse between time of pouring

columns and floor slab, in order to allow for settlement. It is probable that the shrinkage takes place some time after the concrete attains its final set, and also that most of the settlement occurs within the first two hours.

With an idea of determining how soon this settlement took place, readings were taken on three columns, which were poured up to the under side of the girders. The first reading was taken about 45 min. after pouring and other readings at intervals of several hours, for a period of 10 hours. No difference in the elevations of the tops of the columns was noticed, which seems to indicate that the maximum settlement takes place before the concrete takes its initial set. A number of prominent engineers are of the opinion that at least six to eight hours should elapse before placing concrete on the top of columns. The final report of the Joint Committee on Concrete and Reinforced Concrete states, "it is desirable to cast an entire structure at one operation," etc., and further, "before placing the concrete on top of a freshly poured column, a period of at least two hours should be allowed for the settlement and shrinkage."



DOES SHRINKAGE CAUSE A VOID?

The writer believes his objection to pouring columns and slab monolithically is a practical one. The steel bent up over the column for negative movement from the spandrel beams together with the electric conduits coming from the column forms a network of steel in a plane about 2 in. below the top of the slab. When the column and the slab are poured together, the concrete over the top of the column is exposed to the air and the water evaporates much more readily than in the center of the column, about 10 or 12 in. below the top of the slab. This leaves the concrete on the surface stiff, while the mixture below is relatively plastic. Due to this stiffening near the surface, the supporting action of the bent-up steel, and the adhesion of concrete over the column at the top to the concrete in the beams and slab, there is a tendency for the concrete to arch over the columns. If settlement takes place, it is possible that a void is left in the center of the column 6 or 8 in. below the top of the slab, about as shown in the sketch.

On account of the large number of reinforced-concrete structures going up at this time, this point may interest other engineers, and the writer would like to see some discussion either substantiating or disapproving his contention. CARL H. COTTER,

Assistant Civil Engineer, United States Navy.

Washington, D. C.

Engineering Degrees Open to All Who Can Pass Examinations

Sir—It seems to the writer that in these times, when there is such a demand for engineers and technically trained men in general, the time is ripe for a broader view in regard to the methods employed by individuals in obtaining technical education.

A good deal has been said of late about the subject of engineering education at colleges, and also in regard to the prestige of the profession in the eyes of the general public, but little, if any, mention has been made of the correspondence school graduate. The fact that a great number of correspondence school graduates or otherwise self-educated men are in the technical professions today cannot very well be overlooked. A good many such hold important executive positions demanding the very best of engineering ability.

Anyone of fair mind will admit that an individual who completes a good correspondence school civil engineering course, will, with the exception of higher mathematics, have a thorough training in civil engineering knowledge. Especially is this true if such a course is accompanied by actual practice. Higher mathematics, etc., can be obtained through university extension courses, either by personal attendance or by correspondence.

The writer is not prejudiced in favor of one method or another, but thinks the best way of becoming an engineer is to attend some college. The next best is to take a correspondence course and see it through. Sometimes the next best can be made the best, depending on the individual.

In cases where a self-educated engineer has, on account of his ability, risen to a high position, a peculiar condition sometimes exists. He has no degree of B.S. or C.E., whereas some of his subordinates may have the C.E. and very often the B.S.

To standardize the technical professions there should be some way of obtaining a degree by passing through an examination held either by a college, the state or the American Society of Civil Engineers, or all three, without the necessity of spending several years at some college. In other words, if an individual thinks he has acquired knowledge up to the standards required, he should have an opportunity to take an examination in civil engineering. If he passes, the degree of C.E. should be conferred upon him. If he does not, but successfully fulfills some lower requirement, he should receive a subdegree, as draughtsman, surveyor, etc. That would be somewhat along the line of civil service. Anyway, let knowledge count, and let the individual choose his own method of obtaining it.

It is the belief of the writer that if such a system were generally inaugurated it would raise the standards of the technical professions and give them a higher prestige among the general public, besides tending towards greater efficiency all around.

Richmond, Cal. GEORGE W. FORSBERG.

[Examinations for membership in the associate grade of the Institution of Civil Engineers have been held for years past. Chemical and other technical societies in Great Britain conduct examinations and give certificates of proficiency. The Royal Sanitary Institute conducts examinations for municipal sanitary inspectors. These various certificates are recognized by municipalities seeking candidates for positions.—EDITOR.]

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

"Packing" Things Even a Few Steps Doesn't Pay

SHOVELERS on an excavation job visited recently were loading a belt conveyor which carried the dirt hardly 15 ft. to a dump car. On another job a roller chute, perhaps 12 ft. long, handles bags of cement from the receiving point to the mixer-charging bins.

Using short conveyors and chutes is an economy often overlooked in construction. Workmen carrying a load, even a 12-lb. shovelful of earth, walk very slowly, not more than 150 ft. a minute. About 150 shovelfuls are required to fill a 1-yd. car. If the carry to the car is 15 ft., the shoveler walks 30 ft. to place each shovelful and travels about 4500 ft. to load a cubic yard. Working steadily, he won't load the car in less than half an hour. Casting from where he stands to dig, the same shoveler will average 10 shovelfuls a minute and a cubic yard in 15 min. By means, then, of a 15-ft. belt conveyor the output of loaded cars can be doubled. Perhaps the gain accomplished on the work observed was not so great; possibly earth movers will choose to increase or decrease the specific figures employed in the preceding analysis, but the ratio between the speed of shoveling directly into place, and the speed of shoveling with a short carry to place, will hold about the same. Mechanical conveying, even for short hauls, effects enough economy, as compared with carriage by hand, to pay interest and profit on a considerable investment in conveying plant. C. S. H.

Other Articles in This Issue of Interest to Contractors:

Sand and Gravel Washing Plant Built for Six-Mile Concrete Road

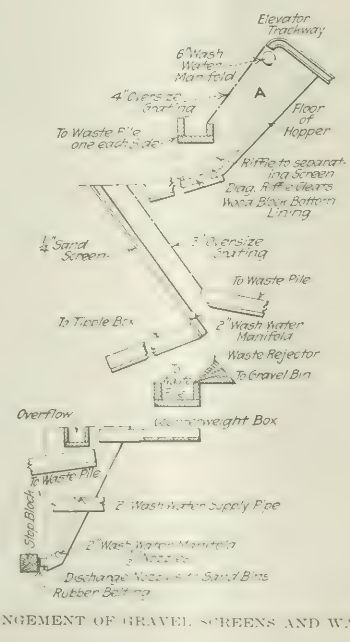
By W. L. Hill, Jr.

Seattle, Washington

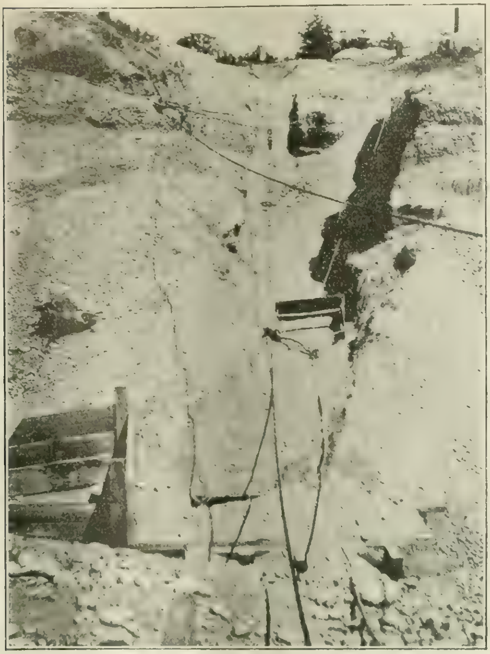
A MEDIUM-SIZED sand and gravel washing plant having a capacity of 400 cu.yd. per day was built for a 6.2-mile concrete road 20 ft. wide in King County, Washington. The plant operates with a force of five men, and when being used at capacity turns out clean sand and gravel at a cost of 7.13c. per cubic yard at present rates of wages. The smallness of the force required for operation is especially advantageous just now.

The contract for the road, the Auburn-Enumblaw highway, was let by county officials to the H. J. Kaiser Paving Co., which opened up a gravel pit near the center of the road and built the washer for the purpose of obtaining a clean aggregate. Photographs of the plant layout and a diagram of the process through which the material passes are shown herewith.

Successful operation of a washing plant is necessarily dependent upon a proper supply of water, and provision of this proved to be one of the great difficulties encountered on the work. A large spring, reputed to have great capacity, was first tried and soon pumped dry; next, several wells were tried and also pumped dry; finally, it was necessary to extend a pipe line 7300 ft. to a creek, where a sufficient supply of water was available. The creek, known as French Creek, has a flow of about 2 sec.-ft. One 3-in. triplex belt-driven pump and one 4-in. duplex belt-driven pump were mounted over a small basin into which about one-half the flow of the stream was diverted. The pumps were belted to a single-cylinder 6-hp. gasoline engine of the hopper-cooled type. Water was delivered to the bunkers through 4800 ft. of 4-in. and 2500 ft. of 6-in.



ARRANGEMENT OF GRAVEL SCREENS AND WASHERS




MATERIAL EXCAVATED AND DUMPED THROUGH PLATFORM INTO ELEVATOR CAR AUTOMATICALLY

wire-wrapped wood-stave pipe, against a static head of approximately 120 ft., as read from the pressure gage at the pumps when at rest. At the bunkers a 15-hp. gasoline engine, belted to a 4-in. centrifugal pump, boosts the water under pressure to the washing nozzle on top of the bunkers, which are 40 ft. above the supply line discharge from the creek.

Although the greatest difficulty and expense encountered in erecting this plant lay in providing the water-supply, by far the most interesting feature is the arrangement of the plant and the bunkers and the equipment for washing and grading the aggregate.

Pit-run material is excavated by a dragline scraper operated by means of a steam donkey engine. This dumps through a hole in the platform, as shown in the illustrations, into a delivery car operated by another donkey engine. The delivery car is drawn up the incline to the bunkers and automatically dumped into the first screening and washing bin.

The washing apparatus is arranged in a series of three drops, as shown in the diagram; the first being the receiving hopper at A, where the pit-run material, after passing through a grizzly of heavy bars spaced 4 in. in the clear, which rejects most of the oversize material and sidetracks it to the dump, is met by a number of streams of water issuing from ½-in. and 1-in. holes in a 6-in. manifold. The water and the aggregate then pass down a riffle about 15 ft. long, lined on the bottom with end-grain wood blocks which have diagonal 1-in. cleats nailed to them to form the riffle. The grizzly and the riffle are shown in one view.

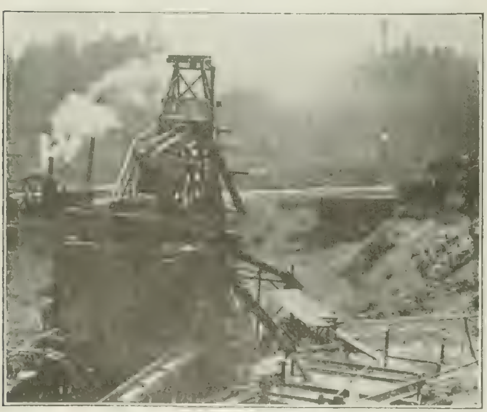
From the riffle the aggregate passes upon the separating screens, which are most ingeniously arranged. A second grizzly with bars spaced 3 in. in the clear rejects the remaining oversize material and deflects it down a chute to the waste pile, while the sand and the gravel under 3 in. is projected with considerable force upon a stationary ¼-in. sand screen standing at an angle of about 55°. Near the bottom of this screen a 2-in. water pipe crosses it, resting directly upon it; this has a number of small holes through which water is forced in a practically continuous sheet, washing the sand and gravel as it passes.

This pipe also serves another purpose. Gravel-size material, rolling down the upper face of the screen, encounters the pipe and its spray of water and is thrown upward, and the momentum of the heavier material carries it to a chute, by which it is conveyed to the gravel bins, while the waste water, sludge and other light material fall short of the gravel chute and drop into a second chute which carries them to the waste pile. This completes the segregation of the coarse aggregate.

The material which passes through the sand screen is carried to the tipple box, which is arranged to wash the sand thoroughly before discharging it. In this box, for the discharge of the sand, there are two outlets which are automatically closed when the box is in the filling position, and above each of them is a ½-in. pipe forming a nozzle through which the washing water is forced. These nozzles point slightly upward and the streams from them keep the sand constantly "boiling," thus thoroughly washing out all the dirt and float, which are carried away through the overflow. When

INITIAL SCREENING BIN REMOVES LARGE STONE AND WASHES REMAINDER DOWN THE RIFFLE

the tipple is filled it tips automatically and discharges the sand into the bins, giving it a final washing as it flows to the discharge pipes.



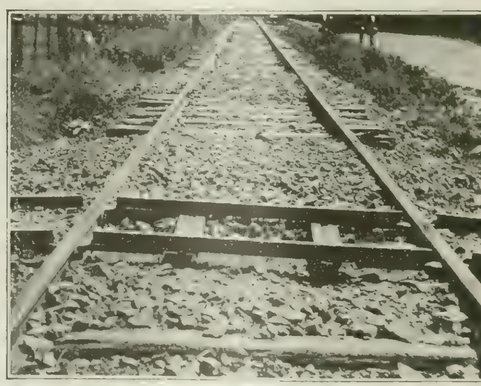
MATERIAL PASSES THROUGH SCREENS AND WASHERS TO BUNKER AND GRAVEL BINS

As finally bunkered, the material is well washed and quite evenly graded, but a fourth and final washing of the aggregate occurs as it passes down the loading chutes to the material trucks. The various operations are performed automatically, obviating the necessity of more than one attendant at the bunker; and the whole layout, besides being a notable example of special effort on the part of the contractor to obtain first-class material under adverse conditions, is well worth the attention of anyone interested in the construction of concrete pavements.

The entire crew necessary for an output of 400 cu.yd. of material per day of eight hours is five men, organized as follows: One hoistman, operating both the dragline scraper and elevator cars; the fireman; one general utility man in the gravel pit; one man taking care of the pumps and discharge chutes, and one bunkerman who also acts as foreman. Unit labor cost is thus reduced to the minimum, being at present labor prices about 7.13c. per cubic yard when the plant is operating to capacity.

Bolt Light Railway Track Sections to Crossing Railway to Prevent Derailments

A LIGHT industrial railway crossing temporarily a standard-gage electric road has been kept free from crossing derailments by bolting rigidly the two sets of rails, as indicated by the accompanying picture. The light railway carries four-car trains of gravel for road work. Such crossings are frequently built so that



CARS DO NOT JUMP THE TRACK ON THIS CROSSING

the flanges of the light car wheels ride up onto the main-line rails and fail to cross the gaps in the light-track rails. In this case, on both sides of the gaps were bolted plates bent at right angles, one arm to the bottom of the light rail and the other arm to the web of the heavy rail, so that the tops of the light rails would be held 1¼ in. above the top of the heavy rail. The light 20-lb. rails were cut to make a 5-in. gap at each crossing point. By this arrangement the flanges of the 12-in. wheels on the light cars just touch the tops of the heavy rails in passing the gaps, and the chances of derailment are greatly reduced. The crossing was designed by the Lakewood Engineering Co., for the contractor, Thomas E. Currie, Detroit, Mich.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Reconstruction Problems To Be Studied

National Research Council Committee, with F. H. Newell as Vice-Chairman Outlines Tentative Program

The National Research Council, in its survey of the larger possibilities of science, is making through its committee on reconstruction a study of after-war or reconstruction problems, this activity being in accordance with the executive order issued by the President of the United States on May 11.

In the matter of preliminary research as the first step in such survey, the committee is preparing a concise statement of agencies, public or private, engaged in whole or part on those matters which lead to reconstruction, with a brief résumé of the scope of action, methods and results of each.

There is general appreciation of the immediate need of such mapping of the field of action, as already there appears to be more or less confusion and overlapping of work, with corresponding neglect of important details. Many organizations and individuals are already concerned with the different phases of this broad subject and a large literature is rapidly growing up.

In order to outline the work in hand the following definition has been tentatively adopted:

"Reconstruction is the rebuilding on normal peace lines of the activities, mental and physical, which prevailed before the war, with such improvement or advance in ideals, methods and machinery as may have been made possible by recent experience. It begins primarily with the returning soldier, in his rehabilitation if necessary, and his return to the industry which best suits his capacities and desires. It includes the placing of other war workers as conditions change and of any human effort where it may be most effective. It means better use of our natural resources in lands, minerals, waters and forests, to furnish larger and more nearly equal opportunities for each citizen and the placing of industry, including agriculture, mining and transportation, on a basis to meet the changed needs of the country. In short, it means the intelligent planning and execution of plans for a better community."

The scope of research is defined as research for reconstruction which should touch upon all lines of science and especially their application to the public welfare. It should approach the subject by preparing: (a) A list of agencies, public or private, engaged in whole or in part on those matters which lead to reconstruction; (b) a résumé of the scope of action, methods and results of each agency; (c) a description of the degree of coöperation existing on related lines and which may be desirable and practicable; (d) comparison with similar efforts in other countries; (e) listing of those items of scientific research and their application not now covered by any agency, and which should contribute to the public welfare; (f) formulation of projects of research in these lines not now satisfactorily covered; (g) preparation of definite recommendations as to the methods and organization to undertake such projects.

The fields of research as they pertain to reconstruction problems may be considered as being in three interrelated classes: (a) materials, including lands, minerals, waters, forests and manufactured products; (b) men or man power, such as the returning soldier; workers displaced in war industries; young men entering business; women workers; emigrants and others; (c) ideals or principles, including the plans or theory of action which underlie laws and regulations governing the use of materials and employment of men for the public welfare.

A research into agencies for the accomplishment of this work and a listing of these concerned with reconstruction leads to a consideration of (a) Federal bureaus; (b) state departments; (c) civic organizations; (d) volunteer associations, coöperative, scientific and others. All of these are concerned to a greater or less degree with materials and men, and the plans or the principles of their utilization and employment.

[Suggestions for fields and agencies of research may be sent to Prof. F. H. Newell, vice chairman reconstruction committee, Urbana, Ill.—EDITOR.]

Engineer Corps Commissions for Men Between 32 and 42

Engineering News-Record is informed by a special representative in Washington that the Chief of Engineers is now permitted to commission properly qualified men between the ages of 32 and 42, as engineer officers. This ruling supersedes the order announced in Engineering News-Record of Aug. 15, p. 335, that no commissions in the Engineer Corps would be given until the draft law had been passed.

McAdoo Issues Final Form of Railroad Contract

Railway Executives' Committee Accepts It, but Security Holders Object on Three Counts

Director General McAdoo has announced the form of contract which the Government is willing to make with the railroads to cover the period of Federal operation, and has issued a supplementary statement explaining his position on certain debated points. He holds that no company need sign the contract, but that he will make no further changes in the general form. The Railway Executives' Advisory Committee approves the contract. The National Association of Owners of Railroad Securities still make emphatic objection to three features—that barring the security holders from the right to make claims in court for loss of traffic, that compelling them to finance and pay at present-day high prices for improvements that may be of no benefit to them, and that making the Interstate Commerce Commission the court of last resort on many important questions.

The contract comprises nine sections. Section 1 is devoted to definitions and generalities. Section 2 defines the property taken over by the Government. Section 3 stipulates that the company accepts all the terms of the Federal control act, including those relating to compensation for any loss of traffic due to Government operation, and that nothing in the contract is to be construed as prejudicing the Government's future policy concerning ownership, control or regulation.

OPERATION AND ACCOUNTING

Section 4, the longest section of the contract, covers operation and accounting during Federal control. It provides among other things that the Government shall receive all operating revenues and pay all operating expenses; that expenditures for additions and betterments shall be charged to the company; that expenses of maintaining the corporation shall be borne by the company, the Government, however, to bear such expenses of valuation as the Director General deems necessary; that the Director General shall at his option be substituted in place of the company in respect of the benefits and obligations of operating and supply contracts; that the company shall have access to the books and accounts.

Upkeep is covered in Section 5. The Government is to pay for maintenance, except that the company is to pay for such additional expenditure for maintenance as the Director General elects

to make to bring the property to safe operating condition. A clause stipulates that in case of dispute the ruling of the Interstate Commerce Commission shall be final.

Section 6 provides that the Government shall pay all taxes except war taxes assessed against the company during the control period.

COMPENSATION

Section 7 covers compensation. It stipulates the annual amount, to be determined separately for each company, guaranteed the company; and provides for quarterly payments, with deductions of amounts required to reimburse the Government for the cost of additions and betterments not justly chargeable to the Government. It is stipulated that power to make these deductions shall not be so exercised as to prevent the company from paying corporate expenses, keeping up sinking funds, or meeting interest, rents or taxes due; and that deductions shall not be made for additions and betterments for war purposes only.

This section also provides that the company shall not issue securities or enter into contracts without the Director General's approval; and that during the control period the Government shall pay the company interest at a reasonable rate on the cost of additions and betterments made during the period.

Claims for losses on additions or extensions, Section 8 provides, may be determined by agreement between the Director General and the company, or ascertained in the manner provided in the Federal control act; provided, however, that no claim shall be made because of the high cost of present-day construction.

Section 9 has to do with the final accounting. It provides for the return of the property at the end of Federal control.

OWNERS' OBJECTIONS

The National Association of Owners of Railroad Securities objects, first, to being compelled to sign away in advance, without knowledge of the extent to which the companies' operations are to be abandoned or their business diverted, their right to claim loss of traffic or good will, in return for "a compensation that was intended only for the use of their own property and not for the possible destruction of its value in the process of unification." The association asks that the question be left open. Second, it holds that the owners should not be required to finance and pay for at present-day prices improvements that they may not need. It contends that as the Government gets the whole benefit during the control period for the improvements it should bear the cost, charging for them at their value at the end of the control period. On this basis the companies would be willing to finance them. Third, the owners insist that they should have the right to appeal to the courts all decisions of the Interstate Commerce Commission.

In his supplementary statement Director General McAdoo says that provision is made for appeal to the courts for claims of losses on additions and extensions, but asserts that in other matters the commission's decision is properly final. Regarding claims for diversion of traffic, he asserts that the Federal control act definitely contemplated unified control and use, and a single basis of settlement for such unified control and use, and that the companies, if they, as is optional with them, sign the contract, should be denied the right to make separate claims for such loss of traffic. His statement does not touch the objection of the owners to paying present-day prices for improvements that do not benefit them.

Greet New Secretary of American Association of Engineers

About fifty Chicago engineers attended a dinner given at the City Club on Sept. 6, to C. E. Drayer, the new secretary of the American Association of Engineers. The president, W. H. Finley, made the introductory speech, and Isham Randolph acted as toastmaster. Among other speakers were J. N. Hatch, who presented the after-the-war problems of the engineer; L. K. Sherman, who urged the importance of local chapters of engineers; Joseph Harrington, fuel administrative engineer for Illinois, and H. W. Nichols, secretary of the Chicago section of the American Society of Mechanical Engineers.

Mr. Drayer in his address outlined the field and opportunities of the association and the advantages accruing from the desired universal coöperation of engineers and engineering societies. He urged that engineering organizations should be based on service; that engineers should put aside old jealousies, and get together and assign society work in accordance with their past development and present capacity.

Tomlinson Heads Inland Waterways

George A. Tomlinson, who for several months past has been Federal manager of the New York and New Jersey canals, has been made director of the newly created Division of Inland Waterways, under the jurisdiction of the Railroad Administration. Mr. Tomlinson is a lake shipping man of many years' experience, and was a member of the waterways committee of the Council of National Defense. The new division supersedes the Committee on Inland Waterways, of which Maj. Gen. W. M. Black was the chairman and Brig. Gen. C. Keller was the secretary, and takes over its records.

Mr. Tomlinson has been succeeded as Federal manager of the New York and New Jersey canals by H. S. Noble, president of the Great Lakes Transit Corporation, the consolidated package freight line of the Great Lakes. Mr. Noble has also been connected for many years with lake shipping.

Army Construction Costs More Than a Billion

Building construction inside the United States strictly for the war and in charge of the Cantonment Division, now the Construction Division of the Army, will total $1,083,766,000, according to a statement just issued by the War Department. To provide for the needs of the Army, the Construction Division has undertaken since April, 1917, a total of 323 operations and now has in prospect 153 more. To the end of August, 93 operations had been completed, including the camps and cantonments. The cost of the finished operations was $277,745,847. Additions and alterations of minor character are not figured as "jobs."

There are now under construction 266 jobs, which will represent a cost approximating $636,858,351. Practically all of the work now under construction will be finished by Jan. 1, next. However, some of the larger jobs, which are of a permanent nature, will not be completed until October, 1919. Included in the present construction is the development of eight port terminals at a cost of approximately $150,000,000. One of these, the Brooklyn Army Supply Base, estimated to cost $40,000,000, will have the largest warehouses in the world. The other terminals in the course of construction are at South Boston, Mass., estimated to cost $28,000,000; at New Orleans, La., $10,000,000; at Charleston, S. C., $25,000,000; at Norfolk, Va., $20,000,000; at Philadelphia, Penn., $15,000,000; at Newark, N. J., $10,000,000, and at Newport News, Va., about $5,000,000.

Projects now under way include a large number of ammunition depots, quartermaster's warehouses and storage depots in inland cities, hospitals, ordnance plants, new training camps, and the enlarging of other camps to provide accommodations for the increasing Army and the newer methods of training. The major portion of this class of work will be finished by Jan. 1, 1919.

Water-Power Bill Passes House

After a lengthy controversy over the maximum length of the license and the question of whether "fair value" or "net investment" should be the basis of recapture, the House of Representatives, Sept. 5, passed the so-called Sims water-power bill, the bill to grant licenses to private companies for the development of navigable rivers or streams in the public lands. The Senate has already passed the Shields bill for similar purposes, and the two bills will now go to conference.

The recapture provisions provoked the greatest discussion. The bill as reported provided that in paying for a water-power property recaptured by the Government after the expiration of the license the basis of payment should be the "net investment . . . as defined and interpreted in the 'classifica-

tion of investment in road and equipment of steam roads,' issue of 1914, Interstate Commerce Commission. President Wilson objected to this clause and suggested the substitution of the term "fair value not to exceed the actual cost." An amendment incorporating the "fair value" idea was submitted in two different forms but was lost, in the first vote by 71 to 83 and in the second by 128 to 133. Other amendments were similarly lost, and the committee's bill was then passed 231 to 23.

War Subjects to Dominate Safety Congress

Director General Schwab and Secretary Lane Included in List of Speakers at St. Louis Meeting

The program of the seventh annual safety congress of the National Safety Council, to be held at the Hotel Statler, St. Louis, Sept. 16-20, will be devoted in large part to war subjects, including the opening address by Charles M. Schwab, director general of the Emergency Fleet Corporation on "The Democratization of Industry," followed by an address by Secretary of the Interior Lane on "Safety as an Asset in Winning the War." "Safety in Warfare" and "Accident Prevention in the Shipbuilding Program" are other subjects included in the five-day program. The women's session, which will be held on the third day of the convention, will include an address and discussion on "The Effect of War upon Women in Industry."

The meeting of the construction section of the congress will be held Sept. 18, both in the morning and afternoon, and will include the following subjects: "Organizing for Safety—How to Secure the Coöperation of Superintendents, Foremen, and Men;" "Safe Construction of Scaffolds and Falsework;" "Effect of Accident Prevention on Insurance Rates;" "Benefits of Accident Prevention in Contracting."

The annual meeting of members will open the congress on the morning of Sept. 16, and will be followed by a general session in the afternoon, including the address by Mr. Schwab, as well as papers on "The Personnel Problem in Industry" and "The Economic Value of Health of Industrial Employees."

A public mass meeting will be held in the evening of the same day and will include the address by Secretary Lane and the New York Central R.R. Co.'s new drama safety film, "The Rule of Reason."

The second and third days of the convention will largely be given up to "sectional meetings," including the chemical, logging, miscellaneous manufacturing, public utilities and steam railroad sections, and the sections of public administration and public safety. The meeting of the public safety division on the afternoon of Sept. 17 will include an address on "City Planning as Related to Public Safety," by Thomas Adams of the Conservation Commission of Ottawa, Canada.

Engineering Employment Service Not Military

Some engineers apparently have assumed that the new division of engineering, United States Employment Service, is a military organization, for the Chicago office of the division has been flooded with requests for enrollment which indicate a desire for military service.

This belief is false. The division which has offices at 29 So. La Salle St., Chicago, is a Government free employment agency for civilian work. It provides work for engineers and technical men, free of charge. It places these men with industries that are doing war and nonwar work, according to the desires of the applicant. It also furnishes men who are needed immediately for work in departments of the war and the industries. There are no obligations and no fees. The division, however, furnishes a means of direct contact with the Government and gives advice and help in regard to military enlistments.

Contractors' Committee to Meet Before Loan Drive

Sept. 23 has been set as the date for the meeting at 51 Chambers Street, New York City, of the executive committee appointed to form a national organization of contractors.

The change, it is announced, advancing the original date one week from Sept. 30, was made because of the number of members of the committee found to be on Liberty Loan committees in their own cities, making it difficult for them to be absent during the first week of the coming drive.

Appoints Committee for Study of After-War Conditions

W. H. Finley, president of the American Association of Engineers, has appointed a committee to study after-the-war conditions. The committee consists of Isham Randolph, chairman; Edmund T. Perkins, consulting engineer, Chicago; Gardner S. Williams, consulting engineer, Ann Arbor, Mich., and Samuel Moreell, Chicago, secretary. The committee will be increased as its gets into the work and will join forces with other agencies in Chicago and throughout the country that are now studying the problem.

Approve Mayor's Nominations for Boston Transit Commission

The Massachusetts Civil Service Commission has sent to Mayor Peters of Boston its approval of the names of the three men designated by the mayor to act as transit commissioners of the city. These men will take charge of the work formerly performed by the Transit Commission, which expired June 30 after an existence of nearly a quarter of a century.

The men whose names have been approved are former Mayor Josiah Quincy, who was a member of the old commission; Thomas F. Sullivan, public works commissioner, and Thomas W. Murray, city treasurer.

The Civil Service Commission also approved the names of Herbert A. Wilson, building commissioner, to succeed Patrick A. O'Hearn, Thomas Allen, art commissioner, and James B. Shea, park and recreation commissioner.

Fleet Corporation Fights Mosquito Pest

Local Authorities Coöperating With Shipping Board in Washington, at Many Yards

Almost over night a great national mosquito-fighting army has been created by the health and sanitation section of the industrial relations group through the United States Shipping Board, Emergency Fleet Corporation. This force is conducting a continuous offensive against the pest which for a time threatened to undermine the morale of hundreds of thousands of employees of shipyards and auxiliary plants. Lieut. Col. Philip Schuyler Doane, a member of the staff of Surgeon-General Gorgas at the time he eliminated the mosquito pest from the Panama Canal Zone, is director of the department of health and sanitation of the United States Shipping Board, and is organizing the war against the mosquito in all parts of the United States where there are shipbuilding activities.

At the Hog Island shipyard, a comprehensive campaign has been inaugurated against the mosquito. There are about 30,000 men employed in this yard, which is situated in a waste of marshes along the Delaware River. The territory included in the mosquito belt covers 14½ square miles, or 9100 acres. After looking over the situation, officials of the Shipping Board's Department of Health and Sanitation decided that an anti-mosquito campaign in the district, to be successful, must be a coöperative one. A conference of the various interests at stake was called and a coöperative plan was adopted. The Emergency Fleet Corporation, the State of Pennsylvania, the City of Philadelphia and the private interests subscribed a war mosquito fund aggregating $250,000 to be spent in drainage, oiling and inspection work. The work is being carried out according to a schedule evolved by the Pennsylvania State Board of Health to which has been given supervision of the whole work in order that all parts of it may be properly coördinated.

Methods of mosquito elimination employed include the sprinkling of pools with oil, the cutting down of high weeds which form prolific breeding places, and the digging of lateral ditches in the 9100-acre tract. Within three months after work was inaugurated the water area was reduced by 95 per cent. Breeding had been virtually stopped.

With the coöperation of local authorities, the fleet corporation is carrying out similar work at many other points.

Make Gasoline Mileage Tests with New Army Trucks

Utilizing 5 two-ton motor trucks of the "Army A" type, tests were made Sept. 4-6 of gasoline consumption when the trucks were operated over various road surfaces, paved and unpaved, in the vicinity of Cleveland. The trucks were taken from stock made by the White Co. just previous to delivery to the Government. The roads traversed ranged from earth on which rain had fallen two days before, to excellent semi-monolithic brick and concrete in good condition. Stretches of good and poor gravel and an uneven asphaltic macadam were included. The lengths varied from 1.1 to 5.6 miles.

The main purpose of the tests was to show the fuel cost of operation, loaded and empty, over paved and unpaved sections of country roads, rather than a detailed scientific study of draw-bar pulls or engine efficiency. The results will be available as soon as worked up.

The tests were carried out as a co-operative enterprise between the White Co. and the Portland Cement Association. Representatives of the Lakewood Engineering Co., the United States Office of Public Roads, city and county officials and *Engineering News-Record* were present and assisted in making the observations.

District of Columbia Improvements Postponed for War Work

Engineering and construction forces of the District of Columbia will be transferred as far as feasible from district improvements to Federal war construction, according to a recent decision of the district commissioners. It is hoped that the labor shortage in Washington will be relieved soon enough to permit the district expenditures for construction authorized in the appropriations for the current year.

Typhoid Carrier Causes Epidemic

Presence of a "typhoid carrier" in a farm dairy caused a recent typhoid epidemic at Wheaton, Ill., with three deaths. The state authorities and the typhoid expert of the Chicago Health Department were called in by the local health officer. Tests of milk sent from this farm to Chicago were satisfactory, as pasteurization of such milk is required.

Distinguished Service Crosses for Engineer Officers

In the list of officers and men to whom the Distinguished Service Cross has been awarded and who have been mentioned in army orders by General Pershing, appear the names of George Winfield Kuehlman and James Stanley Colton, second lieutenants of engineers.

The order states that on the night of Aug. 5-6 Lieutenant Kuehlman was sent to make a reconnoissance of all possible means of crossing the River Vesle near Fismes. It had been reported that the Germans had all retreated from the south bank of the river, but he found that such was not the case; they were there in force. Nevertheless, such were his bravery and determination that he crossed into and through the German lines, made a full reconnoissance and returned with his report.

From Aug. 4-6 Lieutenant Colton successfully carried out a reconnoissance for the location of possible bridge sites across the River Vesle, near Fismes. He was constantly under heavy shell fire and was frequently harassed by fire from hidden machine gun nests in the town. He passed, however, beyond our furthest lines and obtained the desired information. He was wounded before his mission was accomplished, but refused to return to his battalion until he had made his reconnoissance and had been relieved by another detail.

Brockton Postpones Building Its Activated-Sludge Plant

The State Board of Health having advised further sewage-treatment experiments, Brockton, Mass., has postponed until after the war the building of its proposed activated-sludge plant. The board advised further experiments with both activated sludge and sprinkling filters of small-sized stone, the filters to be deeper than those of the present installation. H. S. Crocker is city engineer and superintendent of sewers.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

The Duluth Engineers' Club held a dinner and meeting on the evening of Sept. 9, which was addressed by Sidney J. Jennings, president, and Bradley Stoughton, secretary, of the American Institute of Mining Engineers, and Horace Winchell, mining engineer. The date of the dinner was arranged to coincide with the date of the meeting of the western group cost data committee of the President's Conference Committee on Railroad Valuation. Arrangements were made for the use of the assembly room of the Duluth Commercial Club all day on Sept. 9 for the Cost Data Committee meeting. For the benefit of the Cost Data Committee the club also conducted a trip to the Mesaba range, which required the making up of three parties, on account of difficulties in train schedules. The first party left Duluth Monday evening and the other two on Tuesday morning.

The meeting of the **American Association of State Highway Officials** which was scheduled for Oct. 7-9, in Chicago, has been postponed to Dec. 2-6.

The Southern Appalachian Good Roads Association will hold its annual meeting in Asheville, N. C., Nov. 19-21.

The Engineers' Society of Milwaukee (the Milwaukee section of all national engineering societies) held its regular monthly meeting Sept. 11 under the auspices of the Milwaukee section of the American Institute of Electrical Engineers. E. R. Shepard, associate electrical engineer of the United States Bureau of Standards, delivered an illustrated address on the work of the bureau with special reference to local electrolysis surveys.

Personal Notes

WILLIAM G. THOMPSON, state highway engineer of New Jersey and previously assistant to Gen. George W. Goethals in the building of New Jersey's highway system, has been granted leave of absence by the Highway Commission for the period of the war to enter military service. It is stated that Mr. Thompson will probably receive the rank of lieutenant colonel.

H. H. RUSSELL, assistant division superintendent of the Pennsylvania R.R. at Pittsburgh, has been appointed division superintendent at Williamsport, Penn., succeeding H. P. Lincoln, who has been made special agent at Williamsport. Mr. Russell entered the service of the Pennsylvania in 1895 as rodman, and became successively trainsitman, assistant supervisor, supervisor, division engineer and assistant division superintendent.

L. H. GOEBEL has resigned as superintendent of filtration and chief chemist of the water filtration plant of the Union Stockyard and Transit Co., Chicago, to become associated with the engineering staff of the Wallace & Tiernan Co., manufacturer of chlorine control apparatus and sanitary engineering specialties. Mr. Goebel's headquarters will be in Chicago.

A. DANIELS has been appointed district engineer of the northern district of the Chicago, Milwaukee & St. Paul Ry., with offices in Minneapolis.

A. S. CLARSON has resigned his position as city engineer of Verdun, Que.

C. ARTHUR POOLE, city engineer of Rochester, N. Y., has received a commission in the Engineering Corps, U. S. Army, as a captain.

W. R. POWRIE has resigned as district engineer of the Chicago, Milwaukee & St. Paul Ry. at Minneapolis, Minn.

F. C. BLACK, city engineer of Hoquiam, Wash., has resigned to become instructor of mathematics in the Oklahoma City schools. He has been succeeded by William L. Lovejoy, of the engineering department of Aberdeen, Wash. Mr. Lovejoy served a previous term as city engineer of Hoquiam.

GEORGE C. D. LENTH, assistant chief engineer of the Board of Local Improvements, Chicago, has entered on Government work as engineer for M. J. Corboy, who has the contract for installing the water and sewer systems at the Field Artillery Firing Center at Stithton, Ky.

T. R. BURKE has been appointed engineer in charge of highway improvements in the Lewisburg, West Virginia district, succeeding Frank K. Rader, county road engineer, who has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

R. B. BALL has been appointed chief engineer of the coast lines of the Atchison, Topeka & Santa Fé Ry., with office at Los Angeles, Cal. He succeeds G. W. Harris, now chief engineer of the Atchison, Topeka & Santa Fé Railway system and his former position as engineer of a grand division has been abolished.

HUGO E. SURMAN, district engineer for the State Highway Division of Illinois in District No. 2, with headquarters in Moline, has received additional charge of District No. 1. The Moline office is being closed and the two offices are to be consolidated at Aurora for the duration of the war.

WLLIAM BOWIE, hydrographic and geodetic engineer and chief of the Division of Geodesy of the United States Coast and Geodetic Survey, has been commissioned as major in the Corps of Engineers, and assigned to duty in map-making work.

HARRY B. HOMMON, sanitary engineer, United States Public Health Service, has been commissioned as captain in the Sanitary Corps, United States Army.

T. T. IRVING, division engineer of the Grand Trunk Ry. at Chicago, has been appointed chief engineer of the Grand Trunk Western Lines, with headquarters in Detroit.

BURTON J. ASHLEY, sanitary engineer, Chicago, has been engaged for and is now making a sanitary survey of the mining town of Benham, Ky., with reference to improving the water-supply and disposal of sewage, and outlining a sanitary program for the town.

MELVILLE C. WHIPPLE, instructor in hygiene and sanitation, Harvard University, has been commissioned as captain in the Sanitary Corps, United States Army.

CURTIS S. GILES, for the past four years city engineer of Crookston, Minn., has become acting city engineer of Grand Forks, N. D., and will carry on the engineering work of the city in conjunction with Prof. E. F. Chandler, head of the Engineering Department of the University of North Dakota, who has been named city engineer.

AUGUSTUS HUNT, assistant city engineer of Minot, N. D., has been appointed city engineer of Crookston, Minn., succeeding Curtis S. Giles, resigned to become acting city engineer of Grand Forks, N. D., as noted above.

J. H. BROOKS, JR., of the engineering department of the Norton Co., Worcester, Mass., who was previously with the Northwestern Pacific Ry., with headquarters in San Francisco, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

G. F. HAYDEN, chief engineer of the Continental, Fidelity-Phoenix, and American Eagle Fire Insurance companies since 1915, has been appointed consulting engineer and will be succeeded as chief engineer by C. W. Pierce, at present engineer of all three companies in the New England field.

GEORGE E. WILLCOMB, sanitary engineer, Albany, N. Y., has been commissioned as captain in the Quartermaster Corps and assigned to duty at Camp Dix, New Jersey, as assistant to utility officer.

SHELDON S. YATES, of the firm of Yates & Yates, consulting engineers, New York City, is now at the Field Artillery Officers' Training Camp at Camp Zachary Taylor, Kentucky.

W. H. KIRKBRIDE, assistant division superintendent of the Southern Pacific Co. at Sacramento, Cal., has been appointed chief engineer, succeeding William Hood, who, it is understood, will remain with the Southern Pacific's outside properties, including the Southern Pacific de Mexico. Mr. Kirkbride was graduated from Stanford University in 1895. For three years thereafter he was in private engineering and with a United States deputy mineral surveyor. In 1898 he became assistant chief engineer on the location and construction of the Sierra Railway of California, remaining on this work until 1902. He entered the service of the Southern Pacific in 1903 as assistant engineer. From 1904 to 1906 he was roadmaster; from 1906 to 1909, assistant division engineer. In 1909 he was made division engineer at San Francisco, two years later was transferred to Sacramento, and subsequently was made assistant division superintendent.

OBITUARY

CAPT. O. L. CAMERON, of the Canadian Expeditionary Forces, died recently in France from wounds received in battle. Until the time of his enlistment Captain Cameron was in charge of waterway surveys for the water-works department of the city of Toronto. He was a graduate of the School of Practical Science, Toronto, class of 1913. He enlisted with the 208th battalion, but was transferred to the 54th battalion and reverted to the rank of lieutenant in order to hasten his departure for France. He was again advanced to the rank of captain shortly before his death.

CAPT. OSCAR LLOYD HOUSEL, 38th Regiment of Engineers, U. S. A., died Aug. 19 from pneumonia, contracted while his regiment was extending railroads into the newly regained territory of the allies. Captain Housel was 43 years old and was a graduate of the University of Illinois. On leaving the university in 1898 he was commissioned as first lieutenant and fought in the Spanish-American War.

LIEUT. J. IVAN DAPPERT, engineer and son of James W. Dappert, consulting engineer, Taylorville, Ill., who has four other sons in the army, was killed in action on the western front Aug. 11. He was 31, and recently received a commission in the 132nd U. S. Infantry. His early engineering experiences were as assistant in his father's office, on private and Government dredging work, foreman on railroad work in Texas, and concrete construction in California. He was prominent in labor circles in that state, being at one time state secretary of the American Federation of Labor. He was also a member of the Illinois Society of Engineers.

CHARLES A. MILLER, city engineer of Oregon City, Ore., for the past three years, died suddenly Aug. 22. Mr. Miller was born in Centerville, Iowa, in 1861. He went to the Pacific Coast many years ago and was engaged on engineering projects in Oregon for about 25 years. He had charge of the construction of the Willamette Falls Ry. line and on its completion became superintendent, which position he held for more than 20 years, until the line was purchased by the Southern Pacific.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Four Classes of Industrial Priority Named by War Industries Board

Intended as Selective Mobilization of Industry for Winning War Rather Than as Embargo on Those Not Listed

Four priority classifications for industry have been issued by the War Industries Board. The classification will act as a selective mobilization of industry to aid in winning the war and it is stated that the list is elastic and will not act as an embargo on those industries not mentioned. In this connection the bulletin announcing the list states that the preference list is made up of industries and plants which in the public interest are deemed entitled to preferential treatment. The effect of the inclusion of these industries and plants on the list will be to defer the requirements of all other industries and plants until the requirements of those on the preference list shall have been satisfied. While it is very necessary that high ratings be made in order to stimulate production to meet the abnormal demand or depleted supply of war requirements, some ratings will be made on products the intrinsic importance of which may be less than those in lower classifications, on account of the fact that the supply of the products of higher value is already meeting the demand without the stimulus of high priority. The aim, it is further stated, is a well-balanced production program including all the important factors.

The four classes are summarized as follows:

CLASS I

Plants principally engaged in producing aircraft, supplies and equipment, ammunition for the United States and the allies, ordnance and small arms for the United States and the allies, chemicals for explosives, ammunition and aircraft used in chemical warfare, metallurgical coke and by-products, including toluol, explosives for military purposes, feed for livestock and poultry, food, including cereals and cereal products, meats, including poultry, fish, vegetables, fruit, sugar, syrups, glucose, butter, eggs, cheese, milk and cream, lard, lard compounds, oleomargerine and other substitutes for butter or lard, vegetable oil, beans, salt, coffee, baking powder, soda and yeast, and ammonia for refrigeration, fungicides, oil and natural gas for fuel or mechanical purposes (including pipe lines and pumping stations), toluol (gas plants), ships, other than pleasure craft or vessels not built for the United States or the allies or under license of the Shipping Board; steel plants, plants producing solely steel ingots and castings by the various processes; domestic consumers of fuel and electric energy for residential consumption, including homes, apartment houses, residential flats, restaurants and hotels; coal mines, arsenals, cantonments and camps of the army and navy yards, railways operated by the United States Railroad Administration, maintenance and operation of ships, excluding pleasure craft not common carriers and maintenance of public buildings used as hospitals or sanitariums.

CLASS II

Plants principally engaged in producing locomotive or traveling cranes, rolling and drawing copper, brass and other copper alloys, coke not otherwise classified and listed, ferro alloys, machine tools and wire rope, blast furnaces producing pig iron, steel rail mills (producing rails over fifty pounds a yard), construction work of the war or navy departments in embarkation ports, harbors, fortifications, flood protection operations, docks, locks, channels, inland waterways and in maintenance and repair of same, mines producing metals and ferro alloy minerals, street railways, electric lighting and power companies, gas plants not otherwise classified, telephone and telegraph companies, water supply companies and like general utilities, railways not operated by the United States, excluding those operated as plant facilities.

CLASS III

Plants engaged principally in producing food not otherwise listed, not including soft drinks, confectionery and chewing gum, ice, mining tools and equipment, equipment and supplies for producing or transporting oil or gas for mechanical purposes, iron and steel chains, electrical equipment, explosives not otherwise listed, tin plate, and small or hand tools for working wood or metal, fuel and electric energy for domestic consumers not otherwise listed, steel rolling and drawing mills not otherwise listed, maintenance of public buildings other than those used as hospitals and sanitariums.

CLASS IV

Laundries, plants engaged principally in producing and manufacturing hemp, jute and cotton bags, manufacturing chemicals not otherwise listed, medi-

(Concluded on page 517)

All German-Owned Industries To Go Under Hammer

Holdings Amounting to $600,000,000 to be Sold to Break German Grip on American Trade

All industrial plants and other industries owned by alien enemies are to be sold at public auction. No secret sales will be made except by order of President Wilson, and he will not order such to be done without positive evidence that such action is absolutely necessary for the public welfare. These announcements were made by A. Mitchell Palmer, alien property custodian, at a recent luncheon with New York editors. He further stated that if Congress will take the action on certain plans which he recommends the proceeds of these sales may amount to more than $600,000,000, and will go toward paying the claims of Americans against the German Government immediately instead of waiting for adjustment at the peace conference.

Mr. Palmer stated that the alien-owned property in the United States was being divided into two distinct classes. One class contains the small investments made by individuals in Germany who had bought American securities with their savings. The other class contains large plants and extensive financial operations which show plainly a widespread and deeply-laid plan of invasion of American industrial life, with the clear intention of domination. The ramifications of this German industrial invasion were so far-reaching and complete that when brought to light so as to reveal their true intent they proved to be extremely startling, said Mr. Palmer.

The first intention of the Trading with the Enemy Act was to have this property taken in trust by the alien property custodian, and the properties operated or managed so that the financial returns would continue to flow and would be deposited in the United States Treasury. The properties were to have been held intact for possible return to the owners after the war. These properties were found to be very lucrative and under the industrial activities of today were becoming more and more valuable. Consequently, Mr. Palmer recommended and Congress passed an amendment whereby the German owners would not benefit by the prosperity these industries now enjoy. Mr. Palmer announced that if he will have sufficient time before the end of the war all of these industrial holdings will be so completely disposed of that it will be impossible for the German financiers to recover even a vestige of their former power. At the auction sale every

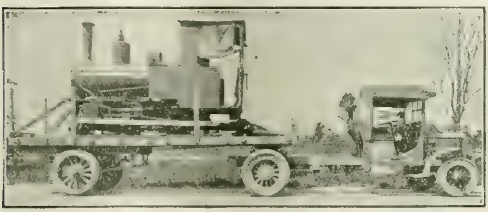
purchaser will be thoroughly scrutinized and every possible precaution taken to prevent the property from reverting to its original owners.

The alien property custodian's force is today the greatest trust corporation in the United States, stated Mr. Palmer, the total value of the properties now being held in trust amounting to more than $600,000,000, and perhaps even to $1,000,000,000.

Motor Truck and Trailer Solve Transportation Problem

A problem recently confronting the road commissioners of Wayne County, Michigan, for transporting materials and equipment to remote portions of the county was solved by the use of motor trucks and trailers. The largest item was the hauling of an industrial locomotive weighing 10 tons.

The scarcity of freight cars, with embargoes, etc., making the transportation of supplies for road work in various parts of the county difficult, caused the Wayne County commissioners to study every possible means of relief. From their base at Wayne they are compelled to haul supplies and equipment to the farthest sections of the county and are often rushed to keep supplied the several crews of road workers. The commissioners state that the varied nature of these supplies and the long hauls presented a problem that was complex. One of these outfits is shown in the illustration and consists of a 10-ton, Fruehaus, semi-trailer manufactured by the Fruehaus Tailer Co., Detroit, Mich., used with a four-ton motor truck.



TRUCK AND TRAILER IN HIGHWAY WORK

Hospital Plans Not to Interfere with Chemical Exposition

The plans of the United States to convert the Grand Central Palace, New York City, into a base hospital will not interfere with the Fourth National Exposition of Chemical Industries to be held there Sept. 23-30, according to information received from the chemical industries. The report states that 350 exhibitors have signed contracts to date for space, which means that all of the floor space will be filled.

It is said that high officials of the Government consider the exposition of such importance that they do not desire to interfere with its success.

Priority Classes Named

(Concluded from page 516)

cines and medical and surgical supplies, fertilizers, fire brick, gray iron and malleable iron castings, food containers, insecticides and fungicides, soap, tanned leather and tanning extracts, cotton and woolen textiles, including spinning, weaving and finishing cotton and woolen knit goods, textile machinery, binder twine and rope, plants engaged exclusively in manufacturing boots and shoes, plants engaged exclusively in manufacturing pulp and paper, cotton compressing, plants engaged principally in producing newspapers or periodicals which are entered at the post office as second class matter, plants preserving, drying, curing, packing and storing tobacco, but not for manufacturing and marketing.

In compiling the list, plants and industries have been divided into the four classes according to their relative importance. In determining the relative importance, consideration has been given to the following factors: (1) the intrinsic importance of the product for war use and the urgency in point of time for the demand of this use; (2) the necessity for increasing the total quantity of production, depending upon the relation of the supply to the demand for essential uses; (3) the proportionate capacity of the industry or plant devoted to the production of the essential product.

Under certain circumstances, it is stated, individual plants have been found to be entitled to preference, although the general industry to which they belong is not, and in other cases where an industry has been accorded a degree of preference, particular plants might be placed in a higher order. This has made necessary the classifying and listing not only of industries but to a certain extent of individual plants, and where it has been found to be necessary to speed up the production of a particular product required at a particular time in connection with some important program, a high priority will be given although changing conditions may thereafter demand a reclassification. Certain plants produce commodities of great relative importance, but at the same time produce other commodities of less relative importance, and under such conditions weight is given to the ratio of production between the more and less important commodities. Instances may arise where a plant may be given preference on account of a local public demand for a particular service, although taking the country as a whole the supply of that product is ample to meet demands.

It is announced that requirements of industries in Classes II, III, and IV will in general have precedence over those not appearing on the list. As between these three classes, however, there will be no absolute preference, the division into classes being for the purpose of presenting the relative importance of the industries and plants in each group. It is not intended that the requirements of any of the higher groups shall be fully satisfied before supplying any of the requirements of the following, but should there be a threatened shortage in the supply of labor or raw material the higher classifications will be served first and those following will be served from a possible surplus.

Business Notes

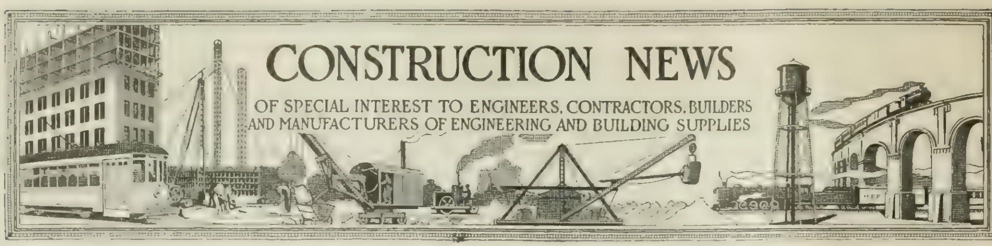
The La Salle Portland Cement Co., La Salle, Ill., which was reported as doing a business approximately $3,000,000 a year, has been taken over by A. Mitchell Palmer, alien property custodian, on the ground that 72 per cent. of its stock is held in Germany. A recent note in *Engineering News-Record* announced that the company had changed its name from the German-American Cement Co. to that given above.

The Chicago Pneumatic Tool Co. announces that contract has been let and work started on the erection of an addition to its Cleveland plant. It is expected that work will be completed on the building itself about Nov. 1. The equipment, it is believed, will be ready for installation by the time the building is completed.

Trade Publications

Northwestern University devoted one of its weekly bulletins to the descriptive, the courses of study and other information regarding the evening classes in the school of commerce for 1918-19. The schedule of subjects suggested for the present school year, which may be modified on account of war conditions, is as follows: Business administration, accounting, advertising and selling, banking and finance, factory management, foreign trade, public service, secretarial work, transportation.

The Permanent Highways Corporation, 50 E. 42nd St., New York City, has issued a 20-page pamphlet, 6 x 9 in., on its "National" pavement, composed of bitumen and finely pulverized earthy material mixed by the company's machines.



Building Work Shrinks More Than Half Since 1914

Totals of Contracts let Measured by Increased Circulation of Money Shows Rapid Decline

A comparison of building operations in the United States since 1910 shows approximately constant figures until 1917 when rapid decline in value occurs. In spite of the large Government contracts that have been let since the declaration of war in 1917, the total for 1918 at the present rate will be less than half that of 1914 and less than one-third that of 1916.

The total contracts let the first seven months of 1918 throughout the United States as compiled from the Construction News Section of *Engineering News-Record* amounts to approximately $416,000,000. The building permits issued for twenty of the largest cities of the United States amount to approximately $161,000,000, making a ratio to the total work of 1 : 2.58. Applying this ratio to the building permits issued by the twenty large cities from 1910 to 1917 inclusive, the totals amount to approximately $1,393,000,000 for 1910; $1,388,000,000 for 1911; $1,429,000,000 for 1912; $1,287,000,000 for 1913; $1,194,000,000 for 1914; $1,302,000,000 for 1915; $1,605,000,000 for 1916; $1,029,000,000 for 1917 and at the rate of $416,000,000 for 7 months of 1918—$710,000,000 for the year.

Owing to the increasing amounts of currency in circulation, costs of materials and labor have risen so rapidly that an equitable comparison is impossible without this factor. Prior to 1916 the average per capita money circulation was approximately $34.50; in 1916 it was $39.34; in 1917, $45.64, and for the first seven months of 1918, $49.67. Multiplying the totals of the years of 1916-17 and 18 by the ratio of the per capita circulation prior to 1916 to that afterward will give totals that can be compared to the pre-war figures on a more equal basis.

The per capita ratio for 1916 is $(34.5 : 39.3) = 0.88$; that for 1917 is $(34.5 : 45.6) = 0.76$, and for 1918 is $(34.5 : 49.7) = 0.69$. Multiplying the volumes of business given above by the corresponding ratios gives $1,412,000,000 for 1916, $768,000,000 for 1917 and $499,000,000 for the whole of 1918 at the rate of the first seven months.

Of the total of $416,000,000 for contracts let reported in *Engineering News-Record*, $200,000,000 is work by the Federal Government; $147,000,000 is for the construction of industrial plants, and $69,000,000 is for non-industrial work.

Federal Government work is rapidly reaching its limit because the period of construction is giving way to the period of production and this holds true to a large extent with industrial plants. On the other hand, the scarcity of labor and raw materials has become such that the Priorities Committee has found it necessary to protect the supply by still more stringent rules. A pledge is now exacted from all applying for priorities on building materials wherein the manufacturer must guarantee that none of the materials sold shall go into any construction other than that contributing directly toward winning the war. The manufacturers say that it is impossible to obtain such a pledge. Each contractor having an unfinished job must get his priorities from the commissioner in order to permit the manufacturers to sell goods to a dealer who supplies the contractor.

A committee of building material manufacturers from the New York district were in conference with Washington authorities recently and pointed out that building operations in their district had declined more than 30% the past months on the one hand and that the demand for housing such as commercial, residences and storage had increased abnormally due to the large number of Government requisitions.

The National Federation of Building Industries, in a memorandum sent to the War Industries Board, has recommended that action by the Government be taken establishing a definite point of contact between the Government and the building industry and suggest the creation of a Governmental unit or board with which the builders may deal. Such a unit, they point out, could coördinate all functions involved, for the benefit of the Government and the industry.

Continuing, they point out that at present the building industries are subject to the actions of no less than six administrative agencies:

1. War Industries Board Priorities Committee.
2. War Industries Board, Resources and Conversion Section.
3. The Railroad Administration.
4. The Fuel Administration.
5. U. S. Employment Service of the Department of Labor.
6. Capital Issues Committee of the Federal Reserve Board.

PROPOSALS

For Proposals Advertised See Pages 51-53 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Sept. 17	Missouri City, Ia.	Sept. 12
Sept. 20	Tulsa, Okla.	Sept. 12
Sept. 20	Akron, O.	Sept. 12
Sept. 25	Okmulgee, Okla.	Sept. 12

SEWERS

Sept. 13	New York, N. Y.	Sept. 12
Sept. 18	Lakewood, O.	Sept. 12
Sept. 19	Boston, Mass.	Sept. 5
Sept. 19	Garrett, Ind.	Sept. 12
Sept. 19	Fairmont, Minn. Adv. Sept. 12.	Sept. 12
Sept. 24	Macon, Mo. Adv. Sept. 12.	Sept. 12
Sept. 26	Chicago, Ill.	Sept. 5
Oct. 10	Cleveland, O.	Sept. 12

BRIDGES

Sept. 16	Lawrenceville, Va.	Sept. 5
Sept. 16	Fairport, O.	Sept. 12
Sept. 16	Lincoln, Neb.	Sept. 12
Sept. 18	Buckhannon, W. Va.	Sept. 5
Sept. 24	Greensburg, Pa.	Sept. 12
Sept. 25	Meadville, Pa. Adv. Sept. 12.	Sept. 12
Sept. 30	Eldora, Ia.	Sept. 12

STREETS AND ROADS

Sept. 13	New York, N. Y.	Sept. 12
Sept. 16	New Mexico.	Aug. 8
Sept. 16	Chicago, Ill.	Sept. 12
Sept. 16	Idaho	Sept. 12
Sept. 17	Granite Falls, Minn.	Sept. 5
Sept. 18	Uniontown, Pa	Sept. 5
Sept. 18	St. Clair Heights, Mich.	Sept. 12
Sept. 18	Chicago, Ill.	Sept. 12
Sept. 18	Key West, Fla.	Sept. 12
Sept. 20	Cincinnati, O.	Sept. 12
Sept. 20	Taylorsville, N. C.	Sept. 12
Sept. 21	St. Peter, Minn.	Sept. 5
Sept. 22	Pocahontas, Ark.	Sept. 12
Sept. 24	Wabasha, Minn.	9ug. 29
Sept. 24	Harrisburg, Ark.	Sept. 5
Sept. 25	Pennsylvania. Adv. Sept. 12.	Sept. 12
Sept. 26	Williamson, W. Va.	Sept. 5
Sept. 30	Greensburg, Pa.	Sept. 12

EXCAVATION AND DREDGING

Sept. 16	Bradentown, Fla.	Sept. 5
Sept. 17	Albany, N. Y. Adv. Aug. 22 and 29 and Sept. and 12.	Aug. 22
Sept. 17	Brownsville, Tenn.	Sept. 12
Sept. 17	Caruthersville, Mo.	Sept. 12
Oct. 2	Charles City, Ia.	Sept. 12
Oct. 8	Albany, N. Y. Adv. Sept. 12.	Sept. 12

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

September 19, 1918

Twin Traveling Concrete Towers on Pier Shed at Boston Army Base

Kreolite Lug Wood Blocks

"The Paving that's Saving"

The "Block that's Better" is on the Map.

100% Efficient

Under all kinds of traffic and climatic conditions, the Lug is the factor of safety. It absorbs the stresses of expansion and prevents buckling; permits filler to penetrate the full depth of the block on all sides; prevents the Kreolite Oil from being squeezed out of the block. Get these advantages in YOUR pavement.

"The Lug Makes a Good Block Better."

THE JENNISON-WRIGHT COMPANY

2479 BROADWAY, TOLEDO, OHIO

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, Editor — Charles Whiting Baker, Consulting Editor

Volume 82 — NEW YORK, THURSDAY, SEPTEMBER 19, 1918 — Number 12

Liberty Speaking

SYMBOLIC of the universal call and its nature is the poster heralding the Fourth Liberty Loan included with this issue. Liberty speaks to all. The response should be equally universal.

Thirteen Million Strong

EXPECTATIONS were realized in the largeness of the selective draft registration last Thursday, which reached a total of about 13,000,000. The country gladly gives men to the speedy winning of the war. It is a grim sort of rush American job on which the more force and speed used the fewer the lives we will lose and the greater the number we will help save. Altogether, then!

Spoilsmen Threaten the Next United States Census

ACCURACY, completeness, expedition, will be doubly essential in the 1920 census on account of the bearing of its data on reconstruction problems. The House has passed a bill which by letting down the bars to spoilsmen threatens the value of the next census. The Senate should be urged by engineers and engineering societies to see that the bill contains adequate civil service provisions.

Is Railroad Stock Watered?

IS RAILROAD stock watered? The first final valuation of the Interstate Commerce Commission, that of the Texas Midland R.R., scores one point for the negative side of this argument. Three cost figures for this road range from $2,850,000 to $3,700,000, as compared with a capitalization of only $2,112,000. Nor does the income account show the squeezing out of water through excessive profits; on the contrary, the annual net income has been more often negative than positive. The importance of the Texas Midland case rests solely on the fact that its was the first valuation completed. But those who cry that all railroad stock is watered cannot use this first valuation as evidence.

A Higher Plane for Society Sections

RECENT formation of a joint council representing five San Francisco sections of national engineering societies places those sections on a higher and broader plane of usefulness. Of late local sections have been growing in importance and influence, particularly in western territory where members are too far from headquarters to feel that local conditions could be thoroughly understood by the parent society, and now it is not unusual to find members of really live sections feeling that they derive more benefit from the local than the national body. Certain it is that the local organization can do effective and much needed work for the advancement of the profession. A section organized and officered so that it can grasp and successfully cope with local problems involving the betterment of conditions under which the profession works is of far greater benefit to its members than one which limits its activities to technical discussions. The sphere of the engineer is rapidly broadening, and to keep abreast of the times the technical society must likewise adopt a broader viewpoint and render service in keeping with the real needs of the engineer. The program of the San Francisco Council outlined on p. 558 indicates a realization of this fact.

War Economy Promoted by Resourcefulness

IN DIRECT response to the demand of the times, economy of the kind realized in the construction of the bridge described on p. 538 of this issue represents valuable engineering work. Our national equipment is increased whenever discarded, old material is utilized in productive service; the material and labor saved add to our stock for the time being just as surely as though an equivalent amount had been created. There is need and opportunity for many similar economies, now that war service, having enlisted the full output of mine, mill and shop, yet calls for more. To provide the increased productive capacity which is everywhere demanded, new construction is imperative. But this means that material and the use of manufacturing facilities must be secured—a more difficult task just now than finding the necessary money credit. Using old material offers a way out of the difficulty. It is dependent, however, on careful planning. The engineer's resourcefulness is of greater value here than mastery of standard forms of design.

One of War's Good Byproducts

PORT development in the United States in the early years after the war must be rapid and sure enough to provide ample accommodations for our new merchant marine. This is axiomatic; but it is hard to arouse local energy or to find local funds sufficient to start the work now. Some few ports are doing so. New Orleans is well along on its own project and Seattle has just voted bonds for an ambitious development of its already worthy accommodations, but most of the cities practice a familiar procrastination. "Sufficient unto the day" remains the municipal motto. In some of them, fortunately located for war transportation, the Federal Government is solving the problem by the construction

of army supply depots. Boston, New York, Newark and Charleston, for instance, will find themselves after the war in possession of elaborate terminal port warehouses far outdistancing any present accommodations and fitted admirably for peace-time operations. The control of such terminals—whether it be Federal, state, municipal or private—is among the many post-war problems to be solved, but the benefit of having such facilities ready to hand would be one of the few good things incidental to the war.

Unification and the Railroad Contract

JUST what the owners of the railroads are to get as a result of the taking over of their properties by the Government is still undetermined. True, what Director General McAdoo asserts is the final form of the contract has been given forth, and the Railroad Executives' Advisory Committee endorses it. The National Association of Owners of Railroad Securities does not, however, and so long as it holds to its present attitude—not to oppose the Government's operations in any way, but merely to insist on leaving open for the courts to decide who shall pay the bills and the damages—it seems to have the better of the argument.

Unification and the preservation of each railroad's integrity are incompatible. Much, according to the Director General's report to the President on the first seven months of Government operation, has been accomplished in the way of unification, but this much is only a beginning of what is possible if the roads are in truth to be treated as a single vast railroad system. Roundabout routes that have been painfully developed to give carriers a chance at traffic on which they had no rational claim are already going into the discard; and on the other hand, lines which had only secondary value to the properties of which they were part are being combined with secondary lines of other properties to form very useful routes. Merely a hasty glance at the maps in the railway guide will reveal the haphazard way in which some companies have pursued their policies of annexation, while a more careful comparison of the maps will reveal how effectively some of the misfit lines could be traded off to other companies. And this trading is being done by the Government for the period of the war. It is an essential part of unification, and the longer the war lasts the more revising of the maps in the railway guide will take place, the more diversion of traffic from uneconomic routes will be made, and the more nearly impossible it will be to return the properties to their owners as they were before the war.

Possibly the security holders themselves were the first to realize the extent to which ostensibly temporary control could change the railroad map. At first it seemed that in their zeal to protect themselves they were trying to deter the Railroad Administration from effecting the economies of unification. If they were they have abandoned that plan. They now submit to whatever mutilation of their properties is necessary for winning the war, and ask only that they be permitted when they have seen the results to lay their cases before the courts. If their properties are to come back to them they want the right to claim compensation for whatever, including traffic, does not come back. If the Government is to retain them permanently they do not want going value that has been destroyed during the period of the war to be thrown out of the reckoning without the right of appeal to the courts. Also, they do not wish to pay present-day high prices for improvements of which the Government will get the sole benefit during the war—improvements they might not need at all after the war, but could perhaps, if required, build much cheaper then. Their contentions seem reasonable.

There is another argument for granting their demands. While whatever is needed for winning the war should be done, it should not be forgotten that the owners are still the owners, though their property was taken away from them almost overnight, and every care should be taken to avoid *unnecessary* damage to that property. And unnecessary damage is more likely to be avoided if the door is not barred to the presentation of claims for damage.

Whether the courts would award damages for traffic diverted and good will destroyed—that is a very different question. It may be argued that a traffic which could not justify itself to the Railroad Administration, and was turned to other lines in the interests of economy, was worth nothing, and that the cost of developing it was money thrown away. That question, with all of the other points, the courts could decide—after the event.

It may still be argued that the owners are under no compulsion to sign the contract at all. But there is general agreement that in most respects the contract admirably covers the situation. With the whole matter in suspense the owners would not be much better off than if tied to a contract that gave them a large part of what they sought.

Water Taste Problem Serious at Milwaukee

APPRECIATION of the necessity of safeguarding a city against contaminated water by disinfection is yet far from being universal. This was brought out most clearly in Milwaukee recently in an open hearing on the subject of increased typhoid incidence and water taste. The hearing was before the local Board of Health and was attended by representative business men and officials of the Association of Commerce. The latter suggested boiling by the consumer in place of sterilizing at the pumping station, so as to get away from the taste, little realizing the almost impossible task of educating everybody to drink boiled water only. The Milwaukee situation is unusual. Gas house wastes combined with the chlorine make such a disagreeable taste in the water that complaints almost overwhelm the water-works officials. Dr. Ruhland, health commissioner, stated that recently an employee at the pumping station, to whom complaints had been made, eliminated the chlorine application for a 12-hour period, but a system of checks had been devised so that this could not happen again. Gas company officials, who attended the hearing, promised to cease discharging the wastes from their plants into the lake after Dr. Ruhland had demonstrated that a combination of gas house waste, chlorine and spring water in the same proportions as in the city water gave the same disagreeable tastes. Milwaukee appro-

priated $30,000 not long ago for experiments in water filtration. The results, conclusions and designs for a purification plant can come none too soon.

Defining Shortage Would Help

THERE is plenty of bad feeling in industrial and construction circles which would not exist if there were a more general understanding of what is meant by "shortage" of materials or transportation of labor by the federal officials who are trying to apportion these vital resources among governmental and private applicants. It is exasperating for a manufacturer who wishes to fill a contract from material in stock to be told to keep that material because essential war-time work requires it. He knows nothing of government orders in prospect and can learn nothing about them. The government merely says that the whole output must go to swell the already large stock because there is a "shortage."

The explanation of this situation, such as it is, is that only those persons who are actively engaged in allocating our country's products on the basis of the estimated war-time requirements and civilian needs can form any idea at all of the relation between future demands and probable future supplies. The men who are dealing with priorities in Washington receive from the War and Navy Departments, the Allied Purchasing Board and the Emergency Fleet Corporation notices of the materials they will need months ahead of the dates when deliveries must be made. These requirements mount up to staggering totals, as the little information the officials give out from time to time shows. Probably these imposing total requirements affect their judgment of what can be given for civilian needs, for they are primarily concerned with the things that will win the war and private needs necessarily occupy a secondary place in their thoughts. It is unfortunate that this is so, but it would take a superman to think otherwise when harassed with war essentials. And as a result of this, all through the summer, work has been checked on account of "shortage" although nobody connected with the work could see the slightest lack of anything for the orderly prosecution of the undertakings.

It is unfortunate that those who have official knowledge of these future shortages have been unwilling to speak more openly and clearly about them, because the absence of any information regarding their reasons for closing down work when money, materials and labor were apparently available for it makes their orders seem like the decisions of persons having authority but lacking judgment. Such explanations as have been given out generally indicate that the "shortage" which is most feared is that of fuel, and consequently materials which require fuel in their production should be used with the utmost economy and be replaced by those requiring less fuel, so far as possible. Even this explanation is not made officially by any board having authority to speak, but merely exudes occasionally from some harassed official, as a sort of generally accepted principle governing the attitude of those who are applying brakes to public and private works which those in charge can see no reason for checking.

A clear statement of the actual condition of the labor and material fields, as seen by the officials who are stopping work on account of shortages which cannot be seen by those not in official position, would be welcome. The generalities occasionally given out to the press by publicity departments without any knowledge of the information desired by men engaged in industries and construction are calculated merely to exasperate these men, because the assertions made concerning the shortages which are the reason for restrictive action do not agree with the facts as they see them.

Will Denver Justify Municipal Ownership of Its Water-Works?

DENVER having achieved municipal ownership of water-works after years of effort it is now incumbent upon the city government and the newly created water board to see that the city has at least as efficient a water service as was furnished by the company which it so much desired to eliminate.

Water-works efficiency includes quality, quantity, pressure, prompt extensions of mains and provision of new services where needed, courteous and fair dealings with consumers and economy of operation. We pass no judgment upon the efficiency of the Denver water-works under private ownership, nor do we question the possibility of efficiency under municipal ownership at Denver or elsewhere. There are pitfalls to be avoided under either form of ownership.

Chief among dangers at Denver and elsewhere under city ownership are that sinister political rather than sound business considerations will govern the selection of the working force, the manifold operations of the works, and particularly financial policies and methods, including rate fixing and accounting. Under city ownership it is too easy and too common to curry popular favor by lowering water rates unduly, juggling or neglecting the accounting system so as to blind the fact that a considerable part of the burden of providing a public water-supply is placed on the shoulders of the tax-payers—present or future—instead of upon the water consumers. Or, yielding to other considerations, the taxpayer may be spared by putting the burden of a water-supply for public purposes wholly upon the water consumer.

Much depends, at Denver and elsewhere, upon the chief executive and his staff chosen to operate the water-works. But it is not enough to choose able men. They must be given a reasonably free hand and have the backing of the city government, the water consumers and the citizens generally.

In war time, particularly, no municipal service is more vital than water-works. Denver has achieved its desire of years to own and operate its works. It is doubly imperative just now that it, as well as other water-works in the country, should be operated with efficiency, which includes economy and due regard to the interests of consumers and taxpayers. Under these circumstances, and as the latest example of change from private to public ownership of water-works in a city of considerable size, many eyes will be turned to Denver when it assumes ownership and operation of the water system.

Boston Army Supply Base Will Be Valuable Permanent Port Terminal

Built at Record Speed for Storage of Military Supplies, But Will Remain as Radical Improvement of Port Facilities After the War—Sixty Acres of Storage Space Provided in Waterside Buildings

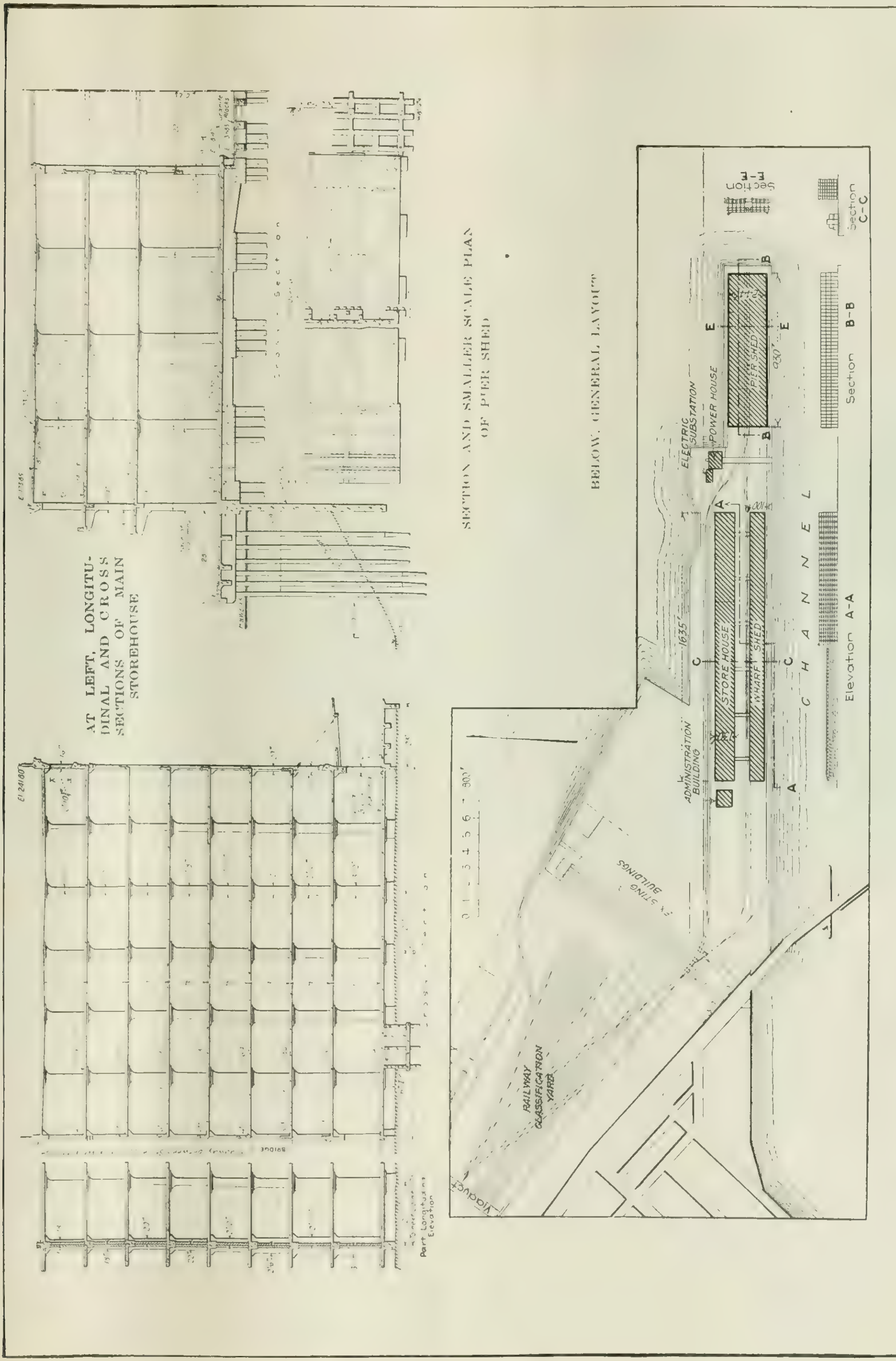
LOOKING AT THE OUTER END OF THE 1638-FOOT LONG STOREHOUSE UNDER CONSTRUCTION AT THE NEW BOSTON ARMY SUPPLY BASE

ARMY port terminals to store and handle the vast quantities of supplies required by the overseas forces are being built in several of the Atlantic and Gulf cities. Some of these are of the one-story timber-shed type, spreading over a large area and requiring entirely horizontal transportation in handling freight. In construction and layout such terminals are temporary, though in all probability they will remain in use many years in such ports as require their service. The larger army terminals, however, have multi-story concrete warehouses and transfer houses with waterside connections, and although they are being built under forced pressure for immediate war use they are of such design as will make them a most valuable part of the necessary post-war facilities in the ports where they are located. In this latter class is the new Boston army supply base.

The site of the new terminal is a formerly unoccupied area in the harbor of Boston. Its long side borders on a channel now having a usable depth of about 30 ft., and its far end projects toward the 35-ft. main ship channel of the harbor, forming a pier-like area with deep-water frontage on the two sides and the end. The shore end of the lot is convenient to trunk-line railroads and has sufficient area to permit of the layout of a large railway yard leading up to the warehouse section. When the army entered upon the property the water lines were marked by wooden bulkheads which were not coincident with the new bulkhead lines required, so that considerable filling and dredging have been required to delimit the area shown on the accompanying drawing. Furthermore, the channels adjacent to the terminal were nowhere near the required 35-ft. depth, and dredging to the extent of some 2,800,000 yd. will have to be completed to make the terminal accessible at all places to deeply laden vessels.

The principal structures of the base are the main storehouse, the wharf shed and the pier shed. The main storehouse is an eight-story reinforced-concrete building 126 ft. wide and 1638 ft. long. It is divided into six equal sections, each 126 x 273 ft., but the separations between the different sections are only structural; the building is a unit containing 1,651,100 sq.ft. of floor area. Joined to this storehouse by bridges across an 86-ft. paved street containing railroad tracks is the wharf shed, which is alongside the 35-ft. channel and accessible to and from ships lying along the wharf. This wharf shed is 100 ft. wide and 1638 ft. long and has two stories. It is to be built with a wooden-pile and reinforced-concrete substructure carrying a steel frame. At the far end of the plot is the so-called pier shed, which is to be used during the war by the Navy as a storehouse. This pier shed consists of twin buildings each 100 ft. wide by 924 ft. long and three stories high, connected by bridges and built of reinforced concrete. The wharf shed has a floor area of about 360,000 sq.ft., and the Navy pier shed of about 580,000, giving a total floor area, of the main buildings of the entire terminal, of 2,600,000 square feet.

In so far as war operation is concerned, the pier shed is to be separate from the storehouse and the wharf shed, and will receive and deliver its stores without reference to the layout of the other two buildings. After the war, if the plant is turned over to commercial operation, it can be worked into the general scheme of the terminal. For war operation, the army stores to be transported overseas are brought in over the main-line tracks and stored and classified in the extensive



NEW BOSTON ARMY SUPPLY BASE COMPRISES THREE BUILDINGS AND TWO WHARVES ON 35-FOOT CHANNEL IN THE HARBOR

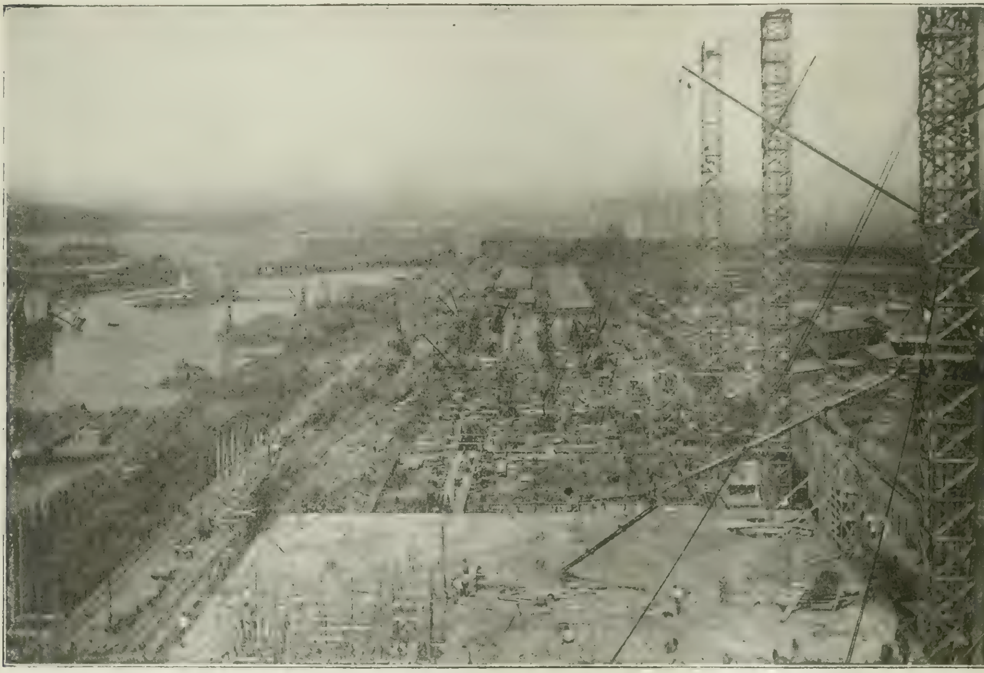
railway approach yard. Carload lots will then be brought to the main storehouse, on the railroad tracks on the northern side, and delivered to the eight floors by trailer trucks and elevators.

The wharf shed is to be used for the assembly and short-time storage of freight which will be loaded onto vessels. This freight may be taken from the storehouse or brought directly to the wharf shed by rail or motor truck, and stored on the first floor, ready to be loaded aboard the vessel when it arrives. The storehouse will be used as a reservoir to care for materials which it is expected will be stored for some time, and to supply cargoes in case of delay of expected shipments.

The pier shed is to be provided with tracks running between the twin buildings, from which tracks cars can be unloaded to trailer trucks and the freight can be distributed throughout the shed by means of the trucks and elevators. Material will be moved by trailer trucks from the pier sheds to ships. Material will be unloaded from the balconies at the upper floors to the ships, or vice versa, by means of a system of cargo hoists.

The main storehouse is remarkable mostly for its size. It is an eight-story reinforced-concrete building, 126 x 1638 ft. The structural details are of the simplest. Flat-slab floors on the two-way system are carried on round columns spaced 21 ft. center to center in both directions, a maximum uniformity in panel sizes being adopted. The structure rests on concrete cylinder piers 6 ft. in diameter, one pier to each column, the piers rising for their full shaft diameter to the under side of the first floor, which floor is carried on the pier by the usual drop head. In preparing the original design comparisons of various types of footings were made, wood piles, concrete piles, and the cylinder piers all being analyzed as to cost and ease of construction. In every way the cylinder piers were estimated to be superior. Their construction has been carried out with remarkable speed and effectiveness.

As stated above, the building is divided into six equal sections and was so constructed, the section nearest the outer channel being started first and construction proceeding toward the shore. The end walls of each section are continuous across the building between the columns, which are separated for each section, complete expansion joints running clear across the building. The expansion joint extends below the first floor, where the respective walls are carried each on separate beams spanning the pedestals of the piers. The openings between the various sections are provided with fire doors. The outer walls are of concrete.



VIEW FROM UPPER STORY OF ONE OF THE OUTER STOREHOUSES, LOOKING SHOREWARD OVER FOUNDATION WORK. WHARF SHED PILES AT LEFT

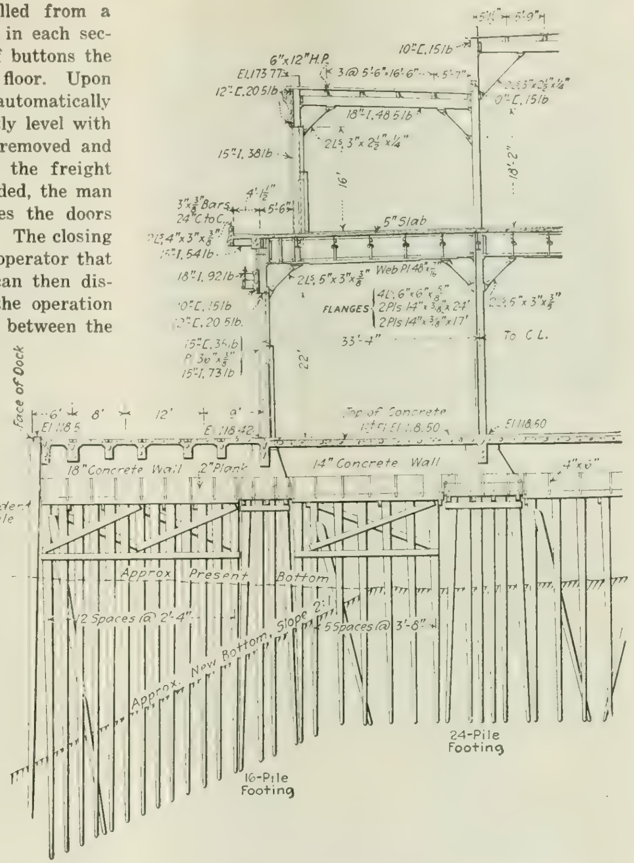
The first floor of the main warehouse is on a level with the street, so that motor trucks can run directly onto the floor; this will have wood-block paving to take care of this extra wear. The remaining floors of the building have a 1-in. granolithic surface.

Transportation inside the storehouse is to be effected by means of tractor and trailer trucks and elevators. The elevators, which carry four trucks each and have a capacity of 10,000 lb. at a speed of 150 ft. per minute,

are remarkable in that they are controlled from a central dispatch station on the third floor in each section of the building. Through a series of buttons the operator can dispatch the elevator to any floor. Upon arrival at the floor the doors are opened automatically and the car is automatically brought exactly level with the landing. The empty trucks are then removed and loaded trucks pushed on the elevator by the freight handler at the floor. When the car is loaded, the man at the floor presses a button which closes the doors by means of an automatic electrical device. The closing of the door gives a signal to the dispatch operator that the car is ready for use. The operator can then dispatch the car to the proper floor, when the operation is repeated. A complete telephone system between the dispatcher and each floor keeps the operator in constant communication with all parts of the building. This method of elevator control insures the obtaining of the maximum capacity from the elevators.

Automatic interlocking devices prevent the elevator doors being opened unless the car is at the landing, and also prevent the operation of the car unless all doors are closed. A lamp signal system on the dispatcher's desk indicates the exact position of each elevator in the well. To provide for trouble with the automatic operation each elevator has a car switch which will permit the manual operation of the car.

A rectangular tunnel having two parts runs longitudinally under the storehouse. One part contains high-pressure steam pipes for heating the building; the other part contains the electrical distributing mains. This tunnel is connected at its eastern end to the electric substation and to the boiler house. The storehouse is to be heated by a combination sprinkler and heating system, with auxiliary low-pressure steam radiators at the walls.



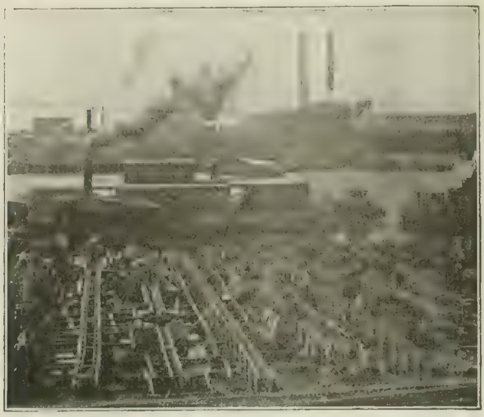
WHARF SHED HAS STEEL SUPERSTRUCTURE ON CONCRETE BASE AND TIMBER PILE FOUNDATION

The wharf shed was built mostly over the water, the old bulkhead running just outside the inner wall of the shed, as shown in some of the drawings. The shed itself is of the simple steel-frame type made familiar in the various transoceanic piers of the Atlantic ports. It is 1638 ft. long by 100 ft. wide and divided into three transverse bays each 33 ft. 4 in. wide. The second floor, of concrete carried on steel floor-beams, extends out as a balcony on the water side, to permit the unloading of package freight. The first floor is at the level of the adjoining street. The outside walls are of concrete, between the very numerous vertical lift doors.

The substructure consists of transverse concrete walls carrying the longitudinal concrete beams and the concrete floor, the walls spanning between pedestals resting on timber pile groups. Additional piles are spaced between the pedestal groups so as to form cross bents and to carry part of the load of the main deck of the wharf. The details are shown in one of the drawings. Transverse expansion joints occur through the building every 546 ft. An interesting detail is the embedment directly in the concrete of the rails for the railway tracks along the capsill of the wharf.

The elevators in the wharf shed are similar in size and capacity to the storehouse elevators, but are controlled by an operator on the car. The doors, however, are electrically operated by buttons in the car and on the landings. Freight is to be moved from the wharf shed to the ships by means of semi-portal bridge cranes and a system of cargo hoists, on the water side of the wharf shed, taking the freight from trucks or trains on the wharf or on the balcony in front of the second floor of the shed.

The pier shed is a reinforced-concrete structure 924 ft. long, divided into four sections of 231 ft. each, and 300 ft. total width. It is in reality composed of two longitudinal buildings, each 100 ft. wide, connected by four bridges, with an intermediate 44 ft. in which run three standard-gage railroad tracks. These tracks are depressed, as shown in the drawing, so as to bring the car door flush with the first-floor level and also so as to give free clearance of the trains beneath the



PUTTING UP FORMS FOR WHARF SHED STRUCTURE

second floor bridges between the two sections. The building is also of the reinforced-concrete flat-slab type, the first floor being 24 ft. high and the other two floors 14 ft. each. These upper two floors extend out beyond the outer wall in balconies which are to be used in transferring freight to the ships lying at the wharf alongside. This wharf is a 28-ft. extension of the first floor of the building on both sides and the end.

Structurally, the substructure of the building consists of groups of concrete piles capped to form the column pedestal and tied together with transverse reinforced-concrete girders clear across the building. The soft clay fill on which the building is founded is retained on either side within the outer wall limits by a row of heavy precast reinforced-concrete sheet piles 21 in. wide and running up to 48 ft. in length. Outside of these retaining piles the marginal road floor is carried on piles with short penetration in the outer dredged slope.

The elevators in the pier shed are similar to the storehouse elevators except that they are controlled by buttons at the landings instead of from a central point.

Between the pier shed and the main warehouse will be located a central boiler house to supply heat for the whole project. Connected with the boiler house will be an overload coal bunker equipped with modern coal unloading and handling machinery.

All the current for lighting and power will be obtained at high tension from the Edison Electric Illuminating Co., and will be transformed for distribution about the site in a substation near the boiler house. There will also be an administration building at the shore entrance to the site.

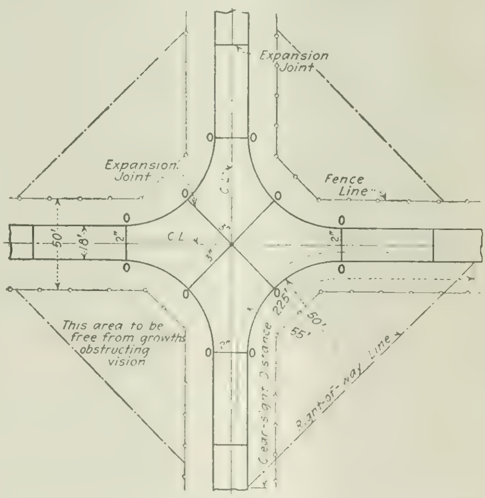
The Boston army supply depot is being built under the direction of the Construction Division of the Army, Brig. Gen. R. C. Marshall, Jr., in charge. The engineering design and supervision are in charge of the firm of Fay, Spofford & Thorndike, consulting engineers, Boston, and the construction is being carried out under the direction of Maj. C. R. Gow, constructing quartermaster. The main contract is held by the W. F. Kearns Co., Cambridge, Mass., but the substructure for the main storehouse was let to the P. McGovern Co., New York and Boston; the substructure of the wharf shed to Holbrook, Cabot & Rollins, Boston; the substructure of the pier shed to the Raymond Concrete Pile Co., and the railway track work, grading, and underground structures to the T. Stuart and Son Co., Newton, Mass. Work was started Apr. 3 of this year, and is scheduled for completion, with the exception of some of the outer dredging, by the first of the year. Rapid progress has been made and it is practically certain that the terminal will be ready for operation before that time.

Proper Radius for Turns at Intersection of Highways

Permissible Banking Has Small Effect on Allowable Speed—Number of Automobiles Necessary To Warrant Use of Extra Area

By G. S. Eaton
Assistant Division Engineer, Universal Portland Cement Company

PROPER radius for turns at highway intersections should receive careful consideration. The chief relief from hard turns must come from increased radius, as the allowable amount of banking has small effect upon ease of turning. However, excessive cost for extra paving and right-of-way at long turns should be considered with reference to the extra convenience of the traffic. In this, the number of vehicles passing the point



INTERSECTION PROVIDES ADEQUATE TURNING RADIUS AND CLEAR-SIGHT DISTANCE

is a factor, and it can be shown that the actual saving in gasoline will warrant a change from 20- to 50-ft. radius where 112 automobiles pass, while 171 are required to warrant a 90-ft. radius. Clear-sight distance is also desirable, and an intersection combining ease of turning, clear sight and economy is shown in the illustration above.

The design just mentioned, with the analysis on which it is based, is not given because of its unusualness nor as necessarily the best practice, but rather to serve as an example of the general method of attacking the problem. Credit for the scheme used in obtaining a

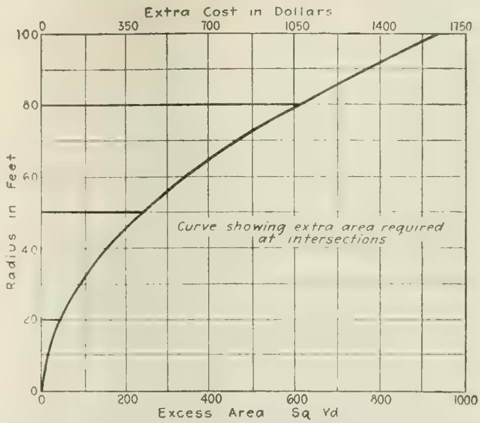
satisfactory clear-sight distance should be given to H. E. Bilger, road engineer, Illinois Division of Highways, whose article entitled, "A Modern Intersection Designed for Paved Highways," appeared in *Engineering News-Record* of July 19, 1917, p. 134. It should be noted, however, that the important distance is the one measured around the curve, which separates two automobiles when they become visible to each other, and is not the length of a straight line connecting the two.

In the article referred to, the design advocated calls for a 125-ft. inside radius, with small unpaved areas near the center. While having many advantages, such a layout would be expensive, and the unpaved areas, if not fully drained, would be dangerous to motorists. If paved with concrete, $1400 would be a low estimate for the cost of such an intersection (exclusive of the area in the straight 18-ft. pavements), while at the same unit prices one built according to the design now suggested should not cost more than $500, allowing $100 for the cost of extra land required, which in each case is less than half an acre. Of course, the turning radius in the latter case is not nearly so great as with the former design.

In order that an automobile may turn without slowing down too much, a turning radius is needed that is more than the few feet which served for horse-drawn vehicles. At any particular speed doubling the radius will halve the centrifugal force, which tends to cause skidding and overturning. Ease in following a curve at a fair speed demands that it be unnecessary to turn the steering wheel too suddenly. Yet economy forbids the use of too great a radius. The rapid increase in paved area, as the inside radius becomes greater, is shown by the curve plotted for various radii.

In the following analysis, an inside radius of 50 ft. was chosen because that will allow a turning radius of at least 55 ft., or even 60 ft., without the automobile getting out of its own track. Reference to the tabulations will show that no trouble should be experienced in rounding such a curve at 15 miles an hour. The centrifugal force developed is about equivalent to that present when making a turn on a 25-ft. radius at 10 miles an hour. With a 90-ft. inside radius, 20 miles an hour should be a safe speed. The plan of flattening the curve near its center was investigated, but with a radius as large as 50 ft. no considerable saving would result from following this scheme, instead of increasing the inside radius.

Superelevating of intersections was another matter carefully considered and then discarded as unwise. On double-track roads, if superelevation is used to help vehicles turning to the right along the edge of the pavement, it will make it harder for the vehicles traveling in the opposite direction, of which an equal number may be assumed. If the turns are banked the dangerous tendency to use the wrong side of the road will be encouraged. When turning on a 55-ft. radius, increase in speed made possible by using the allowable limit of ¾-in. superelevation per foot of width would be small at best. That only 16.6 miles an hour on the banked turn would be permissible, if 15 miles an hour were the safe speed on the flat pavement, is shown by the following example, where the average weight of automo-



EXTRA AREA AND EXPENDITURE REQUIRED BY INCREASED RADIUS SHOWN BY CURVE

bile was considered 2600 pounds. Since centrifugal force varies as the square of the speed it increases very rapidly with the higher velocities.

Centrifugal force $= \dfrac{WV^2}{gr}$ where W = weight in lbs., V = velocity in feet per second, g = force of gravity and r = radius.

$$\frac{2600 \times 22^2}{32.2 \times 55} = 710 \text{ lb.}$$

Centrifugal force compensated for by ¾-in. superelevation per foot of width = 160 pounds. Total centrifugal force allowable = 870 pounds.

$$870 = \frac{2600 \times V^2}{32.2 \times 55} \text{ or}$$

V = 24.4 ft. a second = 16.6 miles an hour.

On curves where all traffic is benefited by superelevation and where the radius should be much greater, the advantage to be obtained is worth while; this is not the case on double-track pavements where intersections are entirely paved. How radius, speed and centrifugal force are related is shown in the tabulations as follows:

THE RELATION BETWEEN RADIUS, SPEED AND CENTRIFUGAL FORCE COMPUTED

Turning Radius (Ft.)	Speed (Mi per Hr.)	Centrifugal Force (Lb.)*	Speed Compensated for by Allowable Superelevation (Mi per Hr.)
25	8	442	4.8
	10	698	
	15	1,564	
55	10	317	7.2
	15	710	
	20	1,260	
95	15	412	9.4
	20	730	
130	20	533	11.0
	25	836	

* For automobile weighing 2600 lb.

In determining whether an inside radius of 50 ft. or more at intersections would be justified by the resulting saving in operating cost of automobiles, the following assumptions were made: Weight of average automobile with passengers (trucks excluded), 2600 lb.; average car when traveling on level pavement at constant speed can make 17 miles on one gallon of gasoline; cost of gasoline, 23c. per gallon; tractive resistance on level, 30 lb. per ton. Only important loss in power

AMOUNT OF MONEY SAVED BY INCREASING RADIUS

Change in Inside Radius	Change in Speed Made Unnecessary (Mi per Hr)	*Work Saved (Ft. Lb.)	Saving per Automobile
20–50	10–15	11,387	$0 00075
20–90	10–20	27,330	0 00180

*Allowance made for shortened distances around flatter curves

is that needed to regain speed after slowing down at intersection.

Work done equals change in kinetic energy; $KE = \frac{1}{2}\frac{W}{g}(V_1^2 - V_0^2)$. With 20 miles as the maximum allowable speed at intersections, the above figures give the amount saved, if it is not necessary to slow down to 10 miles per hour at the intersection. While gasoline is only one factor entering into the cost of operating an automobile, it is by far the most important one in this case.

The daily number of automobiles which will be required to justify a change from 20 to 50 ft., or from 20 to 90 ft., for the radius of the intersection is given below; these values were obtained by dividing the daily cost by the corresponding saving per automobile.

NUMBER OF AUTOMOBILES WHICH MUST MAKE THE TURN TO JUSTIFY CHANGE IN RADIUS

Inside Radius	Permissible Speed (Mi. per Hr.)	Sq.Yd Excess Area	Difference in Yardage	Total Cost, ($)	*Annual Cost, ($)	Daily Cost, ($)	No. Autos Turning to Justify Improvement
20	10	38					..
50	15	238	200	350	30 52	0 0836	112
90	20	773	735	1285	112 10	0.3070	171

* To discharge debt of one dollar at 6% interest in 20 years requires an annuity of $0.0872; this was used in figuring annual cost

If unrestricted amounts were available for construction, traffic on many main routes would warrant intersections with 90-ft. radii. But inasmuch as funds are usually limited a 50-ft. radius should give a satisfactory intersection at low cost, unless travel is unusually heavy.

War Problems of Water-Works Practically Discussed

Abstracts of Papers and Report Presented at the Win-the-War Meeting of the New England Water-Works Association: Saving Water and Conserving Coal—The Fuel Situation in New England—Detecting Underground Leaks—Thawing Frozen Pipes by Electric Current.

Practical Methods of Detecting Leaks in Underground Pipes

By David A. Hefferan
Superintendent of Water-Works, Milton, Mass.

ABNORMAL water consumption has prevailed this year on account of water run to waste to prevent freezing during the severe winter weather, and because leaks then created have not yet been stopped. It has been calculated that the elimination of water waste in New England alone would save 150,000 tons of coal a year.

Waste in houses and in service pipes may be curtailed by house-to-house inspection, the use of the aquaphone, on services and work. In distributing mains the problem is different. Given a knowledge of the total volume supplied and various conditions causing legitimate variations in consumption, waste-prevention is largely a matter of detecting and locating leaks.

There are several methods of discovering leaks. The old-fashioned test pit scheme is as good as any, provided the distribution system is well equipped with gates. The test pit is nothing more than a manhole of convenient size built around a valve. On either side of the valve and within the manhole a tap is made and a corporation inserted. This furnishes the foundation for a bypass around the gate. In the bypass a meter is set. If the section is a large one, necessitating a meter larger than 2-in., it is well to make a supplementary bypass with a small meter around the larger one. The section to be tested should be carefully laid out and all gates located beforehand to eliminate delay and tested for tightness.

The test for a leaky valve is simple. Close the gates to be tested and open a hydrant on the line between, removing the suction cap. Then open one valve slightly until the water in the hydrant barrel rises to the level of the suction nozzle and just flows out. Then close the valve again. If the water continues to flow from the nozzle one of the valves must be leaking. Of course, for a few minutes the flow might be from the houses in the district, but this should stop shortly.

If the level of the water lowers it shows a leak somewhere in the cut-off section, below the level of the hydrant nozzle; but it would indicate a good-sized leak, as the open hydrant removes all pressure from the line. Aquaphones may be used on each gate for further tests of tightness. The best hours for the actual testing are from 1 to 4 a.m.

Locating the Leak: a Useful Instrument

If all the gates are tight, it is evident that no water can enter the section so cut off unless it passes through the meter on the bypass. If readings are taken at set intervals and, gate by gate, the area of the section covered by each test pit lessened, it can be seen with ease that the leak will be discovered to be between the two of a certain pair of valves. After its general location has been determined in this manner, the exact point where the water is escaping can be found by looking for any luxurious growth of vegetation at the side of the road, by dampness on the surface of the street, by driving down a bar and noticing any moisture on removing it, by means of an instrument magnifying the hissing sound of escaping water, or by using any other convenient method. In this manner, a whole city or town may be covered.

The instrument just mentioned is contained in a small, light box. A small four-legged brass table is set on the ground over the pipe, where the leak is supposed to be.

The box has a raised bottom so that it may be placed over the table to keep out foreign noises. On the table is a microphone-detector with wire connection to an amplifier battery contained in the box. Very sensitive ear receivers are wired to the battery. When the instrument transmits a rushing noise to the ears it is evidence that the leak is close at hand. The affair is set at different points along the pipe line until the point where the noise is loudest is reached. The leak will be found to be directly under this spot. Used in connection with the wireless pipe locator, it will be found satisfactory.

The beauty of the test-pit scheme is that it is permanent. The pits are always ready for use in time of need. If it is not desired to construct the manholes the same results may be obtained by connecting two hydrants with fire hose, one hydrant being inside and the other outside the section to be tested.

Other Methods of Leak Location

Another method, quite as accurate, but probably more complicated and requiring more delicate apparatus, is the use of the pitometer. There are also several special methods. One, called the caustic soda method, was described at a meeting of the New England Water-Works Association some years ago by F. J. Hoxie. Another is a special device making use of water hammer. It works on the principle that the sudden closing of a valve produces an impulse which travels through the water in a wave, decreasing in intensity in passing an opening in the pipe. It is asserted that the relative distances from the instrument to the break and to the suddenly closed valve are readily determined, but with what accuracy I cannot say.

From our experience in Milton, we believe the test-pit method to be as accurate as any and simpler than most. It proved its value this spring when we found our daily consumption, which had been away above normal all winter on account of water being run to prevent freezing, was not at all reduced when mild weather set in. We were using at the rate of 500,000 gal. daily, which was 56% above normal. The leak was discovered in short order, the average daily consumption was reduced 180,000 gal. and the night flow was reduced from 20 gal. to 10.

Saving Water and Conserving Coal

By George W. Carpenter
City Engineer, Pawtucket, R. I.

Reducing to a reasonable figure water consumption in cities which have high per capita averages would save far more water than would a small horizontal cut in all cities. In the absence of any considerable volume of data throwing direct light on the question in hand, the author has used 1915 water consumption statistics of the United States Bureau of the Census as a basis for computing possible coal saving by reducing water consumption.

Statistics for 155 cities owning their works showed that for a total population of a little more than 25,000,000 an average of 3,748,000,000 gal. of water was supplied in 1915. The report states that 80% of the water supplied is pumped and that 80% of the pumping, or 64% of the total, is done by steam power—about 114 gal. per capita per day. The average horsepower of the pumps per million gallons capacity is given as 36.

Assuming a saving of 64% of 26,000,000 gal. daily (10 gal. per capita), an average of 36 hp. per 1,000,000 gal. pumped against a head of 207 ft., and a coal consumption of 2 lb. per horsepower-hour, we find that 14¼ tons of coal could be saved daily by a reduction of 1 gal. per day in the per capita consumption. This would be approximately 5200 tons of coal a year, or 52,000 tons if the per capita reduction were 10 gal. per day. Can water consumption throughout the country be reduced 10 gal. per capita per day? Yes, that amount and more too, on the average.

Tackle the Heavy Water Wasters First

The writer, however, does not believe that this saving should be made by a *uniform reduction* of all consumption, regardless of present rates, for there are many cities that have already reduced water consumption to a very low figure, while others are wasting water in a prodigal manner.

An examination of the tabulated statistics of 148 of the cities reported, representing a total population of 25,644,000, indicates a daily per capita consumption varying from a minimum of 34 gal. for Woonsocket, R. I., to a maximum of 324 gal. for Buffalo, N. Y.

Of the 150 listed in the Census Report of 1915, 55, representing a total population of 4,590,000, now have an average per capita consumption of less than 100 gal. per day, and 88 cities, with a population of 14,546,000, have an average of 125 gal. or less per day. If we assume that 125 gal. per capita daily is a reasonable allowance, we find that 48 cities could save a total pumpage of 663,000,000 gal. daily, and that of this total Chicago alone could save 37% by reducing its present consumption of 226 gal. per capita per day to 125 gal. The four cities of Chicago, Philadelphia, Pittsburgh and Buffalo, with respective averages of 226, 182, 252 and 324 gal. per capita, could save 495,000,000 gal. per day, or nearly 75% of the total.

If we make the same assumption with respect to the 663,000,000 gal. that could be saved by the 48 cities referred to—namely, that 80% of the pumping is by steam power, we have a total of 530,000,000 gal. pumped by steam; and by applying our previous assumption as to the use of coal to pump this amount of water, we have a possible saving of 458 tons of coal per day, or 32 times as much coal as could be saved if *all cities* reduced the per capita consumption by 1 gal. per day. A saving of 458 tons daily is about 167,000 tons annually. Chicago, Philadelphia, Pittsburgh and Buffalo could save about three-quarters of this, or 125,000 tons, by a reduction of the average per capita water consumption to a figure already reached or improved upon by 88 of the 148 cities reported. If we assume a per capita allowance of only 100 gal. daily a very much greater saving of coal can be made.

Pump Slip Should be Reduced

The writer believes, however, that a reduction of consumption to reasonable limits is not the only objective which should be sought in order to conserve fuel. Pump slip is often a source of an enormous waste of power. We often find reports where total consumption, engine

duty, etc., are figured to all manner of degrees of precision, only to discover, upon critical inspection, that all these figures are based upon plunger displacement, with no knowledge of, or attention paid to, the probable slip.

Referring to the figures previously used, 3,748,000,000 gal. pumped daily by 155 cities in this country, and calling 80% of this pumped by steam, we obtain 3,000,000,000 gal. If we assume a slip of 5% only, and use our previous figures of 36 hp. per million gallons and 2 lb. of coal per horsepower-hour, we find that this slip is equivalent to the wasting of 130 tons of coal per day or nearly 50,000 tons per year. This is about as much fuel as we found would be saved by reducing the average per capita consumption of the 155 cities previously cited by 10 gal. per day. If we stop to consider that in many pumping plants the reducible slip is probably greatly in excess of 5%, we may realize that one profitable field of investigation may lie very close to the pumping station itself.

Unfair Burden on the Conscientious

To assume, however, that conservation of fuel can be obtained by a *uniform reduction* of the per capita consumption of water throughout the United States, without first giving wide publicity to the wastefulness existing in certain cities, is unfair to those cities and officials now using every effort to keep water consumpton within reasonable and proper limits and conserve and increase pump efficiency. It will furnish one more example of the faithful, conscientious citizen hastening to do his "bit" and carrying also the additional burden caused by the thoughtless extravagance and wastefulness of those who will not or do not care.

Never in the history of the world has the absolute dependence of one nation upon another, one community upon another and one individual upon another been recognized as it is today. This world war has brought home to thinking minds a realization of individual responsibility, of the necessity of unity of purpose, and of individual sacrifice for the common good, that could have been produced in no other way.

To-day, therefore, is an opportune time to bring to the attention of those cities whose prodigal use of water amounts almost to a crime the fact that such wastefulness is far-reaching, that its effect extends beyond the borders of the city itself and may reach even across the seas, tending to withhold from those brave men upon whom civilization now depends for its existence the arms, ammunition and supplies needed in its defense.

The Fuel Situation in New England

By Charles T. Main

Consulting Engineer, Boston

The bituminous coal needs of New England for 1918 were estimated at 33,400,000 tons by the New England Fuel Administration. The United States Fuel Administration estimated the needs as 30,000,000 tons, but later cut it down to 25,000,000 tons. Present indications are that there will be a shortage of at least 6,000,000 in bituminous coal and that New England will get about its usual allowance of anthracite. Storage has been limited to 60 days' needs.

New England could get along with less coal by shutting down the less essential industries, but this should be the last resort. Oil as a substitute presents transportation difficulties and at present fuel-oil companies will not take more contracts. Wood could be made to help out. Hydro-electric companies in Massachusetts are fully loaded. Many of the water-power plants in New England could be improved and increased in capacity in a reasonably short time. The most promising immediate method of getting along with less coal is to study various possible losses and reduce these to a minimum.

A Fuel Saving Committee for Each Plant

A plan which is being urged is the setting up of a fuel committee in each establishment where fuel is consumed, to see that fuel is conserved and steam not wasted. An advisory engineering committee has been formed to visit local plants and give advice. This committee has issued a bulletin of coal-saving suggestions. In addition, a bulletin has been prepared by a committee of firemen and engineers for men of their class. These bulletins may be obtained from the Massachusetts Fuel Administration, Boston. Every water-works plant using coal or other fuel might well establish a fuel and power committee from among its own men.

Electric Thawing of Frozen Water Pipe

From Report of Committee on Frozen Water Pipes.
Frank J. Gifford, Chairman, Dedham, Mass.

Thawing frozen water mains by electric current was the method commonly employed, according to reports from a considerable number of works obtained by the committee on frozen water pipes, of which the writer was chairman. Current from lighting wires, portable motor-generator sets and storage batteries was used.

The method best known and most generally used was connecting with the overhead wires of the lighting companies. In this type the high-tension primary wires, carrying 2200 to 2400 volts, were tapped, and the current was carried to cut-out boxes with suitable fuse wires. From the fuse boxes the wire ran to one or more transformers whose capacities ranged from 15 to 75 kw. In a large majority of cases the voltage was reduced by the transformers to 110, and the amount of current delivered upon the pipe was further controlled by the use of a water rheostat.

Motor Generators on Trucks

The motor-generator set was used to a considerable extent. One outfit consisted of a 25-volt, 250-ampere, direct-current generator, equipped with a volt-meter, an ammeter and an automatic circuit-breaker, mounted on a motor truck. On the truck was also mounted a countershaft carrying a sprocket wheel at each end, and a driving pulley which was connected to the generator by means of a leather belt. On each side of the jack-shaft of the truck was attached a new sprocket wheel just outside of the existing driving sprockets. Upon arrival at the point where the work was to be done the chains were taken off the driving sprockets and attached to the new sprockets at the jack-shaft and

to those on the countershaft mounted on the truck. The motor truck engine was thus utilized to generate the required current.

A limited use was made of the storage battery. One outfit consisted of three trays, each containing eight 2-volt cells, so connected up that a voltage of 16, 32 or 48 could be obtained. Another of six trays of four 2-volt cells each was still more flexible, as voltages of 8, 16, 24, 30, 36 and 42 were possible. Another of six trays of three 2-volt cells was connected in multiple series, giving a voltage of 35. This outfit proved unsatisfactory, as serious damage was done to the pipes in a number of cases.

The properly connected storage battery has proved very efficient. Like the motor-generator set, it is flexible and portable, and when operated by an experienced man the method is safe. If it is improperly used, damage to the pipes and to the battery itself can result easily. The batteries must be recharged after a continuous day's use, the operation taking eight hours. The storage battery is delicately constructed and can be easily damaged both in discharging and in recharging. It deteriorates when not in use, especially during the long period of the year when it is not needed.

While available data are to some extent conflicting, and more exact information is desirable, yet general experience shows that for the work of thawing $\frac{5}{8}$-in. lead or $\frac{3}{4}$-in. iron service pipes of average length, using 4/0 wire for leads, and with good connections, the following figures may be considered as approximately normal: Drop in pipe, 14 to 18 volts; total voltage required, 20 to 30; amperes required, 175 to 225; time required to thaw, 6 minutes, plus or minus. With larger pipes, or with pipes longer than the average, of course more electrical energy and time are required.

For all-round, efficient, economical work the committee looks most favorably upon the motor-generator set. It is flexible, can be taken where the work is to be done, can work continuously, does not deteriorate when not in use, can be made almost fool-proof, and, if properly designed, is the safest type of apparatus from the point of view of avoidance of danger to the water pipes.

Peak Run-off Data on Restricted Dry-Wash Channel

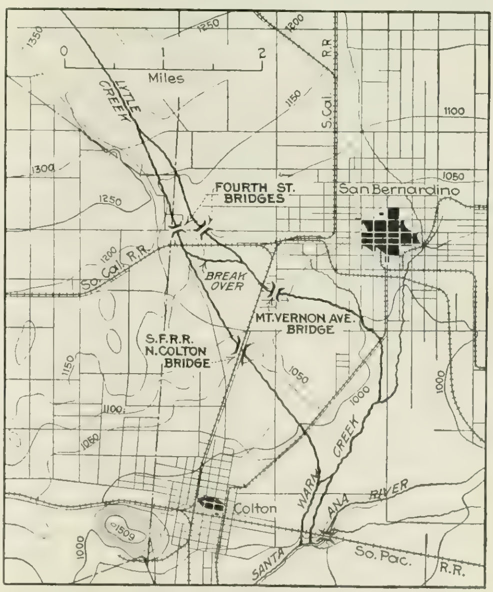
Sounding Rod Thrown Forcibly from Bridge Into Swift Current to Measure 18-Foot Velocities at Ten-Foot Depths

ENCROACHMENT upon the dry-wash channels of southern California streams, all appropriated normally for irrigation, is a great temptation to land owners, particularly in the orange belt, where land values are high. For this reason, data on the run-off during extreme floods are particularly valuable. In many of these streams the dry-wash area is being restricted to narrower and narrower limits, so that this peak run-off may cause great damage. Little is known as to the actual flow of these peaks, so that records taken at Lytle Creek in January, 1916, and recently made available, are both valuable and interesting. Although the records were made under difficulty, one of the bridges from which the gaging was done being washed away, an almost complete curve was obtained by the promptness of the engineers rushing to two lower bridges.

Lytle Creek is the most important single tributary of the Santa Ana River, and has its source in the San Bernardino Mountains near the foot of Mt. San Antonio. After 17 miles of cañon the stream spreads out in an erratic course across the foot hill mesa land to a point seven miles below the mouth of the cañon, where it is joined by a smaller stream, Cajon Creek. Thence it continues down the San Bernardino Valley, dividing into branches flowing respectively through San Bernardino and Colton, and continuing for eight and nine miles across the valley to the Santa Ana River.

Property directly affected is valued at about $30,000,000, and the property and damage loss by the flood of 1916 was in excess of $100,000. The problem of flood control has repeatedly been under consideration, but has not taken definite form until recently.

By a combination of careful planning and fortuitous circumstance, the "big flood of 1916" was caught at its inception and was followed by careful measurements, taken four or five times a day and two or three times a night, until it subsided. The bridge station on West Lytle Creek went out during the second rise of the flood, on Jan. 18, and it seemed for a time that the records might be broken at the very peak of flood. By making hurried use of two other stations, 1½ miles downstream, and of a third of the old Fourth St. bridge on East Lytle Creek, the records were kept uninterrupted, and an actual measurement of flood



ON FAILURE OF FOURTH STREET BRIDGE, ENGINEERS TRANSFERRED GAGINGS TO LOWER BRIDGES

flow was obtained within a few minutes of the maximum peak of flood.

Channel measurements were made by the common use of sounding rods, this being rendered possible by the unusually low clearance of bridges. For the first low flood measurements, an ordinary 10-ft. cross-section rod was used. Depth measurements were taken at 3-ft. intervals across the channel, measuring the depth below the top of parapet wall on concrete bridges, or below the top of bottom chord on steel or combination bridges. The first set was taken to the surface of the water, then a set to the bottom of the channel and a third set to the surface of the water. Velocity measurements were then taken at intervals across the channel, and then another group of depth measurements, taken in three sets as before. By this means the actual mean section was determined for which the measured mean velocity was applicable. Later it was found advantageous to reverse the process, taking first one set of measurements for velocity, then one for depth and finally another set for velocity, thus obtaining the mean velocity for the actual channel measurement.

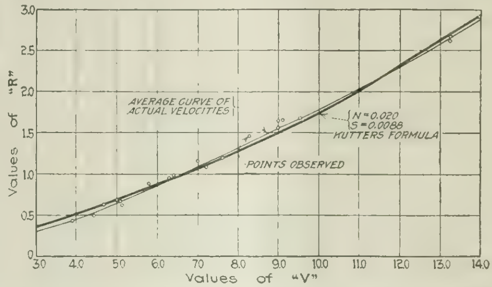
FLEXIBLE TRAINING WALL OF CABLES AND HOG WIRE RESTRICTS FLOOD ENCROACHMENTS

As the stage of flood increased it was found impracticable to manipulate the wooden cross-section rod, because of increased depth and increased velocity of current. Acordingly, a measuring rod was devised that was composed of three 8-ft. sections of 1-in. wrought-iron pipe. This was marked in feet and tenths along the section where a measurement reading was required. Even with this rod difficulty was experienced in touching bottom. With experience and repeated trials, however, it was found that a powerful man could poise the rod in a vertical position, and then with considerable exertion, aided by the weighted lengths above, so hurl the rod vertically downward as to catch bottom before the force of the stream carried the rod away. It took a quick eye to note the height; often numerous trials were made before the deep parts of the channel were gaged.

Use of a weighted line was not reliable, as the velocities of flow ranged from 10 to 18 ft. per second. Trials were made, but a weight which one man could handle was not heavy enough to carry the line down at a lesser angle than 30 to 45°. Even at that the weight carried downstream rapidly until the tension on the line, combined with the velocity of the current, lifted the weight from the bottom of the stream.

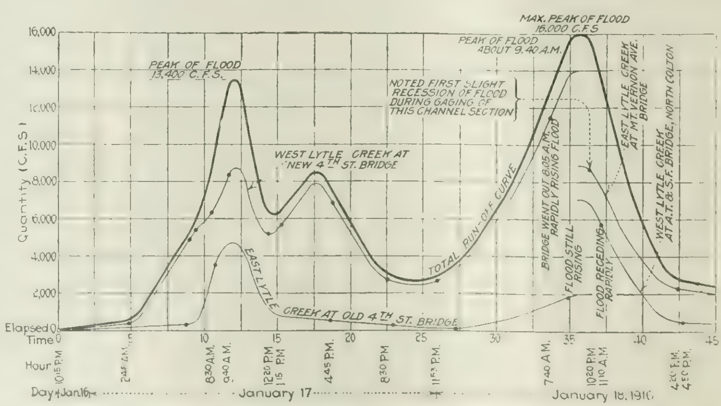
The rod method was at first scouted as impracticable, but by careful manipulation and considerable hard work it was made a success. Maximum depths of 10 ft. were thus measured in water flowing at an average velocity of 18 ft. per second. This record is believed to be unusual for water of such high velocity and carrying large quantities of stones and débris.

The typical velocity curve, as determined for the West Lytle Creek channel at the West Fourth St. bridge, is shown on the accompanying chart, which shows also a dotted line plotted from Kutter's formula with $n = 0.020$. The close agreement of these two curves is rather unexpected. It would have been thought, from the condition of the channel, that a closer agreement would have been found with the curve for $n = 0.025$.



COMPUTED AND OBSERVED VELOCITY CURVES ON WEST LYTLE CREEK AGREE

One of the interesting checks found in taking these measurements was with regard to the ratio of depth of scour to height of rise of water. It was found that very nearly the same curve was followed by these two, the average depth of scour being slightly more, and



FLOOD CURVE OF LYTLE CREEK OBSERVED AT SAN BERNARDINO

closely equal to, the height of stage above average low water.

Lack of sufficient rainfall stations in the Lytle Creek watersheds made it impossible to compare rainfall and run-off data for this flood with any degree of accuracy. Additional rainfall stations have been established, so that a fair average rainfall can now be determined.

This work was carried out under the general direction of J. A. Sourwine, county engineer, San Bernardino County, now a captain in the Engineer Officers' Reserve Corps.

Submerging Bed With Sewage Kills Sprinkling Filter Fly

Larvae and Pupae Destroyed by 24 Hours' Flooding at Plainfield, N. J., Without Materially Injuring Filter Bed

By Dr. Thomas J. Headlee and
Charles S. Beckwith
Agricultural Experiment Station, New Brunswick, N. J.

DROWNING has been proved effective where chemicals failed to control myriads of small grayish to white moth flies at the sewage sprinkling filters of Plainfield, N. J. The problem was brought to the attention of the senior author by the controlling committee of the sewage-works.

Psychoda alternata Say, or the sprinkling sewage filter fly, as we have named it, bred in enormous numbers at this filter plant and was found to rise and fly or be wind-carried for distances as great as ¾ mile. Its small size (3 to 5 mm. long) enables it to penetrate even the finest screen and thus infest the houses of persons living in the neighborhood. It lodges on and in foods and has been charged by the neighbors with the carriage of infections resulting in serious sicknesses.

While investigations made to date show no basis for the assumption that infections are carried by the fly, the belief in the possibility is quite sufficient to entail law suits and to give the committee controlling the operation of the plant a great deal of concern.

A study of the problem showed that this insect bred on the sprinkling filter bed throughout the entire season, and that while there was no trouble from flies during the cold months, they were present on the filter in the larval and pupal stages throughout the winter. The abundance of the flies during the warm season seems to be correlated with the thickness of the film on the stones of the filter. A thick film means more flies and a thin film means fewer flies. It seems that the heavy furry film of late spring gives rise to a tremendous brood, that the sloughing-off process or unloading of the film which follows results in a great reduction in the number of flies, and that the thickening of the film in late summer is again accompanied by the production of an enormous number of flies. Examination of the literature relating to this subject indicates that these flies are practically always developed where sprinkling sewage filters are installed.

A study of the problem showed that under a temperature of 70° F. the fly requires from 11.17 to 19 days to complete its entire life cycle, distributed as follows: Egg stage 32 to 48 hours, larval stage 9 to 15 days and pupal stage 20 to 48 hours. These determinations were made under controlled temperature conditions, and the change in position of the stone on which the immature stages were located might either shorten or lengthen the period. It seems probable to us, however, that the effect of artificial conditions was principally shown in the variation in length of time above indicated. On the filter beds the completion of the life cycle may require much more time in lower temperatures, or considerably less time in higher temperatures.

The study demonstrated that the control of the pest by the destruction of the adults was impracticable and that the attack must be made during the immature stages. The study also showed that in the larval and pupal stages the organisms live embedded in the film and that during both stages they thrust their breathing tubes through this film to obtain atmospheric air. The problem of control was thus resolved into one of finding an agent which would destroy the larvae and pupae and not injure seriously the film on which the efficiency of the filter bed depends. A large number of chemicals were tried. Any of these, when used in strength sufficient to kill the fly, also damaged the film.

Hypochlorite of lime received a rather thorough trial. Twelve pounds of this substance applied at the plant through the dosing tanks on one day, and repeated the second day after, caused 60% of the larvae to disappear. This treatment was followed by the sloughing of a considerable portion of the film in the upper layers of the filter. Similar tests were made with 15, 30 and 50 lb. per acre and the kill was still incomplete. The final test was made by using the hypochlorite of lime for the dosing tanks at the rate of 50 lb. per acre, applied three days in succession. About 85% of the maggots disappeared from the beds, and many as they appeared in the final tank were found to be alive. Following this last treatment the sloughing of the film was very marked.

Being unable to complete certain laboratory studies of the living larvae and pupae before leaving the office, the senior author, intending to continue the study on the next day, covered the material with water. When he again attacked the problem the following day he found that all the larvae and pupae were dead, although other active constituents of the film seemed to be in good condition. This led at once to the test of submergence as a means of destroying the insect. The accompanying table serves to show the results of three sets of experiments.

To make the matter more certain one-fourth of the Plainfield sprinkling filter, amounting to a little less than ½ acre, was submerged for a period of 24 hours with the ordinary sewage water as it came from the

RESULTS OF SUBMERGENCE TESTS ON SEWAGE SPRINKLING FILTER FLY

Length of Time Flooded, Hr.	Condition of Larvae and Pupae.	Condition of Film.
16	Alive	Alive*
18	Alive	Alive
22	95% dead	Alive
24	Dead	Alive
32	Dead	Alive
36	Dead	Slight putrefaction
48	Dead	Putrefaction

*Organisms which largely compose the film alive

dosing tanks. At the end of this period the water was released and many samples were taken. Enormous numbers of larvae and pupae came out with the water, and not one could be found that was alive. Tests of the effluent made by John R. Downes, superintendent of the plant, for a period of one week after this submergence, showed no decrease in the efficiency of the treated portion of the filter. We are, therefore, led to conclude that the sprinkling sewage filter fly, *Psychoda alternata Say*, may be destroyed by the simple process of submerging the sprinkling sewage filter bed with the ordinary sewage water for a period of 24 hours, without in any way seriously damaging the film or interfering with the efficiency of the bed.

Engineering Supervision Improves Water-Distribution System

Plans, Estimates and Progress Records Are Made; Flow and Leakage Tested; New Devices and Methods Proposed

EFFICIENT and economical operation of the water-pipe extension division of the Department of Public Works, Chicago, is facilitated by a special engineering section, as part of the organization described in *Engineering News-Record* of May 9, p. 921. The duties of this section include the preparation of plans, estimates and orders for all work done by the construction forces of the division; the supervision of work in progress and the keeping of records of work; also the testing of flow, pressure and leakage in mains. For this work the city is divided into three districts. As explained in the annual report of the department, each district is in charge of an assistant engineer having three field parties, engaged on construction, street improvement and feeder main surveys, respectively.

Each construction party, consisting of a junior engineer and one rodman, is required to set line and grade stakes for all contract and many city pipe-laying jobs; also to visit jobs in progress and keep a record of the locations of pipe and fittings. This information is used to check the foremen's reports on the jobs and to furnish correct sketches of work done for plotting in atlas records. The party spends considerable time in making inspections on other construction work, such as large sewers, gas mains and track elevation, with a view to protecting the water mains and making recommendations for necessary changes. All of the large feeder mains put in service during 1917 were treated with chlorine by the construction party.

The street improvement party, consisting of a junior engineer and two rodmen, with the necessary laborers, makes tests and investigations on all streets that are to be paved. The results of these tests are the basis of recommendations for work to be done by the district force in order to put the system in good condition and prevent future maintenance expense.

The feeder-main survey parties during 1917 covered practically the entire feeder-main system with flow tests, furnishing data for ascertaining the operating condition of the mains and for planning improvements to the system. Closed surveys were made in some sections and the per capita and peak-load consumption determined. Pressure curves were furnished to the pumping stations to indicate the necessary pressures to be carried at the station in order to obtain satisfactory pressures at remote points on the system. Continual study was made of the pressure conditions as indicated in the daily pressure charts received from the recording gages at various points.

Important work was performed by the feeder-main parties of the central and north districts to conserve the supply in the vicinity of the Springfield Ave. and the Central Park Ave. pumping stations and thereby relieve the low-pressure conditions in Austin. The water department was thus able to increase the pressure at the pumping stations and give better pressures.

In the district supplied by the Roseland station, studies of the feeder-main parties indicated there was an excessive use of water, due to high pressures in some sections. Through recommendations of the division engineer and coöperation on the part of the operating division and the engineer of pumping station efficiency, an operating program was worked out for this station whereby it was able to supply a larger territory and at the same time increase its efficiency.

Analysis of cost of work was the subject of a report which suggested new forms of reports for assistant foremen and new methods of checking costs. A report recommending an improved and standardized design for roundway cocks and shut-off boxes led to the passage of an ordinance establishing this standard. It is proposed to have these articles made or purchased by the city and furnished at cost to plumbers. H. L. Lucas is superintendent and R. S. Spalding is engineer of the water-pipe extension division, under John Ericson, city engineer.

Sand Streaks on Concrete Caused by Boiling Up of Excess Water

Excess mixing water seeking a means of escape causes the sand streaks or "sand showers" appearing on the surface of concrete walls. This fact was established by observation by a concrete foreman on lock wall construction at Troy, N. Y., as reported in *Professional Memoirs* for July-August by D. A. Watt, assistant engineer. Sand streaks usually appear as fan-shaped areas, widest at the top, where the sand aggregate shows uncovered by cement but held just like the sand on sandpaper. Their unusual prevalence on the lock walls led to careful observation. Little ebullitions of water from down in the mass to the top surface were observed. The phenomena were not confined to the surface against the forms but occurred at various points in the mass. The escape of the water was through fissures or holes not larger than a pin head. Flow would continue for a minute or so, and when it stopped a small flat cone of cement would be left upon the surface. Apparently the weight of the concrete forced out the excess water which sought escape by boiling up through the concrete and so carried some of the cement with it. This probably accounts for the fact that no cement is found along the sides or at the bottom of sand streaks as they appear when the forms are removed. The sand streaks at Troy were much more noticeable when steel forms were used, their smoother surface apparently offering less resistance to the movement of the water.

Contract Organization Vitally Important for War Work

Large-Scale Government Construction Demands Most Careful Co-ordination of Forces —Charts Set Forth Organizations for Two Typical Contracts

BY FRANCIS DONALDSON
General Superintendent Empire Engineering Co., Inc., New York City

LIKE every other phase of man's activity, the business of construction has been much affected by the great war. America's entry into the struggle has demanded the building of great camps, shipyards, marine terminals and ammunition plants on a scale and at a rate of speed never before equalled, in the face of constantly changing conditions and rapidly increasing costs. The Federal Government has called upon the contractors of the country to do these things and the contractors are meeting the test, not only by doing them quickly but by developing new methods and new plans of organization to do them effectively. The importance of organization cannot be too strongly emphasized.

The most radical change from the ordinary performance of Government work was the adoption of the cost-plus-bonus form of contract, first by the Cantonment Division and afterward by other branches of the Government in charge of war activities. Without considering the question of whether, under ordinary conditions, this form of contract is as satisfactory as the unit-price or lump-sum form, it is obvious that in war time military works must be well under way before the plans can be completed, and important changes in quantities or design or both must be possible without altering the contract or opening the door for claims. This the cost-plus-bonus contract accomplishes.

Because large numbers of men have to be quickly got together and put to work and vast quantities of materials handled, and because everybody knows "Government money" is being spent, more elaborate organizations are necessary than are ordinarily employed; the features that in ordinary construction work are most important and are first attacked become secondary, and other problems become vital and should receive precedence. The contractors who recognized this in advance were successful, while those who started their jobs along customary lines were never able to catch up with the development of the work and failed to show even moderate efficiency. Transportation and housing the workmen, keeping their time and paying them off, and unloading and distributing construction material are all questions to which too much attention cannot be paid.

DEFINITE RESPONSIBILITY AND DEFINITE AUTHORITY

Of course, the basic principle of organization applies to all work, big or little, hurried or otherwise—definite responsibility and definite authority. The difficulties begin in distributing the authority and making the responsibility "stay put" in handling thousands of men and countless trainloads of material. It is easy to sit down and on paper divide the work into a series of departments along the general lines adopted by many large and efficient manufacturing plants, but it is next to impossible on a large job to make these departments function without interference or lost motion. They are of necessity built up hurriedly of men who are largely unacquainted with one another and with the limitations of their work. This acquaintanceship is the foundation of efficiency in a departmental system, and in a factory is acquired gradually and thoroughly. In construction work, on the other hand, employees of different departments working on the same part of the job will either interfere or leave gaps in the work through which efficiency is lost. Infinite opportunity is also afforded for "passing the buck." Theoretically, this can be prevented by proper coöperation between the department heads, but they cannot be everywhere at once, and, at any rate, perfect coöperation is a great deal to expect. The constant change in its requirements for labor and materials due to its own growth is the point where most construction work differs inherently from manufacturing, and it is the insufficient recognition of this that has caused the failure of many pretty schemes laid out by efficiency engineers successful in other fields.

FEWEST POSSIBLE STEPS

The form of organization best suited to contract work in general, and more particularly to the big "hurry up" jobs of which this article treats, is one with the most definite assignment of responsibility and the fewest possible steps. This is secured by a divisional rather than a departmental system, with a superintendent in complete charge of each geographical division reporting to the general superintendent of the work. The divisions should be small enough to enable the superintendents to supervise in person the foremen directing the activities in their division. Such a plan may result in some duplication of effort, and it does not tend toward standardization, but the loss in these respects is far more than offset by the increased sense of responsibility and interest felt by the divisions. If standardization of certain features of the work is desirable it can be secured by the general superintendent acting through the division superintendents, or by assistants to the general superintendent appointed by him to follow up such features. While absolute sectionalization is impossible on most jobs and certain general departments are essential, the work allotted to the departments should be minimized rather than emphasized.

A case in point is that of a large waterfront plant built in the past year. Here the greater part of the work was performed by subcontractors, each building a geographical section of the whole. In order to obtain through the Government the chief materials of construction, a central purchasing department was established. This department, however, did not confine itself to materials of construction, but was empowered and required to buy everything used on the job. To buy wholesale and distribute to eight or ten contractors the million and one small tools and supplies needed in starting eight or ten big jobs at once is a task that would tax the ability of the best-run contractors' supply house

in existence, and it was one that no newly organized stores department could hope to cope with. Although it is likely that tools and supplies were bought more cheaply than the contractors' buyers could have done in competition with one another, the time lost by the contractors in not being able to get what they wanted when they needed it much more than offset this gain.

A similar difficulty was caused by a general labor department organized to handle all matters connected with obtaining and employing labor; all men hired by the contractors direct had to be brought in through and formally employed by the general department, and so many errors and misunderstandings arose that a large part of the advantage due to the contractors' ability to get satisfactory men for their own work was lost. In both instances the contractors felt that they were being hindered by the department, and whether or not such a feeling was justifiable, its very existence detracted from their energy and initiative and thus hurt the work. The trouble might have been obviated by utilizing the departments to coördinate the work of the contractors' buyers and labor scouts, rather than to attempt to take it out of their hands.

The accompanying organization charts are more or less composite, but they approximate those developed

Chart I—Construction of Cantonment

On this work the design, field engineering and inspection, checking of materials, timekeeping and auditing of vouchers were performed by the Government direct and in consequence these functions are not covered by the chart. Roads and exterior lights and power circuits were constructed under separate contracts. Interior lighting, plumbing and heating were sublet.

GENERAL MANAGER
- **Financial Manager**
  - Auditor
    - Accountants, bill and voucher clerks, cost records
  - Chief Paymaster
    - Division paymasters and clerks
- **Chief Engineer (equivalent to works manager)**
  - Office engineer
    - Estimators of materials
    - Engineers of materials distribution
    - Draftsman on construction methods
    - Plan file
  - Purchasing agent
    - Buyers
    - Chief storekeeper
  - Traffic manager
    - Expeditors
    - Local car movement chasers
    - Car record clerks
  - General superintendent
  - Assistant general superintendent
    - Assistants to general superintendent
    - Superintendent of employment
      - Labor scouts
      - Employment record clerks, messengers
    - Superintendent of sewer and water systems
    - Assistant
      - Field engineer of sewers and water
      - Superintendents of sections
        - General foremen of excavation
        - General foremen of pipe laying, sewers
        - General foremen of pipe laying, water
      - Storekeeper and clerks
    - Superintendent of distribution
      - General foreman of trucks and teams
        - Foremen
        - Expeditors
      - Record clerks, truck and team time
      - Record clerks, material distribution (distribution clerk)
  - Mechanical engineer
    - Foreman of repair shop
    - Foreman of temporary water system
    - Clerks and storekeeper
  - Superintendent of building construction, **section 1** (work divided into about 15 sections with identical organizations on each)
    - Assistant in charge of material
    - General carpenter foreman
      - Foreman of sawmill
      - Carpenter foreman
    - General labor foreman
      - Labor foreman
    - Clerk and storekeeper
- **Subcontractor—Interior Lighting**
- **Subcontractor—Plumbing and Heating**

GENERAL—At the cantonments the construction of the buildings themselves could, in general, progress without regard to the utilities. Plumbing, heating, lighting, etc., followed the construction work without interference. The work of building construction, therefore, was divided into sections of a pproximately equal size (about 2,000,000 ft. b.m.) with similar organizations, each under its own superintendent. As the building lumber arrived at a central yard, a single unloading and hauling organization was needed to distribute it with reasonable fairness. The water and sewer division under a single head was also divided geographically into several sections, each under its own superintendent. In general the subcontractors installing plumbing, heating and lighting followed the same plan.

DESIGN—All designs furnished by Government. Plans issued received by office engineer and recorded, filed and reissued by him.

FIELD ENGINEERING—All field engineering, inspection and measurement of work done performed by Government.

SCHEDULES—Schedules were made up by the chief engineer and distributed to the departments as he saw fit. Schedules were little used in ordering material, as the job had to be done in so short a time that the earliest possible dates of shipment were hardly soon enough. All material was ordered as quickly as the quantities could be computed and the orders placed. Progress records were kept by the Government field engineer.

PURCHASES AND STORES—Requisitions for construction materials originated with the office engineer, whose duty it was to estimate quantities required and rates of delivery; then went to the purchasing agent, who placed the purchase orders and received notice of shipment. Requisitions for supplies originating in the division were signed by the division superintendents and forwarded through the chief storekeeper to the purchasing agent. Division storekeepers reported directly to the division superintendents, but were under the control of the chief storekeeper as regards reports of supplies received and on hand. Subcontractors could purchase their own supplies direct, but were required to forward a copy of each order through the chief storekeeper to the purchasing agent. All orders for supplies called for delivery at the division storehouses. The normal function of the chief storekeeper was to keep in touch with the stock on hand at the various storehouses, to supervise requisitions and generally to act as a clearing house for supplies.

EQUIPMENT—Plant and equipment were bought or leased by the purchasing agent under the direction of the chief engineer.

MATERIAL CHECKING—Checking and auditing were performed by the Government. Approved bills were turned over to the contractor's auditor for vouchering and payment.

TIMEKEEPING AND PAY ROLLS—Time was kept and pay rolls were made up by the Government. Rolls closed Saturday and were turned over to the contractor for payment the following Saturday. The timekeeping method used required all employees to carry metallic checks. The series of checks allotted to each division was given a distinguishing letter and numbered serially from 1 up. Employees were in general required to check through their division time offices at the beginning and end of each shift and in addition were field checked twice daily by time checkers; the time office check was omitted, however, when men were working so far away that they would lose time in going back and forth. Foremen were required to turn in to division time offices at the end of the shift daily time reports showing the numbers and time of the men working under them, and the pay roll clerks were required to compare these with the checkers' reports before entering time on the pay roll. Different grades of employees were given different series of numbers (as 501 to 1000 for common labor, etc.) at the discretion of the division timekeeper. Foremen, however, were numbered 1 to 100 on all divisions.

EMPLOYMENT—The employment office was required to register everyone seeking employment and to assign workmen to the different divisions of the work as directed by the general superintendent. After registration each man was given a dated employment card, was taken by messenger to the division to which he was assigned, and was checked in. The timekeeper assigned him a number, wrote it on the employment card in ink and returned the card to him as identification. His metallic check or badge was issued and the card lifted by the time checker on his second field check. This method was used to prevent men from walking away with their badges before going to work. All badges had to be shown on pay day before the envelope was handed out. Lost numbers were never used on the pay roll. Unissued and returned badges were kept on numbered pins on check boards; and the boards themselves were designed to close and lock. A discharged man was given a discharge ticket by his foreman and was sent to the division time office. Then he surrendered the ticket and his badge and was given an order on the cashier's office for his money. A man quitting kept his badge until the following pay day; before paying off the division paymaster compared the roll which was to be paid with the current roll, marked the envelopes of all men not shown on the latter and these badges were lifted.

DISTRIBUTION OF MATERIALS—All carload shipments were set by the railroad on sidings at a central point, and the materials of construction were unloaded into storage piles or directly to trucks and wagons and delivered to the construction division as required. The superintendent of distribution directed all labor at the central point and the operation of the trucks and teams themselves, but the division superintendents unloaded materials delivered to them. Materials were distributed generally in accordance with the orders of the division superintendents, telephoned to the delivery office and received by the distribution clerk. Deliveries were checked by one of the engineers of distribution stationed at the delivery office and provided with tabular charts showing the total quantities of each, size or kind of lumber or other materials required by each division with spaces to enter the quantities delivered daily. The division superintendents were provided with similar charts.

In theory the division superintendents were required to telephone to the delivery office each afternoon their requirements for the following day. These orders were arranged upon a delivery sheet by the distribution clerk and checked by the engineer of distribution in time for use in the morning. All cars set in during the night were opened and inspected and the contents noted before starting time, and those containing material urgently needed were so marked for immediate unloading.

Loaded trucks and wagons were driven past the distribution office, reported their loads, were directed to the proper division and were checked out. On their return they were checked back and the trip time recorded. All were numbered with painted tin tags for identification. As soon as a load was sent out it was tallied against the division it was sent to, on the daily delivery sheet. For this purpose the unit was the two-horse-wagon load, as a piece tally was too hard to keep straight. Automobile truck loads were marked with two tallies, or as the capacity of the machine required.

Each day the engineer of distribution entered quantities delivered, as shown by the previous day's delivery sheet, on his material charts. He also kept in touch with the material clerks at the divisions and was then able to distribute correctly material on the siding not called for on the day's delivery sheet. Undelivered quantities were not carried forward to the next day's delivery sheet, but the division superintendent was required to reorder. This put the burden of correct daily orders on the superintendents and left the distribution clerk free to devote himself to filling them.

Since the load tally showed the piece quantities only approximately, and since it was frequently necessary to cut or splice lumber to keep things moving, it was necessary for the divisions to take occasional inventories of material on hand and for the office engineer to check these against the records of material delivered and material erected.

Less-than-carload shipments consigned to a certain division were delivered direct. General supplies were taken to a central storehouse and redistributed. Trucks and teams for hauling within the divisions were requisitioned from the superintendent of distribution and assigned by him, and their time was carried on his pay rolls. Division superintendents were required to sign daily team tickets for these, showing the times of their arrival and departure.

Notices of shipment received by the purchasing agent were turned over to the traffic manager, who was responsible for tracing and placing all shipments.

PAYMENTS—Payments were based upon approved and receipted bills and upon properly certified pay rolls, and were made daily through the Government auditor.

Chart II—Construction of Shipbuilding Plant

On this work everything was performed by the contractor acting as agent for the Government.

GENERAL MANAGER
- **Assistants to General Manager—Legal, Executive, Personnel, Contracts**
- **Chief Engineer—Consulting Engineer**
  - Structural engineer
  - Mechanical engineer
  - Engineer of utilities
  - Chief draftsman
- **Purchasing Agent**
  - Buyers—materials, supplies
  - Superintendent of stores and materials
    - Storekeepers
    - Material checkers
    - Bill clerks
    - Expeditors
- **Treasurer**
  - Auditor
    - Accountants, voucher clerks, cost records
  - Chief paymaster
    - Pay staff
    - Division paymasters
      - Timekeepers and checkers
      - Pay roll clerks
- **Works Manager**
  - Office engineer
    - Division materials engineers
      - Estimators
      - Distribution clerks
    - File clerk
    - Blueprint file
    - Draftsmen—construction methods, etc.
  - Traffic manager
    - Expeditors—foreign and connecting lines
    - Yardmaster
    - Master mechanic—locomotives, cars
    - Car-record clerks
  - Superintendent marine transportation
    - Captains, lighters and tugs (not employed on construction work)
    - Foreign and connecting boat lines
  - Superintendent of equipment
    - Purchase orders, leases and records of land equipment
    - Purchase orders, charters and records of floating equipment
  - Chief paymaster (see above)
  - Field engineer
    - Division engineers
    - Chief inspector
    - Estimators of payment quantities
    - Progress records
  - Employment manager
    - Labor scouts
    - Employment record clerks
    - Medical staff
      - Welfare
    - Superintendent of police
    - Fire chief
  - General superintendent of construction
    - Assistants to general superintendent
    - Superintendent of distribution
      - General foreman of unloading
      - Yard foremen
      - General foremen trucks and teams
      - Dispatcher
    - Superintendent of railroads
      - Subcontractors on construction
      - Maintenance foreman
    - Superintendent of roads and drains
      - Foreman of roads
      - Maintenance foreman
      - Foreman of drains
    - Superintendent of water and sewers
      - Subcontractors on construction
      - Maintenance forces
  - Superintendent of light and power
    - Subcontractors on construction
    - Maintenance forces
  - Superintendent of repair shops
  - Superintendent of dredging
  - Division superintendents
    - Division engineers (see above)
    - Subcontractors on construction
  - Superintendent of miscellaneous buildings, etc.

GENERAL.—The size and scope of the work made certain general departments necessary, although construction was subdivided into contracts. The general departments were planned to interfere as little as possible with the contractors and to assist and coördinate the contractors' efforts rather than to relieve them of work. This principle applied straight through, not only to purchasing, timekeeping, etc., but to the construction of everything on the contract sections. Thus, the construction departments building railroads, sewers and water systems, roads, miscellaneous buildings, etc., were permitted to do no work on the territory of the subcontractor for a group of shipways, for example, except at his written request. Such a subcontractor was thus responsible for everything on his section, and for the coördination of all construction processes. As a matter of fact, special work such as tracklaying, electric wiring, etc., was usually performed by the general departments at the contractor's request.

DESIGN—All designing done and drawings made by chief engineer's department, tracings recorded and filed by chief engineers' department; blueprints issued to office engineer and recorded and reissued by him to field engineer and construction divisions. Structural drawings listed materials required as far as possible.

FIELD ENGINEERING—The field engineer's duties comprised: (1) Laying out of construction work, furnishing lines and grades; (2) inspection of construction work as to quality; (3) measurement of quantities of work done, preparation of payment estimates with necessary records; (4) progress charts and records. The division engineers in charge of the field parties in the various divisions were under the direct control of the division superintendents as far as the requirements for lines and grades were concerned, and in this particular the field engineer acted as a clearing house, supplying field men where needed. All records and reports were kept in standard form, however, and were turned into the field engineer's office to be worked up.

SCHEDULES.—Master schedules were made up by the general manager in consultation with the chief engineer and the works manager. Detail schedules for ordering material, etc., were made up in accordance with the master schedules by the division superintendents in consultation with the office engineer and the division material engineers. Progress records and charts corresponding to the schedules were made by the division engineers under the direction of the field engineer and were checked and summarized by the office engineer, who also exhibited them in the chart room.

PURCHASES AND STORES—Requisitions and orders were handled in general as described under Chart 1. Requisitions for construction materials were worked up by the division materials engineers and approved by the office engineer. Requisitions for supplies had to be approved by the division superintendent.

EQUIPMENT—The great quantity of plant required made it necessary to employ a superintendent of equipment to look after it. He was authorized to get prices on plant and to buy, sell and rent it, thus relieving the purchasing agent of the function; was required to record the arrival, transfer and release of all plant items, to inspect all equipment and to arrange with the division superintendents or with the superintendent of repair shops to make necessary repairs before release. His functions did not include any physical work upon the plant except painting or stamping identification numbers. Purchase orders for new machinery had to receive the approval of the works manager.

MATERIAL CHECKING—Material checkers and storekeepers reported receipt of material and supplies on proper forms to the superintendent of stores, who recorded and listed receipts against purchase orders. Lists were then transferred to bill clerks and bills were checked against them. Checked bills were passed on to the Government for approval and then to the auditor for vouchering and payment.

CHIEF PAYMASTER—The chief paymaster, although employed and directed by the treasurer, was under the direct control of the works manager in regard to time, divisions, bonuses of pay, etc. In general, he appointed a division paymaster for each subcontract or construction division, whose duty it was to keep time, make up payrolls and supervise paying off in the division, working in harmony with the division superintendent. The chief paymaster coördinated the work of the divisions, standardized methods and made up all pay envelopes and delivered them to the division offices on pay day. The timekeeping system was the same as that described under Chart 1, except that employees were furnished with numbered badges mounted on pins instead of checks and were required to display them at all times.

EMPLOYMENT—The employment manager directed the actual employment of labor as described under Chart 1, and supervised the work of the subcontractors' labor scouts to prevent interference, and in addition controlled industrial relations between labor, the principal contractor and the Government. In view of the fact that this organization, after the construction of the yard was completed, was to be swung into the permanent yard operation, the employment manager was also put in charge of all welfare work and of the fire and police departments.

DISTRIBUTION OF MATERIALS—Distribution of materials involved first the placement of carload shipments on the right sidings, and second the delivery from central storage points of materials like lumber and cement used by all the divisions. Although rehandling of this kind was undesirable, much of it could not be avoided, especially in the early stages of the work, before much track had been laid. The yard foremen, with their labor gangs for unloading and reloading, and all trucks and teams, were directed by the superintendent of distribution. Assignment of teams and deliveries from the yards were handled generally as described under Chart 1, although the yard records showed only material on hand and material delivered, and deliveries were made only on order from the divisions. Trucks and teams were assigned to the division as described under Chart 1.

The problem of proper placement of cars was more difficult than the rehandling of material, and the method used involved a study of the functions of the purchasing and the traffic departments, and of the office engineer, who originated the requisitions for materials. As described previously under "Purchasing and Stores" and "Material Checking," the purchasing department was responsible for pricing, ordering and shipping material, for checking it after it arrived, for checking bills and for all incidental details. This involved comparing quantities received on each order with the quantity ordered, but did not require any record of the distribution of quantities. Notices of shipment received by the purchasing department were turned over to the traffic department to be followed up.

The office engineer was responsible for planning the distribution of materials. He assigned to each division a material engineer whose duty it was to requisition and follow up the delivery of materials for his division. These engineers, although working under the general direction of the office engineer, were directly responsible to the division superintendents as regards ordering material, planning distribution of it and recording deliveries. The divisions' numbers were marked on all requisitions and as far as possible on all purchase orders. Shippers were required to refer to the order number on bills, invoices and notices of shipment.

In order to afford a clearing house for information secured or required by the three departments, a visible card file was kept jointly by them. In the case of carload shipments, which of course made up the greater part of the incoming material, this information came through telegraphic notices of shipment, invoices, reports of expeditors, reports from nearby railroad yards, and finally from the receiving yard check. The number of each car reported in transit, with the date of shipment and contents if known, was entered on a card as soon as the information was received, and the cards were arranged according to the last figures of the numbers. An engineer assigned by the office engineer was required to keep constantly in touch with this file and with the material engineers for the divisions and to note the destination of each car on its card. Cars arriving at the receiving yard without previous notice were opened on arrival, and the contents noted and reported to the distribution office, and they were then listed like the others. The yardmaster's switching list was made up nightly from the card file. The traffic manager's daily report of cars received, unloaded and on hand was also checked against this file.

PAYMENT—Payments were made as described under Chart 1.

upon recent Government contracts, and for the sake of clearness are commented upon as having been actually used. They apply to two distinct forms of contract, and are published here, together with the notes explaining their features, for comparison. Before deciding upon any form of organization, however, the executive should consider the capabilities and idiosyncrasies of the men whom he has available for the higher positions, for an organization built up about these men is likely in practice to work out far better than one theoretically more nearly perfect in which they are fitted into preconceived positions without regard for their personalities.

The charts are arranged in a more compact form than that commonly used. Titles of equivalent rank are placed with their initial letters in the same vertical line, the more important to the left. Thus men in line 4 report to superiors in line 3, men in line 3 to superiors in line 2 and so on. This arrangement, while perhaps not as clear as the customary rectangles and connecting lines, saves space and also makes it possible to express a large organization on a common typewriter.

Temporary Bridge of Old Girders Has Suspended Floor

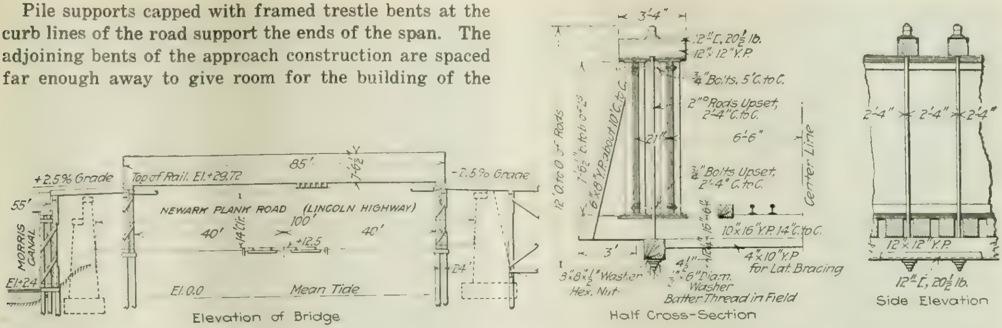
Double Girders Carry Railway Tracks Over Highway On 85-Foot Span—Bolt Suspension of Ties Gives Equal Loading

BY INGENIOUS utilization of available old material the Pennsylvania R.R. has just built an urgently needed highway crossing quickly and at low cost. The solution of the problem involved doubling the girders and suspending the floor from them by long bolts, distributing the load equally between the girders. Timber floor construction was adopted, as best suiting the requirements of the case. The crossing as built is temporary; it is to be replaced eventually by a 100-ft. through-girder span with solid floor, on masonry abutments.

A spur track to the Federal Shipbuilding Co. yard, just west of Jersey City, N. J., was needed, and to reach this from the main track a mile away required crossing the Newark Plank Road (Lincoln Highway), a heavily traveled thoroughfare 100 ft. wide running along the north edge of the shipyard. Among the bridge material which the railroad had on hand were some 85-ft. plate girders, taken out of service because too light for present-day traffic. W. C. Bowles, engineer of construction, planned to use these by placing two side by side and suspending the floor by bolts between the two girders of a pair.

This scheme was carried out, as shown by the sketch herewith. Heavy ties spanning the full floor width are suspended by hanger rods engaging cross-blocks over the top flanges of each pair of girders and a longitudinal timber under the ties. Steel channels distribute the washer pressure produced by the bolt load. The lateral construction of timber diagonals under the floor, bolted to the ties, and the swaybracing of raking timber struts bolted to extensions of the ties and fitted under the top flange of the outside girder are fully shown in the drawing.

Pile supports capped with framed trestle bents at the curb lines of the road support the ends of the span. The adjoining bents of the approach construction are spaced far enough away to give room for the building of the masonry abutments on which the permanent crossing is to rest.



TWIN GIRDER AND SUSPENDED FLOOR CONSTRUCTION MADE POSSIBLE THE USE OF OLD STEEL FOR BRIDGE

Erection was accomplished without interrupting traffic on either the roadways or the trolley tracks of the highway. Timber bents were set up between the tracks and the roadways, dividing the span into three parts, and timber stringers were laid over these to form a temporary support at the railroad grade level. The girders, brought up on cars on the approach track, were skidded along over this temporary supporting structure with the use of rollers and rope tackle. When in the proper longitudinal location they were turned up from the flat position to the vertical position by a derrick car.

The structure was designed in the office of H. R. Leonard, engineer of bridges and buildings, Pennsylvania R.R., and was erected by the Stillman-Delehanty-Ferris Co., contractor.

Trails Constructed by National Forest Service

Classification, Forces Used in Construction and Cost of Unique Class of Road Building in Rough Mountains

MOUNTAIN trails, constructed by the United States National Forest Service, while narrow, are often difficult to locate and build. The illustrations show the sort of rock cuts required, many of them in most picturesque locations. One view shows excavation in progress at the Devil's Backbone, Rogue River Trail, in the Siskiyou National Forest. Another depicts the approaches to a tunnel under a fall on the Eagle Creek Trail in Oregon. A third view shows a completed portion of the Eagle Creek Trail, at a point where it was necessary to place a hand rail at the inside.

These trails are divided into three classes. Class A includes main trails, sometimes suitable for wagon roads; class B, secondary trails, connecting main trails and not used for vehicle travel; class C, branch or spur trails. The points of difference between the three classes are given in the table.

The Forest Service has found that trails can usually be constructed most economically by a 10-man crew, this being about the minimum force which can be managed so that everyone, including the cook, is kept busy. The average 10-man crew frequently includes a foreman, a cook, a packer, two swampers and five graders, or, if the route lies through a region of thick undergrowth, there may be a foreman, a cook, a packer, two brushers, two buckers and four graders. Where much rock work is needed, drillers and powder men are added to the list. By selecting a foreman who can share in or direct any kind of work that may be encountered, the crew often makes very good progress with one or two men less.

ROCK CUT AT DEVIL'S BACKBONE ON SISKIYOU TRAIL

WHERE EAGLE CREEK TRAIL, OREGON, ROUNDS A POINT

TUNNEL CARRIES TRAIL UNDER FALLS

On the eastern slope of the Cascade Mountains the undergrowth is light and the slopes are ordinarily smooth or rolling. In this territory trail costs range from \$20 to \$100 per mile. On the west side of the divide the undergrowth is much heavier, the slopes are steeper, and the rock work is more frequent, so that costs range from \$75 to \$350 per mile, the average being about \$200. This cost includes small bridges. Any bridge estimated to cost more than \$100 is considered as a separate project. Trails are occasionally built through territory where rock work is continuous, thus greatly increasing the cost. An example is the recently constructed 28½-mile Rogue River Trail in the Siskiyou National Forest, which included an unusual amount of rock work and averaged about \$500 per mile in cost.

CLASSIFICATION OF FOREST SERVICE TRAILS

	Class A	Class B	Class C
Tread (net)	15 in. to 48 in. as necessary	12 to 48 in.	12 in.
Grade.....	0 to 15% 10% standard	0 to 20%	Any grade a horse can get over
Clearing (net).	6 to 10 ft	6 to 8 ft.	4 to 6 ft.
Switchbacks	To be avoided	Allowable Legs long	Whenever desirable

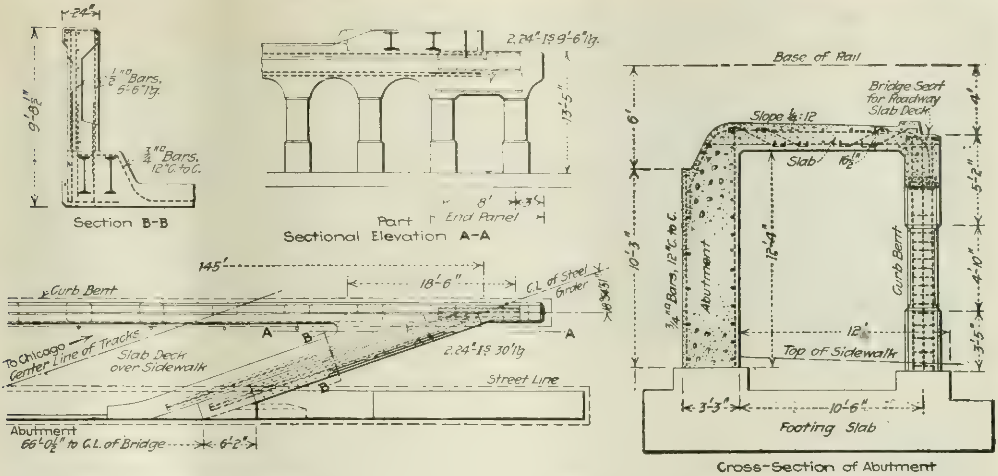
Skew Subway Bridges Require Special Design

Chicago & North Western Uses Monolithic Sidewalk Spans With Roadway Having Precast Slabs and Steel Portal Girders

REINFORCED-CONCRETE subway bridges recently constructed for track-elevation work in Chicago are of unusual design in having each sidewalk span formed as a monolithic structure combining the abutment, sidewalk bent and deck slab. In effect, it includes the footing or foundation slab also, for though this is built in advance it is bonded to the abutment and bent. As a rule, the footings are constructed before the tracks are elevated, and the other three elements are built as a unit after the tracks have been raised. This arrangement permits the footings to be constructed at any convenient time, independent of the elevation of the tracks. This design is used by the Chicago & North Western Ry. on the Mayfair (Chicago) track elevation of its Wisconsin division.

SKEW SUBWAY BRIDGE HAS STEEL PORTAL GIRDERS TO SUPPORT PRECAST SLABS OF ROADWAY SPANS

One advantage of this design is economy of material in the abutment, for this would have to be very much thicker at the footing if it were built independently instead of being combined with the deck slab and bent to form a structure which is stable against earth pressure. Formwork and the placing of concrete are said to be simplified by the monolithic construction. When deck slabs are built separately, the tops of the abutments and curb bents must be formed with care and precision to provide proper seating for the slabs. The latter also must be made with care to insure this seating. Furthermore, it is pointed out that the elimination of joints removes the need of providing special arrangements for carrying the waterproofing across the joints. In the monolithic structure there is no liability of rupture of

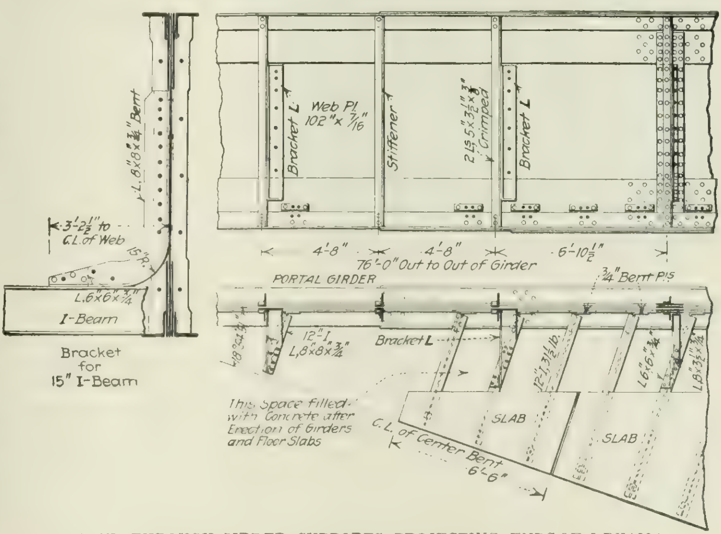


SIDEWALK SECTION OF SUBWAY BRIDGE IS BUILT AS A MONOLITHIC STRUCTURE, ELIMINATING JOINTS

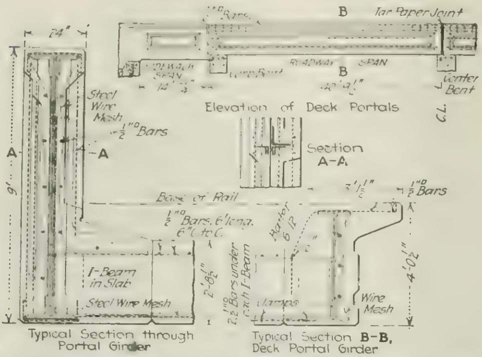
the waterproofing membrane by displacement of parts or local movement under deflection. Foundation piles were not used, except in one case where a sewer was adjacent to the footing slab.

The sidewalk bents have rectangular columns spaced 8 ft. on centers and carrying a heavy cap girder. Arched openings are formed between the columns. The last opening at each end of the bent is spanned by I-beams supported over the columns and embedded in the girder. This construction is necessitated by the fact that, owing to the skew of the crossings, the end bearings of the steel roadway girders and the I-beams in the deck slab of the sidewalk span are brought directly over these end openings. In most cases the supporting I-beams are sufficiently shallow to allow the retention of the arch form of the opening. At Milwaukee Ave., however, the sharp angle of skew makes the bridge girders very long, with heavy end reactions that require deep connecting girders between the two end columns of the bent. In this case a flat-top opening between these columns is made necessary. The clear width of sidewalk, measured on the square, is 8 ft. The deck slab of the subway is 14 in. thick, increased to about 3 ft. at the ends, where it is formed into a girder consisting of a pair of 24-in. I-beams incased in concrete. This girder carries a projecting concrete portal slab forming a runway, which is built after the girder and bonded to it by vertical reinforcing rods. This girder has a paneled face and conforms to the appearance of the concrete-cased steel portal girders of the roadway span. All of the concrete used is a 1:2:4 mix, using crushed stone as the coarse aggregate. The formwork is of wood.

Portable or precast deck slabs of I-beams incased in concrete are used for the roadway spans of 24½ ft. In these the I-beams are designed to carry all the load, the concrete serving as bracing, solid floor and protection for the steel. Cylindrical spaces are formed in the concrete to reduce the weight of the slab. These slabs and the floor construction are the same as used by this railway for its track elevation at Milwaukee, described in *Engineering News-Record* of Mar. 14, p. 511. At Chicago, however, all the crossings are on a skew of such acute angle as to require special construction to



STEEL THROUGH-GIRDER SUPPORTS PROJECTING ENDS OF I-BEAMS OF DECK SLABS



THROUGH AND DECK PORTAL GIRDERS OF SKEW BRIDGE ARE INCASED IN CONCRETE

provide support for the outer sides of the small slabs which fill in the angles of the deck.

This problem has been solved by the use of steel portal girders. These are below the level of the base of the rail, except at Milwaukee Ave., where the extreme skew requires very long girders. In this case, they are through-plate girders 8½ ft. deep with side reinforcing plates and two angles for each chord. The I-beams of the deck slabs are of such length as to rest upon the bottom chords of the portal girders, but the concrete of the slab is made shorter, so that the beams project about 3 ft., and in erection an open space is thus left between the slab deck and the girder. This is done to allow riveting the connections at the ends of the beams, and of placing the curved brackets or gusset angles which are riveted to the web stiffeners and the I-beams. After erection, formwork is placed and concrete is poured to incase the girders and I-beams and to fill the opening along the side of the slab deck.

In the casing concrete ¾-in. stone is used. This concrete is reinforced by vertical and horizontal rods, with wire mesh over the chords, and is anchored to the steel by rods passing through holes in the web stiffeners. After the forms are removed the exposed paneled surfaces of the casing of the roadway girders and the concrete girders of the sidewalk spans are finished by rubbing down with carborundum blocks.

These bridges are designed for Cooper's E55 live load. Dead load is taken as 550 lb. per square foot for the slabs and 3500 lb. per linear foot for the steel portal girders. The use of these girders, necessitated by the skew construction, increases the cost of the design as compared with that of the Milwaukee subways, which are practically on right-angle crossings and have only the deck slabs. It is stated, however, that the cost will not exceed that of the earlier type of subway bridge used by this road, having the spans formed by a self-supporting steel-trough deck carried by steel bents.

The track elevation in these cases was carried on entirely by the railway company's forces, with J. S. Pole as engineer in charge of the work both at Chicago and Milwaukee. The design and construction were directed by W. H. Finley, chief engineer of the Chicago & North Western Ry., and O. F. Dalstrom, bridge engineer.

Labor Shortage Made Good by Station Contract System

Winnipeg Aqueduct Workers Speed Completion of Huge Job at Contract Prices Which Net Thirty to Forty Per Cent Increase in Wages

BY F. P. KEMON
Superintendent, Camps 1 and 5, Winnipeg Aqueduct Construction Company, Ltd.

SCARCITY of labor brought about a trial of station work, or contracting different jobs to a small number of men, on the Winnipeg aqueduct, with the result that in some instances the work is being carried on with men fewer by one-third than formerly. The type of construction required on this aqueduct, which was described by William Smaill in *Engineering News-Record* of Apr. 19 and 26, 1917, pp. 121 and 180, proved ideal for the application of this system because of the extensive repetition of similar jobs.

The contractors decided upon the station system at the beginning of the 1917 season, shortly after the articles mentioned were published. It was the intention to make prices for the work which would allow the men to earn from 10 to 15c. per hour extra. Wages at the time ranged from 30 to 40c. per hour. The men employed included Belgians, Russians, Austrians, Swedes, Poles and Norwegians. They had become very independent on account of the scarcity of labor, and it was impossible to maintain any discipline while working on the hourly basis. When the station work was first proposed, the men refused to accept it, being suspicious and fearing that advantage would be taken of them. In some instances large numbers left the work, as many as 50 to 75 deserting some camps at one time. The most difficult to handle and the last to take hold of the station work were the Austrians. The Belgians accepted it first and proved to be the best workers under this arrangement, with the Swedes second and the Norwegians third. After the men had worked a short time under the system and found that it was possible to make more money than on the hourly basis, there was no further trouble in letting work, and the plan proved successful in conserving man-power.

A schedule of prices to be paid was made up by the chief engineer, but it could not be strictly adhered to on account of constantly changing local conditions. The letting of the work and the prices to be paid had, therefore, to be left to the judgment of the men in charge at the different camps. No record or schedule of working hours was maintained, as in most instances the men would get out an hour or two before breakfast, and would always work several hours in the evening after supper. They also developed in a short time a keen insight into the cost of doing the work, and in dickering for work would try all kinds of subterfuges to in-

WORKMEN MOVED A WHOLE PORTABLE CAMP ON CONTRACT FOR FROM $500 TO $700

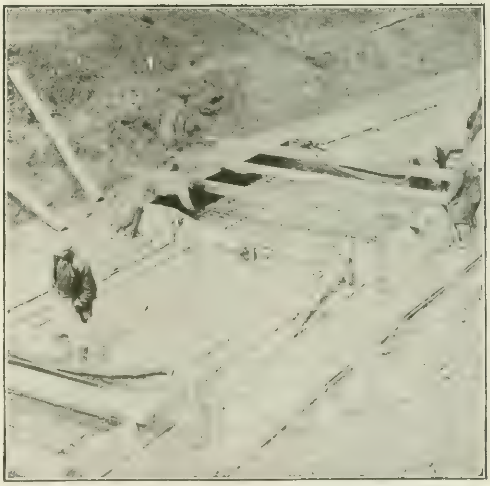
crease the price demanded. Most of them were absolutely conscienceless as to keeping a contract which did not prove as profitable as they had anticipated, and showed no hesitation in throwing up jobs and going to other camps to look for work. Considerable care and diplomacy were required of the men in charge in order to keep the cost of the work down and still continue the system.

When a contract was let and the work started, the resident engineer for the contractor would record the station and report the progress of the work. These reports furnished the basis of payment. Working in gangs, with one of the party acting as leader, the men often earned from $8 to $12 per day. The leader would do the bidding for the gang, and they would be governed by him. Often one gang would take three or four different contracts in order to work continuously throughout the day, and when it was not possible to do this they would work on the hourly basis for several hours while waiting for additional station work to become ready.

As was related in the articles referred to, the excavation to within 6 in. of grade was done by draglines, most of the aqueduct being cut-and-cover section in very flat country. The excavated material was placed alongside the tracks to form an embankment, upon which was built a 3-ft.-gage railroad used in placing concrete. A templet was employed to keep the center line of this embankment parallel to the center line of the aqueduct, so that the traveling concrete chutes would work properly when moved along the line. The grading of the top of this embankment was the first work let on the contract basis, at prices ranging from 3 to 6c. per linear foot, according to the amount and nature of the material to be handled. One or two men usually performed this work.

A wood box drain of 8 x 10-in. section was next placed in the center of the aqueduct trench, 2 ft. below the bottom of the invert grade, with a 2-in. layer of screened gravel all around it. These drains were built of 2 x 6 x 16-in. plank with tops and bottoms of 1-in. material. They were nailed together by contract for 1½c. per linear foot. The work of excavating and setting these drains, including placing the gravel, was let for 5 to 10c. per linear foot, according to the nature of the materials excavated, which varied from creek sand and muskeg to solid rock. Four to eight men usually worked at these contracts. Cross drains at intervals of 500 ft. were also required, which carried water to sumps outside the line of the aqueduct, from which it could be disposed of by gasoline-driven pumps. The gravel used in placing these drains was delivered along the trench, and was not included in the contract.

Following the placing of the box drain, pioneer invert forms 13 x 15 ft. by 6 to 24 in. high were next set. This work, including oiling the forms and placing a 4-in.



FORMS WERE SET AND OILED FOR $1.75 TO $2.50 EACH

copper strip at each end for a waterproofing joint, was let for $1.75 to $2.50 a section, the work being done by two or three men. After the concrete was placed, these forms were stripped and moved ahead for 75c. per set by two men. Intermediate invert forms were set up, dismantled and carried ahead, for 75c. per section, usually by three men.

The excavation for these forms was performed for $1.75 to $5 per section by three to four men. The concrete in the invert section was screeded by three men for 75 to 90c. per section, and the trough finished for

INSIDE AND OUTSIDE FORMS WERE MOVED AND SET BY EIGHT TO TWELVE MEN FOR $20 to $27.50 PER ARCH

60 to 90c. per section, including the placing of a $\frac{3}{4}$ x 1 in. by 15-ft. cedar strip in the center of the haunch and roughing up the top of the haunch with a wire brush after the concrete had set.

In soft ground sections the aqueduct was carried on timber piles 20 to 30 ft. long, eight being used to a section of invert. These piles were driven by a contractor who furnished his own plant. The work of cutting them off and bracing them was done on the station system, for $3.25 per invert section, by four men. This consisted of cutting off the piles and cutting and placing cross braces, drifted to them with $\frac{7}{8}$ x 18-in. square spikes. The inverts and the sections supported on piles were reinforced with 72 pieces of $\frac{3}{4}$-in. twisted bars, which were placed and wired at $3.25 per section, this work including also the cleaning and oiling of the forms and finishing the excavation.

The first section of the aqueduct was made with steel forms in 45-ft. sections between the expansion joints, 6 outside and 4 inside sets being used in each camp. Both the inside and the outside forms were moved on travelers. The former were first erected in the trench on an hourly basis, after which contracts were let at $20 to $27.50 per arch for moving and setting up. This included laying the traveler tracks, dismantling, moving ahead and erecting, and oiling and preparing the forms to receive concrete. From 8 to 12 men were required on this job, according to the varying size of the aqueduct. These gangs would set up three to four arch forms per day. They were furnished with a gasoline dinkey free of charge, to pull the sections, one of the gang operating the dinkey.

Central concrete mixing plants equipped with 18-cu.ft. mixers and bins of 500-yd. capacity were used on the work, being located about half a mile apart. Aggregate was delivered in air-dump cars, the sand and gravel being already proportioned. Cement was delivered in sacks, and was unloaded and stored in the cement houses for 1c. per sack. A 3-ft. gage track at each plant carried $1\frac{1}{2}$-yd. Z-body dump cars, which delivered materials from the bins to the mixer. These cars were loaded by contract at 30c. per yard. As soon as the work was put on this basis the men demanded larger shovels, and from 6 to 8 instead of from 8 to 10 kept the mixers going. One man fed the mixer with cement at 1c. per sack, and did up his own empty sacks in bundles of 50. Previously this work always required two men.

The 3-ft. gage track for hauling concrete to the forms was first laid on the hourly basis in sections 20 ft. long, made up of 20-lb. rail and wood ties, seven to the section. Once laid, it was taken up and moved ahead on the contract, for $1.25 per section. Coal for the draglines and mixers was unloaded for $6 per car.

Foundation fill of gravel was used in soft-ground sections, usually being placed under water in the trench. This material was delivered in air-dump cars to the right-of-way where it was to be used, loaded into wheelbarrows and dumped into the trench from runways. This work was let at 30 to 40c. per cubic yard. In some sections which were so soft that the bank had to be kept an extra distance away from the excavation timber trestles were required for these wheelbarrow runways, which were built at 25 to 45c. per foot. This included cutting from the neighboring brush the timber with which the trestles were built.

That portion of the backfill which had to be placed by hand was contracted at $7\frac{1}{2}$c. per linear foot for each side of the trench. After this fill was placed in 12-in.

SIXTY TO NINETY CENTS PER FORM WAS PAID FOR THIS JOB

layers of sand the draglines completed the backfilling, the top and slopes being then dressed to templet by hand at 4c. per linear foot. The feeding, however, was done on the hourly basis.

Each camp consisted of 12 to 15 frame buildings, made up in sections bolted together, so that they could be taken down and reërected at the next site, as described in *Engineering News-Record* of June 7, 1917, p. 511. Each provided accommodations for 100 to 500 men, $5 per week being charged for board. These camps were taken down and moved complete from one site to another at a contract price of $500 to $700.

The work is being completed by the Winnipeg Aqueduct Construction Co., Ltd., for which William Smaill is general superintendent and W. G. Davies is chief engineer. The writer is in direct charge of camps 1 and 5.

Turnout in High Velocity Canal Gives Good Service

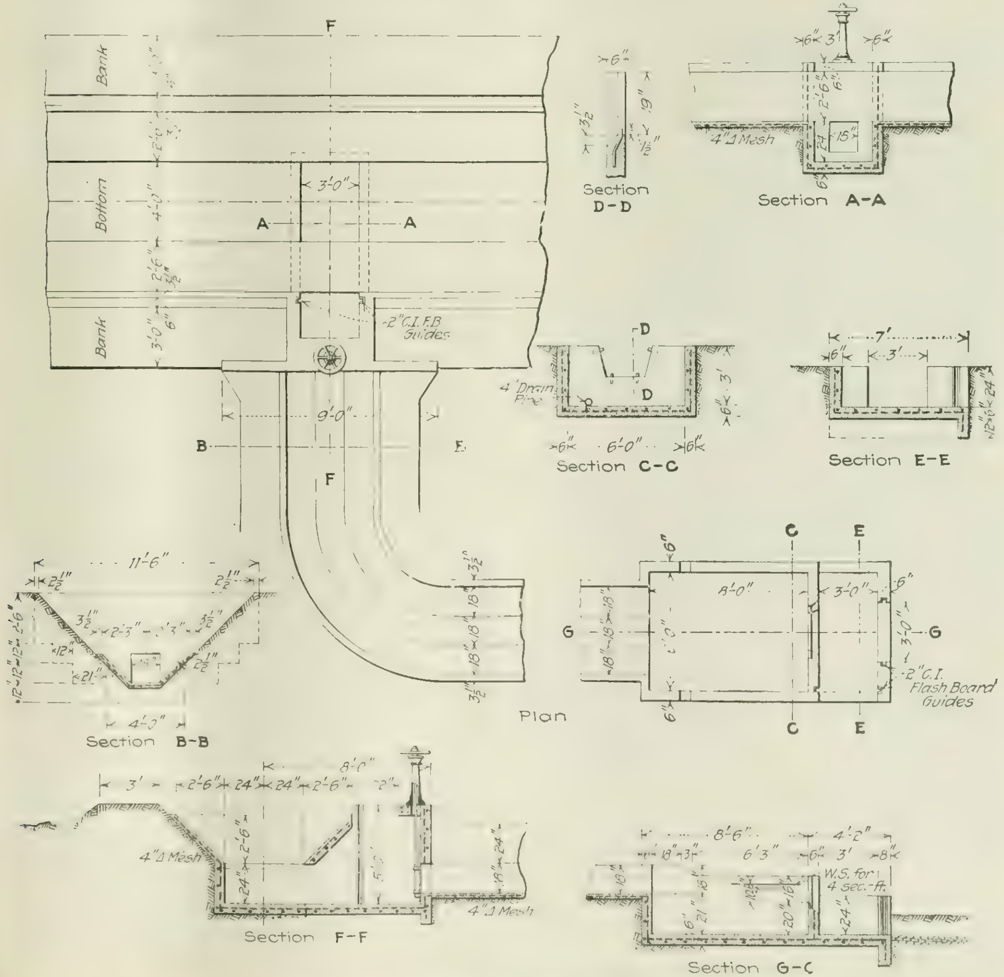
Under Drop in Irrigation Canal Bottom Diverts Water to Branch Without Affecting Capacity of Lateral

By J. L. Lytel

Project Manager, United States Reclamation Service, Provo, Utah

DIVERSION of water under high velocity from laterals to sublaterals is accomplished by under drops on the Strawberry Valley Irrigation Project of the United States Reclamation Service, in Utah. The greater part of the main canals and about 65 miles of laterals and sublaterals are lined with concrete. Many of these laterals are built on comparatively steep slopes and in some of them the velocity of the water exceeds 30 ft. per second. On one of the larger laterals, which has a capacity of 150 sec.-ft., and which was designed and built mainly as a wasteway for the entire high-line canal system, it is necessary to divert water for irrigation purposes at a number of points where the velocity varies from 15 to 30 ft. per second. This must be done without in any way affecting the flow or carrying capacity of the lateral at the point of diversion, as, because the lateral is used for a spillway for taking care of all the excess water that may from time to time be thrown off by the system, the amount of water carried in it is likely to vary considerably, and it may be called on to carry almost its full capacity on short notice. This is particularly true in case of a break on some large lateral of the system or a heavy rainfall.

In order to divert water without interfering with the flow or carrying capacity of the lateral, the special type of reinforced-concrete turnout shown by the accompanying details was designed. The design provides for the water to be taken out of the channel through a rectangular opening in the bottom of the canal, the concrete-lined sides of the canal section not being



TURNOUT IN HIGH VELOCITY CANAL DOES NOT LESSEN CAPACITY OF LATERAL

changed at the turnout. This allows the rapidly moving water to continue on its way without interference, and the lateral will carry its full capacity past the turnout without splashing or unusual commotion. The amount of water taken out at these turnouts varies from 6 to 12 sec.-ft. depending upon the area that is being served from that particular turnout. Turnouts built in accordance with this design have been in operation for several irrigation seasons and have given very satisfactory service under any stage of flow in the lateral.

Railway Corporate Interests Should Be Conserved

Credit Must Be Sustained, and Return of Properties Unimpaired to Owners After the War Is a Duty Under the Law

BY A FORMER GENERAL MANAGER

OPERATION of the railways by the Government brings up prominently the question of the conservation of the corporate interests, not only on behalf of the owners of the railways, but in the public interests as well. The matter of transportation enters so vitally into every avenue of modern life that any disturbance of the conditions affecting it must react upon the public welfare. That anything and everything which affects a war emergency must be done in that interest is unquestionable, but, on the other hand, is it not wise to consider prudently whether the necessity actually exists before action is taken to disturb a situation which does not present a war emergency? The readjustment which will take place after the war will require a return as nearly as possible to normal conditions, therefore is it not wise conservation to distinguish between the essential and the nonessential in adopting the various lines of policy affecting our important transportation interests?

REASONS FOR FEDERAL OPERATION

The railways were placed under Federal operation during the war in order that the maximum transportation, first for war purposes, then for the public interest, could be secured. The corporations were prohibited by law from making combinations of parallel and competing lines, from pooling traffic, from reducing nonessential services, which practices were all made possible under Federal operation as a war-emergency measure. It is safe to assume, therefore, that Federal operation was a war necessity. But this necessity only extended to such changes in pre-war conditions as affected the main purpose. It was not necessary to disturb any condition which in no manner affected the war necessity, and any unnecessary changes must defeat the very purposes for which they were intended.

The railways have asserted that the public policy and attitude toward them for years have rendered it impossible for them to increase their transportation capacity and efficiency, and to do the things which are now being accomplished under Federal operation. Be that as it may, a condition confronted the country, and it was necessary to take such action as would bring about the results demanded by the emergencies created by the war. There was no time to correct the past mistaken policy directed against the roads, if such existed, and the only alternative was to take prompt and decisive action.

We cannot afford, however, to disregard the interests that are involved in the operation under the Government, and their safeguarding is an important question which must receive attention. We are fighting "ruthlessness" and should bear in mind that anything done that adversely affects the corporate interests of the railways which is not a war emergency measure can be classed as an unnecessary disturbance of conditions without any benefit to the public or the war policy. Many things must be done under pressure and the stress of the moment, and some mistakes are necessarily unavoidable, but extreme care and caution should be exercised to conserve in every possible manner the interests vitally affecting the Government and the people as a whole.

The conservation of the corporate interests of the railways calls for the safeguarding of their financial, commercial and physical elements. First, we cannot afford to take any action that will affect the credit of the railways, and must therefore be careful to be just and fair in giving them proper compensation for the use of their valuable properties. Failure to do this must react upon our whole financial policy and destroy confidence in an industry upon which the people are vitally dependent. Second, we cannot afford to disturb needlessly the established commercial customs which are dependent upon rates and service which have been the outgrowth of years of adjustments and development, and which cannot be disturbed without vitally affecting the vast business interests and prosperity of this country. Third, we cannot afford to make a misuse of our railways to the detriment of their physical characteristics. The Federal operation is simply a temporary tenancy, and carries with it the obligations of careful use and return of the railways to the owners in as good condition as when taken over.

The act of Congress authorizing the Federal operation of the railways during the war is ample to protect and conserve fully the corporate interests in the manner above specified, and it should be carried out by those in charge of the Federal operation. Nothing can be gained by endeavoring to carry out a plan that will affect those interests adversely unless it can be shown that it is an endeavor to meet a war emergency. A policy of fairness in conserving the interests of our railways will partly answer the complaint by the railways of the past policy and attitude, which they assert are responsible for their present condition.

Meter Capacity Basis for Charge

Because the capacity of an 8-in. meter is 278 times that of a $\frac{5}{8}$-in. meter, it was urged by the Terre Haute Water-Works Co., in a recent hearing for increased rates, the minimum charges should be proportionate. "Unless proper minimum charges are made for the larger meters," it was held, "the few who enjoy this valuable emergency or auxiliary service will not be paying their share of the cost of water-works maintenance."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Hydraulic Interpretation of Indefinite Water-Power Grants

REVIEWED BY ROBERT E. HORTON

Consulting Hydraulic Engineer, Albany, N. Y.

WATER RIGHTS' DETERMINATION FROM AN ENGINEERING STANDPOINT—By Jay M. Whitman, M.A., M.E., C.E., Consulting Engineer; Formerly U. S. Naval Engineer; Later Professor of Engineering, University of Arkansas. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 204. $2.50.

Essentially a highly specialized book for hydraulic engineers, this work is intended also for the owners of water grants and for their legal representatives. It relates exclusively to questions of riparian water right interpretation under conditions existing in the Eastern states, especially in the older mill communities. It is intended to assist anyone interested in determining the meaning of an indefinite water grant by furnishing precedents and data for converting such grants into terms of horsepower (when the head or fall is given) or into terms of volume of water in cubic feet per second under a given head.

By an indefinite water grant is meant a grant of water sufficient for a specific purpose, but not stated directly in terms of volume of power. It was common in the early days of water-power development in the East for the owner of a water power to sell or lease water rights adjoining a dam or canal, conveying therewith the right to the use of sufficient water for a specific purpose, as for example, "Water for four runs of mill stones, for a muley saw mill, for a cotton mill of 2000 spindles, for a carding mill, a fulling mill, or for a trip hammer and force." These are examples of indefinite water grants in the sense of the term used in this book. The majority of such indefinite grants were made fifty to one hundred or more years ago. They have often passed through many conveyances from one owner to another, with language unchanged down to the present day. Often every vestige of the original mill is gone. Not infrequently the power was never utilized for the purpose specified in the indenture.

The advent of hydro-electric power development, modern high-capacity turbines, and the tendency toward centralization of water-power stations, gave rise to a new wave of water-right litigation. There is hardly a water-power dam in northern New York where such ancient water grants exist that has not had its "day in court" for the power owners in the past decade. Sometimes these questions have been litigated over and over again at the same dam at intervals of ten or twenty years.

Experience shows that the best interpretation of a water grant may, in general, be made by a hydraulic engineer who has become competent through training, travel, observation, experience and research to view the problems both in the light of local and general experience and practice. Such an engineer may be an invaluable adviser to a court or to his clients in the interpretation of water grants. The author of this book has had a long experience in this class of expert service, and the engineering and legal professions are indebted to him for making many of the results of his experience and research generally available, especially as it seems to be the only book on the subject which has been published.

Books which record the personal researches and experiences of the authors are best calculated to contribute to the fund of permanent knowledge. It is rare that such a record of personal experience covers the whole story. This book relates to disputed questions and, like most books of its class, it should be read with discretion.

The volume opens with a discussion of questions relating to the amount of power required to propel a run of mill stones for grinding wheat. The data given show a considerable range. The author has neglected to state in many instances important facts which would affect the results in connection with the different examples given.

Many of the authorities cited are millwrights who had rules as to the horsepower of water wheels to be installed per run of stones, and the power given is figured from the water-wheel capacity. As a matter of fact, this manner of calculation is almost certain to lead to an excessive estimate of the amount of power required unless the water-wheel gate opening is taken into account, which does not appear to be the case here. Good millwrights installed water wheels not only sufficient to do the grinding under ordinary conditions, but often much larger. Usually there was one water wheel to each run of stones where turbines were used. Stock pattern turbines were made in various sizes, and the nearest size larger than was actually required would be installed. Then again, a wheel was put in large enough to furnish the required power with hard grinding and under the most unfavorable conditions as to character of grain, weather and sharpness of the mill stones, and also sufficient for operation in the spring with reduced head due to backwater. Under ordinary conditions a water wheel adequate to meet these requirements would only operate at part gate or part capacity.

A few examples are cited from Leffel's wheel book as to the power consumed in grist mills. These examples apparently relate to cases where the power used was relatively large. The old Leffel wheel books contained scores of examples of power requirements in grist mills where head, gate opening and all needful data were given. These old books are very scarce, and the preservation of these valuable data in tabular form in the present volume would have been well worth while.

In discussing the power required for a run of mill stones as fixed by certain court decrees the author mentions "the practical interpretation of a grant," but does not clearly define what this means. It appears from the context that the author may have construed this legal

phrase as defining the use made of the grant at the time of the interpretation instead of the use at the time the grant was made, as should be the case where prescription is not involved. There are certain other principles of law which an engineer attempting to interpret a water grant should understand but of which no mention is made.

The power required for grinding grain and for driving auxiliary machinery has increased somewhat progressively from the earliest days down to the introduction of the roller process of flour milling. A knowledge of the history of the development of flour milling is a necessary requisite for the interpretation of early water grants in terms of runs of stones. This phase of the subject has been only slightly touched upon and many important features are omitted.

Many of the data on the general subject of water required for a run of mill stones are derived from Oswego valley conditions as they existed in Civil War times and subsequent years. Some of the data for this locality appear questionable, being derived in part from local histories. The practice cited is not necessarily representative of other years or of other localities. Special conditions existed which must be taken into account in applying these data, and in general the story of flour milling in the Oswego valley, the attendant conditions and the circumstances under which various court decrees were made are not set forth in sufficient detail to form a basis for fair judgment. It would appear that the author, having been associated with these matters in the Oswego valley in connection with litigation, has not had available to him all of the pertinent data and has, therefore, failed to tell the whole story. For example, some stress is laid upon the Varick canal decree, which fixed an exceptionally high value of the amount of power required per run of mill stones. There is at least some evidence that this decree was the result of an agreement and was not a well fought issue. Two bitterly contested cases on the opposite side of the river at Oswego, each of which terminated in a supreme court decree fixing the amount of water per run of mill stones at one-half as on the Varick canal, are not mentioned.

On p. 29 a table is given of some of the leases of the runs of stone by the Oswego Canal Co. Some of these leases were dated as early as 1826, yet the author has calculated the equivalent horsepower as that obtainable with a good modern turbine. One-half the leases cited antedate the author's own stated time of the introduction of turbines of any kind, and nearly all of them antedate the use of turbines giving the 80% efficiency which is the basis of the table. Furthermore, there are constructive features affecting the interpretation of these leases which are altogether omitted, and which if taken into consideration may nullify the author's conclusions in regard to them. Very likely the author was not familiar with Judson's tests in the early forties in one of the large Oswego mills, as no mention is made of them.

On pp. 33 and 34 the author seems to question the ability of the late Charles Rhodes, and by inference attempts to impeach his character. Rhodes was well and favorably known in the latter half of the nineteenth century in the milling region of central and northern New York. His ability could hardly be questioned by one who had seen the details of the turbine tests which he carried out and which, it is hoped, may at some time be published. These tests were made in a well-constructed flume using a Francis weir and a good friction dynamometer, almost exactly as such tests are conducted at Holyoke. He was agent for the Oswego Canal Co., the owners of power on the opposite side of the river from the Varick canal. There appears to be no foundation for the author's statement that "he was influential if not controlling in determining the meaning of a run of stone on the Varick canal in 1875 to be water enough to give 37.75 horsepower." If he had any influence it was quite certainly opposed to so large a figure.

Summarizing the whole discussion by the author on the question of water grants in terms of runs of stone, it may be said that the book contains a large amount of valuable data on this subject. Sufficient details are not given and sufficient stress is not generally laid on the importance of the date of the grant as affecting the amount of power required. This chapter does not tell the whole story, and it is certain that an equal number of good additional authorities could be brought forward from the same locality. The results would probably be an agreement with the data cited by the author in many cases, but with a tendency toward considerably lower figures, especially for New York State outside the Oswego valley.

No data are given for Rochester, which was a great milling center contemporaneous with Oswego.

The discussion of runs of stone is followed by briefer treatment of other forms of water grants, including cornmeal and feed mills, corn crushers, distilleries, starch mills, oatmeal mills, pearl barley mills, saw and shingle mills, tanneries and various iron-working industries. The data on these subjects are presented in a less argumentative form than in the case of flour mills and are, relative to the amount of data available, much more nearly complete than in the case of flour mills. In fact, data on some of these subjects are extremely meager, and the author has done well to bring forward those here presented.

Next follows a discussion of the power requirements in cotton and woolen mills. Here the author gives the results of numerous original tests hitherto unpublished, which form a valuable supplement to the extensive data of similar tests contained in Webber's "Manual of Power."

Part 2 relates to the interpretation of grants made in terms of the right to use the flow of a stream of specific size, or the flow through a specific aperture or through a specific water wheel. There is a discussion of the water requirements and efficiencies of various primitive forms of water wheels, including tub, flutter, wooden scroll case central discharge wheels, undershot, overshot and breast wheels. Sparse as they are, the data are well presented.

Next follows a brief outline of the development and history of turbines, with a summary of the Fairmount water-works tests of 1859-60, the centennial tests of 1876 and of tests at Holyoke, mainly by James Emerson, prior to 1880. The volume closes with a bibliography and a good index.

This book is to be considered as a contribution to the subject and not as a complete or extensive treatise. Every water-grant problem requires specific research, and anyone interested in such a problem will find the book a useful starting point for such investigation.

Sewage-Works Investigation and Advice

SEWAGE DISPOSAL IN KANSAS: A Discussion of Practice in Certain Municipalities, Together with Instructions to Plant Operators—By F. M. Veatch, H. P. Evans, and L. E. Jackson, with the Collaboration of the Division of Water and Sewage, Kansas State Board of Health. C. A. Haskins, Engineer, C. C. Young, Director of Laboratory. Division of State Chemical Research, Engineering Bulletin No. 9; Lawrence, Kans.: University of Kansas. Paper; 6 x 9 in.; pp. 166; illustrated.

Designed to show what Kansas sewage-works are accomplishing and to serve as a handbook for plant operators in that state, this pamphlet bids fair to be of general interest and value. The work was done jointly by the two agencies noted in the heading above. Two men from the division of state chemical research of the University of Kansas spent two years on a study of the operation of eight representative Kansas sewage-works. A considerable part of the pamphlet is taken up with a description of these plants and with test data.

Professor Haskins contributes a short discussion on "The Sewage Disposal Problem in Kansas." There are also chapters on sewage disposal practice in America, the operation of small sewage-works, the control of sewage-works by tests, and on the operation of automatic apparatus. A list of Kansas cities having sewerage systems is given, together with the method of treatment employed, if any, and the streams into which the sewage or the works effluent is discharged.

State Control of Stream Pollution

STREAM POLLUTION: A Digest of Judicial Decisions and a Compilation of Legislation Relating to the Subject—By Stanley D. Montgomery and Prof. Earle B. Phelps. Washington, D. C.: U. S. Public Health Service. Paper; 6 x 9 in.; pp. 408. From Superintendent of Public Documents, Washington, D. C. 30c.

Hearty welcome will doubtless be given to this useful digest of court decisions and compilation of legislation and rules now in force governing stream pollution. The court decisions are grouped under those based on the common law and those relating to state legislation. In each case a running summary is given by means of black-faced headings, accompanied by the authors' comments in larger type and extracts from court decisions in smaller type. This plan enables the reader to get the gist of the decisions quickly and easily or to go into the argument in detail, as time and need may require. The state legislation and administrative rules are presented by states, alphabetically, using material available at the Congressional Library up to Oct. 10, 1917.

Mathematics for Engineers

HANDBOOK OF MATHEMATICS FOR ENGINEERS—By Edward V. Huntington, Ph.D., Associate Professor of Mathematics, Harvard University. With Tables of Weights and Measures by Louis A. Fischer, B.S., Chief of Division of Weights and Measures, U. S. Bureau of Standards. Reprint of Sections 1 and 2 of L. S. Marks' "Mechanical Engineers' Handbook." New York: The McGraw-Hill Book Co. London: Hill Publishing Co. Flexible Leather; 5 x 7½ in.; pp. 191 illustrated. $1.50.

Many civil engineers and various others who do not need the whole of Professor Marks' "Mechanical Engineers' Handbook" or who, having it, wish its sections on mathematics and weights and measures in more convenient form, will give hearty welcome to this volume. It is handy in fact as well as in name and may be slipped into a traveling bag or even a coat pocket without inconvenience. Illustrative of the utility of the book to those with no previous acquaintance with some of the subjects treated, the preface states: "The practical use of logarithms and logarithmic cross-section paper, and the elementary parts of the modern method of nomography (alignment charts)) can be learned from this book without the necessity of consulting separate treatises." Special features to which the preface calls attention are "the chapter on the algebra of complex (or imaginary) qualities, the treatment of the catenary (with special tables), and the brief résumé of the theory of vector analysis." The complete handbook from which the present volume is taken was noticed in *Engineering News* of Oct. 19, 1916, p. 747.

The Port and Terminal Problem of Today

PORTS AND TERMINAL FACILITIES—By Roy S. MacElwee, Ph.D., Lecturer in Economics and Foreign Trade, Columbia University; Associate Member, Society of Terminal Engineers and American Association of Port Authorities. New York: McGraw-Hill Book Co. London: Hill Publishing Co. Cloth; 6 x 9 in.; pp. 315; illustrated with 117 line cuts and halftones. $3 net.

"The port and terminal problem is one for both engineers and economists. There has been no real cooperation between the two sciences in the past. There has been a tendency to build wonderful piers as engineering structures which do not make up for the rest of the system, and there has been port planning which would not stand up because of the engineering deficiencies. The day has arrived when there must be a new profession of engineer-economist to solve involved transportation problems."

The foregoing paragraph from the preface is sufficient reason for the wide circulation of Dr. MacElwee's book among American engineers today. One criticism only may be made of the paragraph. The author, in common with many outside the engineering profession, assumes that an engineer is not an economist, that the engineer designs structures, purely as physical problems, and must combine in himself some other profession, or else must seek the aid of another profession, when he has to consider the economic problems of the structures he builds. So long as engineers remain in this limited field, just that long will they continue to be a minor profession. The real engineer is, in himself, an economist.

This introductory comment is but prefatory to a commendation of the book as a whole. It treats of what is perhaps the livest problem before the engineer today—the development of the ports of our country, a development which must follow the enormous increase in our merchant marine. While the author states that a future volume must deal with financing and administration, the present volume is devoted to the mechanism of the port development, rather than to the design of the port itself. Beginning with a brief description of certain of the world's leading ports, it passes to a detailed description of one of the port elements, that is, the harbor belt railway, and then discusses lighterage, cartage, drays, motor trucks, port, shed and warehouse equipment, the relation of the inland waterways to the seaport, and the development of industrial harbors and free ports. Brief references are made throughout to various mechanical and engineering details, but these are subordinated to the general mechanism of the port, with which the

author is obviously more familiar, although his chapters on mechanical handling of freight would indicate considerable experience.

A port is a harbor with terminal facilities, says the author. The construction of the harbor is obviously an engineering problem. So is the development of a port today, though not always so recognized by the public. Engineers who wish to impress upon the public and upon the business man who uses the port the truth of this statement must make themselves familiar with the principles laid down in Dr. MacElwee's book.

Cement Specifications Issued in Spanish

The Department of Commerce through the Bureau of Foreign and Domestic Commerce, Washington, D. C., has begun the issue of a series of Spanish and English pamphlets containing the English original and the Spanish translation of a number of American standards for construction materials. The first pamphlet is entitled "Standard Specifications for Portland Cement," prepared by the American Society for Testing Materials with the coöperation of the American Society of Civil Engineers, the Bureau of Foreign and Domestic Commerce and the Bureau of Standards.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

ANALYSES OF CANADIAN FUELS: The Maritime Provinces. Compiled by Edgar Stansfield, M. Sc., and J. H. H. Nicolls, M. Sc. Ottawa, Can.: Department of Mines. Paper; 7 x 10 in.; pp. 28.

THE BULK SHIPMENT OF GRAIN FROM THE COLUMBIA RIVER BASIN: Portland, Ore.: from Journal of the Oregon Society of Engineers. Paper; 6 x 9 in.; pp. 96; illustrated. 25c.

A commendable effort by an engineering society to bring agricultural and allied engineering home to farmers and shippers. Articles dealing more specifically with engineering subjects include "Country Grain Elevators," "The New Portland Municipal Elevator," "The Astoria Terminal Elevator," "Portland as a Seaport."

A CONVENIENT MULTIPLE-UNIT CALORIMETER INSTALLATION—By J. D. Davis and E. L. Wallace. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 48; illustrated. 15c.

DEPARTMENT OF LABOR, NEW YORK STATE, SPECIAL BULLETIN: Court Decisions on Workmen's Compensation Law, August, 1916—May, 1918. Part 1. Constitutionality and Coverage. Issued Under the Direction of The Industrial Commission, John Mitchell, Chairman. Albany, N. Y.: The Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 379.

DEPARTMENT OF LABOR, NEW YORK STATE, SPECIAL BULLETIN: Labor Laws Enacted in 1918—Issued Under the Direction of The Industrial Commission, John Mitchell, Chairman. Albany, N. Y.: The Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 71.

FIRE WASTE IN CANADA—By J. Grove Smith. Ottawa, Can.; Commission of Conservation. Cloth; 7 x 10 in.; pp. 304; illustrated.

Another example of the useful work being done by the commission named. Contains fire loss statistics, sections on "Building Construction and Fire Prevention," "Standardization and Testing of Structural Materials and Devices," "Prviate Fire Protection," "Municipal Fire Protection"; a list of notable conflagrations in Canada; and other pertinent matter.

FISHWAYS IN THE INLAND WATERS OF BRITISH COLUMBIA—By Arthur V. White, Consulting Engineer, Commission of Conservation. Ottawa, Can.: Commission of Conservation. Paper; 7 x 10 in.; pp. 14.

THE FRICTION OF WATER IN PIPES AND FITTINGS—By F. E. Giesecke, Head of the Division of Engineering, University of Texas. Austin: The University. Paper; 6 x 9 in.; pp. 42; illustrated. Free on application.

Has particular reference to the design of hot-water heating systems. Describes experiments and gives resulting data and conclusions.

GENERAL THEORY OF THE LAMBERT CONFORMAL CONIC PROJECTION—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: Superintendent of Documents. Paper; 5 x 8 in.; pp. 37; illustrated. 10c.

HINTS FROM A PRACTICAL FARMER TO THE SETTLERS ON THE PROJECTS OF THE UNITED STATES RECLAMATION SERVICE: Better Business, Better Farming, Better Living—By I. D. O'Donnell, Supervisor of Irrigation, U. S. R. S. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 137; illustrated.

INVESTIGATIONS ON SWIMMING POOLS AT THE UNIVERSITY OF MINNESOTA—By H. A. Whittaker, Director, Division of Sanitation, Minnesota State Board of Health. St. Paul, Minn.: The Author. Paper; 6 x 9 in.; pp. 12; illustrated.

LAMBERT PROJECTION TABLES FOR THE UNITED STATES—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: Superintendent of Documents. Paper; 5 x 8 in.; pp. 243; illustrated. 25c.

A MANUAL OF ENGINEERING DRAWING FOR STUDENTS AND DRAFTSMEN—By Thomas E. French, M. E., Professor of Engineering Drawing, The Ohio State University, M. Am. Soc. M. E.: Second Edition. Revised and Enlarged. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 310; illustrated. $2.50.

This edition contains a new chapter on lettering, a separate chapter on screw threads, bolts and fastenings, a rewritten and enlarged chapter on working drawings and a new chapter on structural drawing. The chapter on architectural drawing has been extended, new problems have been added in each chapter and some of the older ones redrawn to a larger size. Useful tables and diagrams have been placed in a short appendix. The volume throughout has a practical look.

MEASURING THE TEMPERATURE OF GASES IN BOILER SETTINGS—By Henry Kreisinger and J. F. Barkley. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 69; illustrated. 15c.

MECHANICAL DRAWING PROBLEMS: For High Schools, Normal Schools and Vocational Schools—By Edward Berg and Emil F. Kronquist, Instructors in Mechanical Drawing, Washington High School, Milwaukee Wis.: The Authors. Cloth; 8 x 6 in.; pp. 223; illustrated. $1.

MINERAL PRODUCTION OF CANADA: Annual Report, 1916—John McLeish, B. A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Department of Mines. Paper; 6 x 9 in.; pp. 343.

MINERAL RESOURCES OF ALASKA: Report on Progress of Investigations in 1916—By Alfred H. Brooks and Others. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 458; illustrated.

A NOTE ON THE HISTORY OF SUBMARINE WAR—By Sir Henry Newbolt—New York: George H. Doran Co. Paper; 5 x 8 in.; pp. 26.

PROBLEMS IN COST ACCOUNTING—By De Witt Carl Eggleston, M. E., Author "Municipal Accounting." New York: D. Appleton and Co. Cloth; 6 x 9 in.; pp. 337. $2.

THE PRESERVATION OF HOT WATER SUPPLY PIPE In Theory and Practice—By F. N. Speller, Pittsburgh, Pa., and R. G. Knowland, Boston, Mass. New York: The American Society of Heating and Ventilating Engineers. Paper; 6 x 9 in.; pp. 24; illustrated.

THE PROPERTIES AND TESTING OF OPTICAL INSTRUMENTS: Circular of the Bureau of Standards, Issued Aug. 9, 1918. Washington, D. C.: Superintendent of Documents. Paper; 7 x 10 in.; pp. 41; illustrated. 10c.

THE PUBLIC WATER SUPPLIES AND SEWER SYSTEMS OF MICHIGAN—By Edward D. Rich, C. E., State Sanitary Engineer. Lansing, Mich.: Michigan State Board of Health. Paper; 6 x 9 in.; pp. 40.

Gives ownership, source, treatment, if any, and remarks on water-supplies; tells whether sewers are separate or combined, estimated per cent. population served, and final outlet.

A RAPID METHOD OF PLOTTING COMBINED INDICATOR DIAGRAMS—By A. R. Munro, University of Queensland, Australia. Reprinted from *The Engineer*, London, Feb. 9, 1917. Brisbane, Australia: The Author. Paper; 6 x 9 in.; pp. 6; illustrated.

RELATION BETWEEN LOSS OF PRESSURE AND PIPE SIZE IN LONG STEAM LINES—By H. Eisert. From the *Journal* of the Engineers' Club of Baltimore, Dec., 1917. Baltimore, Md.: The Engineers' Club of Baltimore. Paper; 7 x 10 in.; pp. 19; illustrated. 25c.

REPORT OF COMMISSION ON THE REVISION OF RATES OF THE WASHTENAW GAS CO., ANN ARBOR, MICH. An Ordinance Regulating the Sale of Gas in Ann Arbor, passed Mar. 5, 1917—V. H. Lane, H. E. Riggs, R. K. Holland, Commissioners. Ann Arbor, Mich.: The Commission. Paper; 6 x 9 in.; pp. 39.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1915: PART XII. A—Pacific Slope Basins in Washington and Upper Columbia River Basin—Nathan C. Grover, Chief Hydraulic Engineer, G. L. Parker and W. A. Lamb, District Engineers. Prepared in Coöperation with the States of Washington, Montana, and Idaho. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 254; illustrated.

TESTS OF THE ABSORPTION AND PENETRATION OF COAL TAR AND CREOSOTE IN LONGLEAF PINE—By Clyde H. Teesdale, in Charge Section of Wood Preservation, and J. D. MacLean, Assistant Engineer in Forest Products, Forest Products Laboratory, Madison, Wis. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 42; illustrated. 15c.

WARTIME EMPLOYMENT OF WOMEN IN THE METAL TRADES. Research Report Number 8, July, 1918. Boston, Mass.: National Industrial Board. Paper; 6 x 9 in.; pp. 79.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Engineering Council Getting in Touch

By a long tour of the principal cities of the whole country, Alfred D. Flinn, secretary of the Engineering Council, has been acquainting various local groups of engineers with the centralized activities of the national engineering societies. "The greatest obstacle in the pathway to harmony and solidarity," he told the Twin City engineers at St. Paul, "are those valuable qualities of the engineer's character—his fertility of mind, his individualism and his reluctance to compromise." He concludes that a comprehensive organization is the best local. In some places the general local society comes first, and the sections of the nationals have later affiliated themselves with it. In others it has been found advantageous to unite separate organizations which have been established first, creating a club or association. In any scheme Mr. Flinn sees no reason why provisions cannot be made for general meetings or for civic or other local activities of common interest, while the several branches of the national societies can have meetings of their own devoted to their particular specialties.

Of the various groups addressed Mr. Flinn asked the following questions:

"Do you favor a central employment and personal information bureau for all engineers, with correspondents at selected centers, conducted in coöperation with the secretaries of the national engineering societies? Do you favor a central employment and personal information bureau for all engineers, with correspondents in selected centers, conducted in coöperation with the secretaries of the national engineering societies? Do you favor an Engineering Societies journal as a weekly medium for news and other matters of common interest to all branches of the profession, but not for technical papers presented before the societies? What more can the Engineering Societies library do for engineers at a distance? What additional work should the Engineering Council undertake? How can it better serve and coöperate with engineers at a distance from New York? What suggestions have you for the Engineering Foundation as to investigations of general application or research on broad lines? With whom can the secretary of the central organizations correspond as the representative of all engineers of your locality? If there is no one at present who can perform that function, cannot someone be chosen soon?"

Letters to the Editor

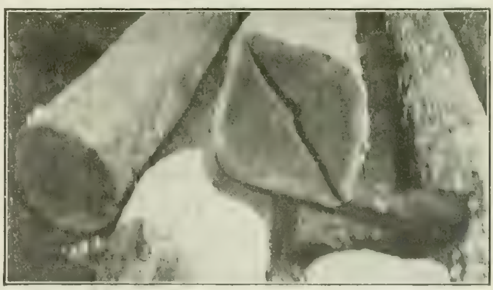
Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Marine Wood Borers Work in Deep Water

Sir—According to all published data the writer has seen and to his own earlier observations, the working range of the small marine wood borer is within or close to the tidal area, but a case has recently come to notice where the boring has not only taken place in deep water but has increased in amount with the depth.

In the Bay of Manati, on the north coast of Cuba, the Manati Sugar Co. built a pier of native hard woods in the year 1913 and in the spring of 1918 a part of it failed, requiring some rapid emergency work to enable sugar shipments to continue without serious interruption. Under ordinary conditions the hardwood piles supporting this pier should have been good for at least 15 years. When the pier was examined after the failure it was found that some of the piles in the apparently good sections had broken off, and upon removal they were found to be honeycombed by marine borers to an unusual degree and with most of the damage apparently in deep water and at or near the mud line. Eight piles were then pulled out of the structure from points that would fairly represent all parts of it, and they all broke off or pulled in two at the mud line. From these samples it was evident that all the piles in the structure were in a precarious condition.

The sample piles that had been pulled were sawed across at low tide level and at intervals of two meters from there down. They were found to be practically free from bores at low tide and above, but beginning at about low tide the boring was progressive with the depth and most pronounced at the mud line, as may be



UPPER VIEW SHOWS PILE CUT AT LOW TIDE LEVEL; LOWER VIEW SHOWS BORES SIX METERS BELOW LOW TIDE

seen from the accompanying photographs of a typical pile.

The bores are very similar to those of the limnoria, but I have never known it to work so deep nor to intensify its work as it went down, as in this case. Most of the bores are lined with mother-of-pearl which takes on color from the wood and is often a very beautiful pink when the boring is in one of the red woods; but this shell lining is quite common in the tropics.

It should be noted that the piles in this pier are not yet five years old and it is the worst case the writer has ever seen of destruction by borers in tropical hard woods. The rapidity with which these piles have been destroyed and the unusualness of the borers' operations would suggest a new variety. There seems to be no reason why the Bay of Manati should have monopoly of this little destroyer. Like many of the bays of Cuba it receives no fresh-water stream sufficient to dilute it, has no city on its shore to pollute it, and, owing to the slight range of the tide and the narrow harbor mouth relative to the area of the bay, the water must be changed quite infrequently.

It is thought this bit of experience may be of interest to your readers and may perhaps be the means of bringing out some further information on the subject.

ARTHUR S. HOBBY,
With The Snare & Triest Company.

Havana, Cuba.

Part Ownership of the Railroads

Sir—As a compromise between the "It shoulds" and the "It shouldn't's," may I advance the idea of a partial Government ownership of railroads, sufficient to give it controlling powers? I am against absolute ownership by the Government. I cannot believe that a post-office department or a railroad can be operated by a man who must depend upon knowledge of its affairs gained from experts, who have no interest beyond retaining their salaries, as efficiently as a man can operate a railroad from intimate personal knowledge gained by experience and assisted by those whose interest is only limited by their individual ability to gain the highest reward. And railroads under political control could easily become a tremendous factor of evil. C. E. NEWELL.

New Orleans.

The United States Engineer Officer Who Located the Mexican Railway

Sir—The interesting account of the engineering experiences of Rudolph Hering and his associates forty years and more ago encourages me to send you some interesting facts regarding the distinguished American engineer to whom credit is due for locating the Mexican railway from Vera Cruz to the City of Mexico. It is generally supposed in Mexico that this remarkable piece of location work was done by English engineers, the road being owned by an English company, but the fact is that the location was made by Capt. Andrew Talcott, who was one of the earliest members of the Corps of Engineers, United States Army.

Mr. Talcott was born in Connecticut in 1796 and was graduated from West Point in 1818, being commissioned in the Corps of Engineers. He served in that corps for some twenty years, receiving his captain's commission in 1830. While serving as astronomer on the survey of the boundary line between Ohio and Michigan, he originated the Talcott method of determining latitudes by observing the difference of the meridianal zenith distances of two stars on opposite sides of the zenith. He used in this work an equal altitude instrument made by Troughton & Simms, of London. The same method was afterwards used by him on other Government surveys and after several years' trial in the Coast Survey was officially adopted by it in 1851.

Captain Talcott's early experience in railway work was as adjunct chief engineer of the New York & Erie R.R. in 1836-37. In 1848 he was made chief engineer of the Richmond & Danville R.R. in Virginia, and held that position seven years. He was chief engineer of the eastern division of the Ohio & Mississippi R.R. in 1856-57, and in the latter year became chief engineer of the Mexico & Pacific Ry., which undertook the location of the line from Vera Cruz to the City of Mexico. For the next ten years a large part of his time was devoted to this work in conjunction with an engineering staff largely recruited from the United States. During the French occupation of Mexico he was engaged in constructing the portion of this railway between Puebla and the City of Mexico. He was "joint engineer" in conjunction with James Samuel of the Imperial Mexican Ry. in 1867, at the time the work was suspended on the withdrawal of the French Army.

Captain Talcott died in Richmond, Va., Apr. 22, 1883.

Buffalo, N. Y. EMILE LOW.

To Find the Diagonal of a Rectangle With the Slide Rule

Sir—I have a slide-rule solution of a common problem that is original with me, so far as I know. The problem of finding the square root of the sum of the squares—that is, to find the length of the diagonal of a rectangle, having given the lengths of the sides—is an unpopular one, owing to the different steps involved, but not an unusual one. When sufficient accuracy is obtainable with the slide rule, the problem is quickly solved.

Let H and V be the quantities the square root of the sum of whose square is desired. On an ordinary slide rule, designate the full scales by the letters C and D and the squared scales by the letters A and B, or $D^2 = A$ and $C^2 = B$. Divide H on the D scale by V on the C scale. On the A scale opposite the index of the slide note $(H/V)^2$. Mentally note position of the decimal point. Set the index of the slide at this plus unity, or $(H/V)^2 + 1$, likewise on the A scale. On the D scale, opposite the quantity V on the C scale, read the answer, or $\sqrt{H^2 + V^2}$.

For example, find the length of the diagonal of a rectangle whose sides are 15.7 ft. and 22.4 ft. Over 15.7 on the D scale set 22.4 on the C scale. The quotient squared is 0.492. Set the slide's index at 1.492 on the A scale and at 22.4 on the C scale, and read the answer, 27.35 on the D scale. The length of the diagonal is 27.35 ft.

The proof is apparent, in that $V\sqrt{(H/V)^2 + 1} = V\sqrt{(H^2 + V^2)/V^2} = \sqrt{H^2 + V^2}$.

Berkeley, Calif. J. R. JAHN.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Center of Gravity of Stock Piles Economically Important

FOUR times as many pounds of stone and three times as many pounds of sand as of cement are used on an average in making concrete. Perhaps twice in three times, in concrete construction, the stone pile is located farthest from, and the cement stock nearest to, the mixer, with the sandpile occupying a midway position. Just this situation was found on a job recently visited where the materials were handled with wheelbarrows. To charge the mixer, four pounds of stone had to be moved three times as far and three pounds of sand had to be moved twice as far as one pound of cement. Work equals weight in pounds multiplied by distance moved in feet. On the job in mind, then, the total units of work of moving aggregates and cement was 19. Had the stone pile been nearest the mixer, and the cement stock farthest from it, the total units of work moving materials would have been 13. This comparison offers a suggestion for economical stockpile location.

C. S. H.

Other Articles of Interest to Contractors In This Issue:

Moving a Construction Train Three Miles Cross Country

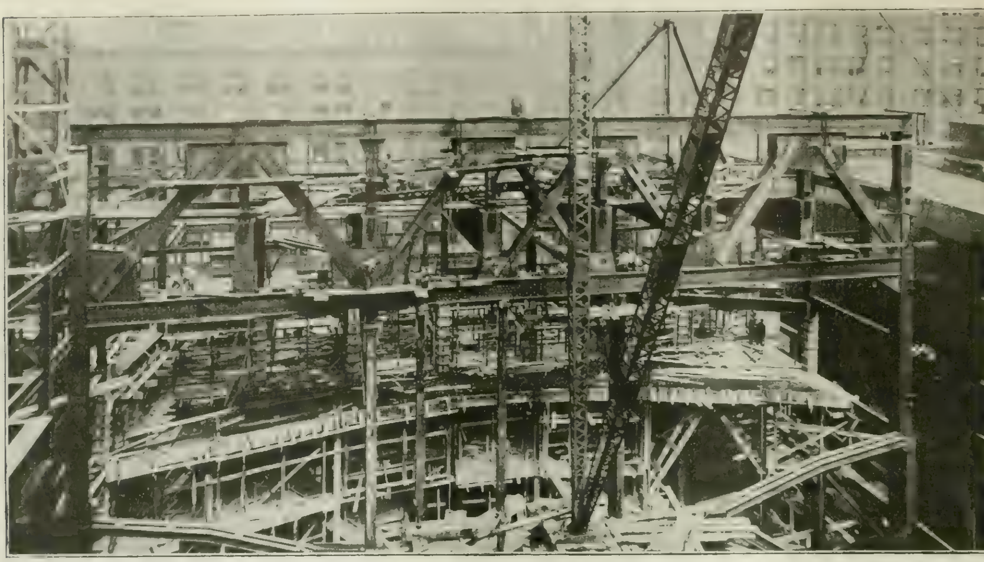
HEAVY single pieces of construction machinery are very frequently moved long distances under their own power, but it is not often that a whole construction train is transported cross country as a unit. How this has been done at the Germantown dam for the Miami Conservancy District in Ohio is described in a recent issue of the *Miami Conservancy Bulletin.*

No railway runs near the site of the dam, so it was necessary to run a standard-gage construction train, with two locomotives, on its own tracks and under its own power on the country highway and village streets, about 3½ miles. The distance was not covered in one run but in short lengths, the rails being taken up behind the train and relaid in front as the journey proceeded. Grades were encountered that were too steep for the entire train to climb, even when driven by both locomotives. To overcome this a siding had to be built at the top of the hill seen in the background in the view. The front locomotive dragged the cars up the slope one at a time and stored them on this siding, where they were made up once more into a train and moved ahead again out onto the main line.

Guy Derrick Places 75-Foot Truss in Chicago Theater

HOISTING a complete truss into position as part of the framing of a building was one of the features of the erection of the State-Lake Building in Chicago, which includes a theater surmounted by office floors. Over the stage front is a 75-ft. truss, 17 ft. deep, framed between a pair of box columns. This truss was assembled at the basement level, about 6 ft. in front of the columns. No end connection plates were fitted, as

STANDARD GAGE CONSTRUCTION TRAIN ON ITS WAY TO GERMANTOWN DAM OVER COUNTRY ROAD



STEEL TRUSS 75 FEET LONG HOISTED INTO PLACE ON CHICAGO THEATER BY GUY DERRICK

these plates were riveted to the columns after their erection.

For lifting, a single hitch was taken at the center of the top chord. The truss was raised high enough to clear the connection plates on the columns, as shown in the accompanying view, and was then lowered till the rivet holes in the chord and end posts registered with those in the plates. Each of these members consists of a pair of channels, which channels are outside of the plates.

A steel guyed derrick was used, having a 100-ft. boom and 112½-ft. mast, both of box lattice construction. Its hoist is operated by a 100-hp. electric motor. The weight of the truss was 40,800 lb. This work was done Aug. 20, by the Longacre Construction Co., which is using two of these derricks on the steel erection work. Lieberman, Klein & Hein are the structural engineers.

Clay Used to Pack Joints in Sewer-Pipe While Pouring With Asphalt

CLAY mud is reported to have been used successfully for packing the joints in sewer-pipes while pouring them with asphaltic cement. The method, which is described below, was used at a nitrate plant where cement joints were impracticable on account of the action of the acid, and where the use of jute for packing the joints was prohibited as likely to form an explosive similar to guncotton and blow up the sewer. Considerable experimentation was necessary to determine the proper packing to hold the asphalt joints, and clay was finally selected.

Jointing of the pipe was carried on in two operations. From one to four lengths were first jointed outside the trench, then they were lowered to position and connected with the sewer already in place. On sizes from 30 to 36 in. it was found that two joints were about as easy to handle as one in lowering into the trench. With 24-in. pipe, it was found feasible to joint three lengths outside the trench, and with 18-, 15- and 12-in. four lengths could be used, provided the trench was 10 ft. or more deep. When the trench was shallow, it was found better to joint two lengths, place them in the bottom of the trench and then joint two more and place them on top. This removed the bother of trying to keep them from falling over when the smaller sizes were handled. Anything above 15 in. would stand alone four lengths high.

Equipment for carrying on this work consists of a portable asphalt kettle and some long-handled dippers, holding about a gallon of asphalt, to carry and pour the joints. The dippers had three spouts to allow pouring from either side or the end.

The joints to be made above ground were made by standing one pipe on its spigot end and putting a thin layer of mud, about the consistency of putty, around the inside of the bell. Then another length was pressed down on top of the clay until tight enough to overcome leaking. The joint was then poured with the liquid asphalt, which cooled almost immediately. In this way any desired number of joints were connected above ground.

After the pipe was lowered into the trench the most difficult job was to form the trench joints so that they would not leak. Regular asbestos runners, the same as used with lead joints, were used for the small sizes of pipe to dam the asphalt at the outside of the joint. Sisal or manila rope was used for the larger sizes. To hold this rope in place an angle iron about 4 in. long, having a hole in one end and a slot in the other, was fastened to each end of the rope, through which a U-bolt was passed to draw the rope up. This U-bolt was ½ in. in size and about 10 in. long, and threaded for nearly its entire length to allow for taking up. By having a hole and a slot, it was possible to pull out the slot end

as soon as the joint cooled, while with holes in both ends it was hard to get the bolt out on account of the asphalt holding it.

In making the trench joints, clay was put in the bell as in the work outside, and on the larger sizes of pipe a man went inside to mud up the joints. He remained there while the joints were being poured. With the smaller sizes, the ends were mudded before being placed, and after being placed the joint was calked up from the outside with mud, by means of a small stick. It was necessary to cover all crevices between the ropes and the pipe with mud, to stop the leaks.

It is pointed out that asphalt for pouring the joints should be very hot, so that it will not cool before it reaches the bottom. It should be poured slowly while watching for leaks, which in the larger sizes of pipe may be seen from the inside, but in the smaller sizes must be gaged by the amount of asphalt used, and by watching for smoke from the upper end of the pipe. In the case of small leaks, these may be stopped by discontinuing pouring for a minute or two while they cool sufficiently to heal themselves.

After the ropes were placed and mudding up was done on the larger sizes of pipe, it was necessary to build almost solid from the ropes to the subgrade to keep the mud from drying up and falling off. This was required on the large sizes of pipe, on account of the slow cooling of the greater body of asphalt. When the asphalt had cooled the ropes were removed by loosening the U-bolt and giving it a jerk.

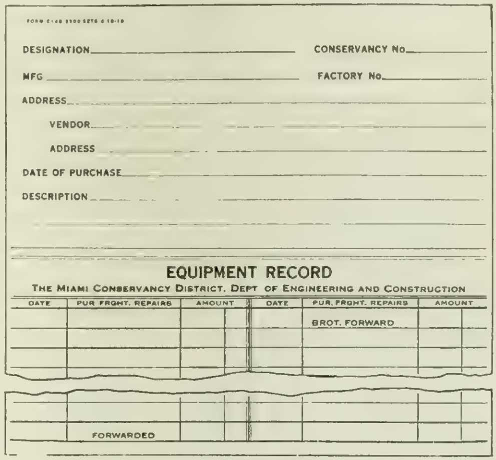
Equipment Cards Carry Cost History of Plant Items

EQUIPMENT cards carry the cost history of every principal item of plant employed on the construction work of the Miami Conservancy District. By means of these cards the plant cost of any item of equipment at any period of its service can be determined, its various transfers can be known, and its successive custodians can be identified.

On the conservancy work all equipment of whatsoever nature when placed in use, whether installed as a part of a plant or used independently as a unit, is taken into the plant account. Each item is then gradually absorbed into a construction feature cost as the work progresses, until upon completion of the job the entire installation cost is accounted for and only the salvage value of the item remains in the plant account. Depreciation is included in this absorption.

Installation cost, as the term is employed above, includes purchase and erection cost, costs of transportation and major repairs and, indirectly, depreciation. Observe here that an item of equipment enters plant account only when it is assigned to a plant or is placed in use. The value of new equipment not in use and of old equipment in hand after dismantling of plant is carried in the general ledger account under "equipment."

Upon the addition to the plant of each item of equipment a card is prepared for it as a drag line, locomotive, motor truck, concrete mixer, etc. The face of this card is reproduced here. On the back are the headings "Appraisals," "Memo-Record of Charges for Use of Equipment" and "Disposition." The face of the card carries the full plant cost record of the item while that item remains a part of the same plant. When transfer is made to another plant, appraisal is made of the value of the item and the amount is charged to the new plant and credited to the old one. The particulars of the transfer, the appraised value and the place to which removal is made are entered on the card, and a



DESIGNATION ________ CONSERVANCY No. ________
MFG ________ FACTORY No. ________
ADDRESS ________
VENDOR ________
ADDRESS ________
DATE OF PURCHASE ________
DESCRIPTION ________

EQUIPMENT RECORD

THE MIAMI CONSERVANCY DISTRICT, DEPT OF ENGINEERING AND CONSTRUCTION

DATE	PUR FRGHT. REPAIRS	AMOUNT		DATE	PUR. FRGHT. REPAIRS	AMOUNT	
					BROT. FORWARD		
	FORWARDED						

CARD USED TO RECORD HISTORY OF CONSTRUCTION EQUIPMENT

new card is prepared for the record of the new plant. Thus the cards always remain a part of the permanent record, and when an item is finally dismantled and disposed of such disposition is entered on the card.

By use of the cards responsibility for unexpandable equipment can readily be placed. The accounting records are supported by separate card records. A duplicate in the general office files gives immediate information, concerning any item, to the engineering construction department. Another copy goes with the item when it is transferred and gives the new custodian all necessary information.

These equipment cards are a part of the cost accounting system of the Miami Conservancy District, of which Arthur E. Morgan is chief engineer. Charles H. Paul, assistant chief engineer, was chiefly responsible for the development of the accounting system of the district.

Strengthen Bridges for Motor Trucks

Increasing use of motor trucks and tractors on public roads has led the Missouri State Highway Department to issue a notice calling the attention of county highway engineers and road overseers to the necessity of looking carefully after the condition of bridges and culverts. The department requires all new structures on state roads to be designed for a 15-ton load, but replacement of those structures which are too light for this load is not insisted upon, if they are safe for ordinary traffic. The existing bridges must be utilized in order to get the benefit of the state roads, but it is planned to bring them up to standard as fast as money becomes available.

NEWS OF THE WEEK

New York, September 19, 1918

Win-the-War Meeting Held by New England Water-Works Association

Fuel Situation, Reducing Water Waste, Locating Leaks, Thawing Pipes and Labor Problems Discussed

Saving water and coal by preventing waste and by the better operation of pumping plants, the fuel situation in New England, water rates, labor problems, and evidences of strong patriotic feeling throughout were features of the win-the-war meeting of the New England Water-Works Association held at Boston Sept. 11 and 12. The usual exhibits and various entertainment features were entirely omitted. All things considered, the attendance was very good. The total registration was 146. Of these, 94 were active, 32 were associate members and 20 were guests.

Close attention and enthusiastic applause were given by the hearers to an address by Prof. William T. Sedgwick, Massachusetts Institute of Technology, past president of the association and chairman of the Massachusetts division of the National Security League. The address was entitled "From Peace to War, from War to Victory, from Victory to Judgment." It reviewed the causes of the war and the conduct of Germany before and during the conflict. The necessity for punishment of Germany was urged; not in the spirit of revenge, but for the same reason as the criminal is punished anywhere and everywhere in civilized society; that is, for the prevention of crime.

The Fuel Problem in New England

No other subject was given more attention by the meeting than the fuel problem. The coal situation in New England was reviewed briefly by Ira M. Hollis, President of Worcester Polytechnic Institute. Suppression of industry and elimination of coal consumption is not coal conservation, in his opinion, nor is using wood or finding any other substitute. Conservation rather is a matter of stopping waste. As an illustration of what can be done, President Hollis said that last December a certain contractor was using coal at the rate of 950,000 lb. a month. A local committee was appointed to study the subject and effect reductions, with the result that the March coal consumption was only 550,000 lb.—March and December being much alike. This is a shameful confession, President Hollis said, especially in view of the fact that last winter wounded soldiers in hospitals in Italy had no heat whatever. The question which should be constantly before us is, Are we doing all we can so our boys can come home?

In the opening part of a paper on the fuel situation, Charles T. Main, consulting engineer, Boston, stated that there would probably be a shortage of millions of tons of bituminous coal in New England this coming season. He presented in detail measures which may be taken to meet this situation. An abstract of his paper appears on page 530. On the preceding page appears an abstract of a paper by George A. Carpenter, city engineer of Pawtucket, R. I., dealing with the possible saving of coal by a reasonable curtailment of water waste. In introducing his paper, Mr. Carpenter pointed out the fact that statistics needed for his study were not available, notwithstanding the adoption by the association of forms adopted to present such figures in annual reports.

Report of Committee on Frozen Water Mains

After the severely cold spell last winter the association appointed a committee to investigate and report on the subject of frozen water pipes. The report of the committee was submitted by its chairman, Frank J. Gifford, superintendent of water-works, Dedham, Mass. Mr. Gifford stated that the committee sent out 215 inquiries and received 95 replies. Very few superintendents ever experienced such extremely cold weather before. An abstract of the report appears on p. 530.

In the discussion of the report Frank McInnes of Boston, a member of the committee, said he was impressed with the need for all possible data as to how water pipes can be thawed by electricity without damage. He had found the use of a storage battery apparatus very successful in Boston last winter, but this device proved to be dangerous unless properly operated. It is too delicate an apparatus for general use. A paper on "Detecting Leaks in Underground Pipes" was presented by David A. Heffernan, superintendent of water-works, Milton. It is abstracted on p. 528. Several members spoke favorably of the use of water-leak locators.

A description of quartermaster terminals required for war work was the subject of an address by Maj. Charles R. Gow, construction quartermaster, Boston. The construction of the Squantum destroyer plant was described by Thomas C. Atwood, resident supervising engineer. Major Gow remarked that with 5,000,000 men overseas it would be necessary to ship 125,000 tons a day of supplies. This would require one train of 40 cars every 12 min. in the 24 hr. or 21 6,000-ton cargo ships per day, and the continuous service of about 600 ships.

The Squantum destroyer plant, Mr. Atwood said, was entirely covered in, both ways and wet basins, at an extra cost of $2,000,000 for roofing. This extra cost would be paid for if destroyer construction was speeded up sufficiently to save only one ship from destruction.

A Radical View of Meter Rates

In the course of a talk on the need of higher water rates to offset increasing cost, John J. Moore, consulting engineer, Boston, spoke very strongly against supplying water in large quantities at a reduced rate. He said that if meter rates were to slide they should slide downward or with decreasing consumption, rather than downward with increasing consumption. The reason that he gave for this was that in the case of many works the large consumers make a heavy demand upon the supply which oftentimes entails an increase in the capacity of works at a very large expense. He favored a flat meter rate. Several speakers agreed with him.

Mr. Moore also urged the general proposition that where it is necessary to get more water revenue by increasing rates the increase should be in the nature of hydrant rental instead of raising the rate for domestic and industrial uses. Private water companies, Mr. Moore said, are having to pay largely increased taxes compared with a few years ago. Their property is assessed at its full valuation, whereas other property in the same community is assessed at only a percentage of the value.

Water-Works Labor Troubles

Opening a discussion on this subject, C. E. Davis, chief of the Bureau of Water, Philadelphia, and president of the association, said that an effective pension system in Philadelphia had had a stabilizing effect on the employees. It has kept many of them from going into private employment even at much higher rates of pay. C. A. Bingham, city manager, Waltham, Mass., said that in his city, with a pension system in force, out of 100 employees, 60 were working, 30 were out on strike for more pay, and 10 were on the fence. If the demand for higher wages were to be granted, it would add $7500 a year to the payroll. There was no money available to meet the

(Concluded on page 558)

Motor Transport Service Needs Recruits

Each American Army Requires 154,747 Officers and Men With Motor Vehicles Numbering 79,500

Thousands of men for the Motor Transport Corps, which was formed recently, are required by the Government. The number of men required for each American army is 154,747, and the number of motor vehicles required for each army is 79,556. Men qualified to drive motor vehicles are needed by the thousands and will continue to be, while men who have good executive experience in business are specially wanted for officers. Many men who were given deferred classification in the first draft, but who now wish to get into the army, are, it is stated, finding excellent opportunity for service in this corps.

The immense scope of this organization is shown by the fact that when the American army numbers 4,000,000 men nearly half a million or one-eighth of the entire force will be in this service. These figures do not include the corps operating in the United States, which has an average of 1500 trucks working in convoy trains.

The vehicle equipment for each army is as follows: Motor trucks, 40,803; motorcycles, 24,215; passenger-carrying motor cars, 7905; ambulances, 6598. These will require approximately 100,000 drivers and riders. The officers will number 4298 and the non-commissioned officers 30,090. Besides this, the headquarters and executive organization will consist of 3122 men and 679 officers, and the total repair personnel in the 273 service parks provided for upkeep will consist of 34,319 men, many of whom must be mechanics.

This corps is cor idered of the greatest importance, and recent events in France have proved its increasing usefulness, and many instances are on record where it has saved critical situations. Those interested in the service can secure information from the Chief of Motor Transport Corps at Washington.

Colored Insert — Liberty Asks for Billions

Published as a supplement to this issue is another patriotic poster in colors, portraying Liberty speaking in behalf of the Fourth Liberty Loan. In the poster, Liberty says billions of dollars are needed and needed now—needed that our armies may win the victory that can be won only by "Force, force to the utmost; force without stint or limit," using the words of President Wilson

North Western First Railroad to Accept Standard Contract

The Chicago & North Western Ry. has notified the United States Railroad Administration of its acceptance of the standard contract. It is the first railroad to do so.

All Construction Must Be Essential to the War

War Industries Board in New Ruling Delegates Authority to Pass on Proposed Construction to State Defense Councils

(Washington Correspondence)

Non-war construction is to be stopped immediately by the War Industries Board. Important projects already under way will in all probability be allowed to continue, and no work will be shut down where such stoppage will entail dangerous conditions or great depreciation when work starts again, but every proposed piece of construction will have to satisfy the criterion of essentiality to the war before being allowed material, and without material construction cannot go ahead. Already the Capital Issues Committee restricts the unnecessary use of capital and the United States Employment Service is curtailing the diversion of labor to non-essential industries; the control of material by the War Industries Board is the final bar to non-war construction.

By an order of the War Industries Board dated Sept. 12 the primary control of material is to be vested in the various state councils of defense. Upon their favorable recommendation the War Industries Board will consider any proposed construction, and if satisfied of its essential nature will issue the permit which is necessary before any material can be obtained for the work. If the State council is unfavorable to the proposed construction the new order infers that the project is dead, so far as material is concerned, although there will undoubtedly remain the right of appeal to the War Industries Board in special cases. The War Industries Board may also decide against a project favorably reported by the State council, in which case also no material will be allowed.

Government Work and Roads Excluded

The new ruling applies to all forms of projected construction except that it does not include undertakings directed by, or under contract with, the War Department, Navy Department, Emergency Fleet Corporation, Bureau of Industrial Housing and Transportation of the Department of Labor, the United States Housing Corporation, and the following civilian enterprises:

Repairs of or extensions to existing buildings involving in the aggregate a cost not exceeding $2,500.

Roadways, buildings and other structures undertaken by or under contract with the United States Railroad Administration or a railroad operated by such administration.

Those directly connected with mines producing coal, metals and ferro-alloy minerals.

Public highway improvements and street pavements when expressly approved in writing by the United States Highways Council. These latter have to pass through the State highway commissions for preliminary approval.

The ruling furthermore applies only to projected buildings and not to those already begun. Where a substantial portion of a building has already been constructed, manufacturers and distributors of and dealers in building materials may continue to furnish such materials for the completion of such building, pending further action by the War Industries Board.

State Defense Councils Important

The regulations governing the operation of this ruling are given as follows:

"Any person interested in a construction project must apply, with a full statement of the facts under oath, to the appropriate local representative of the various State councils of defense. This representative will investigate the necessity of the proposed construction and transmit recommendations to the State council for review. The State council will review the case, and if it decides in favor of the construction it will at once send its recommendation, with a full statement of all the facts, to the Non-War Construction Section of the Priorities Division of the War Industries Board. The Non-War Construction Section will grant or withhold the permit and so notify the State council of defense, and the individual concerned. If the State council decides against the proposed construction, it will notify the person concerned that his project has been disapproved.

"The War Industries Board will inform all persons applying directly to it that they must first take up their projects with the appropriate local representative of the State council of defense."

It is further stated that the "ability of the War Industries Board to enforce this whole plan rests upon the fact that it controls priorities and has also secured from the manufacturers of building materials a pledge not to supply materials for projects which are not authorized under the regulations of the War Industries Board."

What the New Order Means

This drastic control, the correspondent has been informed by one intimately connected with the War Industries Board, has been forced indirectly by the shortage in labor. Practically every war industry is working far under a 100% capacity because it can not get men. The duration of the war, which should be measured in lives of American soldiers as well as in days and months, is being lengthened by this lack of labor. Every construction project which is not contributing to the war is diverting from these necessary industries not only the men who are working on the non-essential project itself

(Concluded on p. 558)

Engineering Co-operation at San Francisco

Joint Council from Sections of Five National Societies Organized—Aims Stated

Five national engineering societies which have San Francisco sections on Sept. 4 organized what is to be known as the Joint Council of the Engineering Societies of San Francisco. The societies represented are the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Chemical Society. Four representatives from each of these societies, constituting 20 men in all, form the Joint Council, which, in turn, is officered by an executive committee of five. The members of this executive committee are C. D. Marx, chairman; E. C. Jones and E. C. Hutchinson, vice-chairmen; N. A. Bowers, secretary-treasurer, and E. O. Shreve, assistant secretary.

This organization is the culmination of several meetings of the secretaries of the five societies involved, at which plans for more effective inter-society coöperation have been worked out. Some of the expected advantages are a closer touch among members of the several associations; putting of the several employment bureaus together in one central office; joint meetings to discuss subjects of common interest; coöperation for the sake of economy, such as in mailing notices, and consolidating headquarters at the Engineers' Club.

In a paper on this subject read at a recent joint meeting, it was pointed out that "Membership in a national engineering society has always carried with it a certain amount of prestige. Here in the Far West we have been content with but little besides that as a return for our annual dues.

"Our parent societies have joined in forming the United Engineering Society, and the plan has proved eminently successful from every angle. May we not begin now to lay the foundation for branches of that organization in Western centers? Why not the San Francisco branch of the United Engineering Society? At least we may suggest this as an ultimate possibility; another incentive among the opportunities that await our pioneer joint council."

The Joint Council will have regular meetings once a month, the executive committee convening at the pleasure of its members. The constitution tentatively adopted at the Sept. 4 meeting sets forth as the purposes of the organization:

1. To foster closer relationship among the engineering societies of San Francisco, especially in those matters
   (a) where coöperation will make for more efficient "win the war" service;
   (b) where coöperation will make for more efficient service to the state of California, its cities and counties;
   (c) where coöperation will expedite progress toward those ideals common to our several organizations.
2. To plan and carry out arrangements for joint meetings of the several societies whenever such meetings are deemed advisable, and to endeavor to make joint meetings effective in developing closer relationships among members of the several societies.
3. To act generally as the clearing house for matters which involve the several societies, especially where the common good will be enhanced by working through an executive head representative of the several organizations.

The first act of the Joint Council was the decision to urge upon the Governor of the State the appointment of an engineer as member of the State Railroad Commission. In making this recommendation it was pointed out that "the best interest of the State would be served by the appointment of engineers as members of commissions dealing with problems the solution of which requires technical training and experience," and that the appointment of an engineer to fill one of the vacancies on the State Railroad Commission would doubtless "be regarded by the people of the State as indicating a wish to place the public service on the highest plane of efficiency and will be creditable both to the appointing power and to the engineering profession."

Seattle Votes Port Improvement Bonds

At the election of Sept. 10 the voters in the Port District of Seattle, Wash., approved the proposed bond issue of $3,240,000 for new port improvements in the Smith's Cove Terminal and also $1,125,000 for the purchase after the war of the warehouse to be built for the present emergency by the War Department.

Construction Must Be Essential

(Concluded from p. 557)

but the labor of all the men who produce the materials which go into the project. In many cases the actual workmen are local men who, with any power now available, cannot be made to leave local work or who are too old or unskilled for any other work; the argument is sometimes made to the board that their services on the project in question do not in any way interfere with the war program. In answer the boards say that while they may not be of any use to some war industry, in many cases the materials they are working with, the brick, the cement or the steel or the labor to make these materials and the cars or motors and men to transport them, should now be going into work which will hasten the end of the war. It is recognized that the enforcement of the order may in some cases result in casualties to established businesses, particularly to contractors whose organizations will be disrupted and whose equipment will deteriorate, but this, in the opinion of the board, must be considered as one of the many deplorable results of war. Labor must shift to war industry; contractors must find war work.

New England Water-Works Meeting

(Concluded from p. 556)

increase. A speaker from Woburn said that the minimum wage had increased there in the last three years from $2 to $3 a day. The men got a raise to $3 by threatening a strike after the mayor had refused to grant the increase. Some of the men were disappointed because there was no strike. Later a demand for $3.50 a day was made, and the mayor was advised to grant the increase but he refused and some of the men have already quit to work elsewhere for higher wages. The speaker urged that men in municipal employ should be regarded as on a different basis than those in private employ, since the former are really municipal stockholders. John M. Diven, superintendent water-works, Troy, N. Y., and secretary of the Amercian Water-Works Association, said that most of the water-works are operated on the budget system, making it hard to increase wages on demand. In Troy a wage increase has been granted three times of late. This has been made possible by cutting down work and keeping the best men.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill; Oct 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Chicago

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

CITY MANAGERS' ASSOCIATION, Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

The American Public Health Association will hold its annual meeting in Chicago Oct. 14 to 17 and not in Boston, as mentioned in the Engineering Societies Calendar in the past few issues of *Engineering News-Record.*

The Engineers' Club of Philadelphia held a joint meeting with the American Institute of Electrical Engineers

and the Association of Iron and Steel Electrical Engineers in Philadelphia Sept. 16, at which H. A. Hornor presented an illustrated paper on electric welding. Mr. Hornor's paper dealt with the applications of welding to the shipbuilding industry. Charles M. Schwab, director general, Emergency Fleet Corporation, presided. The next regular meeting of the club will be held Oct. 15.

The Juneau Society of Engineers, Juneau, Alaska, recently held a farewell banquet for H. P. Crowther, J. P. Walker, Frank P. Metcalf, V. N. Dupuy and R. G. Wayland, who had passed examinations for commissions in the Corps of Engineers.

The Louisiana Engineering Society held a meeting in New Orleans Sept. 9, at which Charles W. Okey's paper, entitled "Main Drainage Channels for Reclaimed Areas of Southern Louisiana," was discussed by Messrs. Dusenbury, Kerr, Klorer and Lawes.

The Youngstown Engineers' Club, Youngstown, Ohio, elected the following officers at a meeting held Sept. 7: President, F. W. Funk; vice-president, W. H. Ramage; secretary-treasurer; R. H. McCarty.

Personal Notes

LOUIS J. HOROWITZ, president of the Thompson-Starrett Construction Co., New York City, has been appointed special assistant to the chief of ordnance, in charge of tanks, in which capacity he will have authority to decide all questions pertaining to the engineering, manufacturing and inspection of tanks.

C. A. MORSE, chief engineer of the Chicago, Rock Island & Pacific Ry., and president of the American Railway Engineering Association, has been appointed manager of the newly-created maintenance of way section, division of operation, United States Railroad Administration. Mr. Morse was born in Maine in 1859, and was graduated from the University of Maine in 1879. His first six years after graduation were spent in various railroad work. In 1886 he began a 27-year period of service with the Atchison, Topeka & Santa Fé Ry., rising from division engineer to chief engineer of the system. In 1913 he left the Santa Fé to become chief engineer of the Rock Island. Last March he was elected president of the American Railway Engineering Association.

LIEUT.-COL. LINCOLN BUSH has been promoted to the rank of colonel in the Quartermaster Corps. Colonel Bush has been in the Construction Division of the army since early in the war, assigned to port and terminal work.

MAJ. F. G. JONAH, Corps of Engineers, previously chief engineer of the St. Louis & San Francisco R.R., has been promoted to the rank of lieutenant-colonel.

MAJ. T. L. HUSTON, Corps of Engineers, previously a New York contractor who had had long experience in Cuba following the Spanish-American War, in which he served as a captain in the 2nd United States Engineers, has been promoted to the rank of lieutenant-colonel. He has been in service in France since early in the war. Lieutenant-Colonel Huston is one of the two joint owners of the New York American League Baseball Club.

MAJ. H. F. CAMERON, Engineers, U. S. A., has been promoted to the rank of lieutenant-colonel. Colonel Cameron for many years has been engaged in engineering work in the Philippines, entering military service early in the war. He has been stationed at Camp Lee and Camp A. A. Humphreys, Virginia, at the Engineer Officers' Training Camp.

D. W. THROWER, assistant valuation engineer of the Illinois Central R.R., has been made valuation engineer, succeeding D. J. Brumley, who has entered the service of the corporation. Mr. Thrower has been in the service of the Illinois Central system since 1900, having been successively assistant engineer, road master, assistant engineer maintenance of way, district engineer of the Yazoo & Mississippi Valley at Memphis, and assistant valuation engineer.

MAJ. G. M. RICE, Corps of Engineers, who was previously chief engineer of the Puget Sound and Willapa Harbor Ry., has been promoted to the rank of lieutenant-colonel.

MAJOR JOHN R. FORDYCE of St. Louis has been appointed advisory engineer to the Federal barge lines of the Mississippi and Warrior rivers, in charge of construction of the terminals for the new river freight line between St. Louis and New Orleans. Previously Major Fordyce was in charge of cantonment construction at Camp Pike, Arkansas.

E. G. LANE, engineer maintenance of way of the western lines of the Baltimore & Ohio R.R., has been appointed chief engineer, succeeding L. G. Curtis, resigned. H. R. Gibson, district engineer maintenance of way at Cincinnati, succeeds Mr. Lane.

C. E. BRINSER, division engineer of the Pennsylvania R.R. at Philadelphia, has been appointed assistant superintendent of the New York division, with office at Trenton. Mr. Brinser, who was graduated from Franklin and Marshall College, and has been in the service of the Pennsylvania since 1900, has been division engineer at various points since 1910. He succeeds G. C. Koons, who is transferred to the Middle division, with headquarters at Mifflin, Penn.

FRANK M. PRESTON has been appointed city engineer of Victoria, B. C., succeeding C. H. Rust, who resigned to undertake corporation work as mentioned in *Engineering News-Record* of Aug. 22, p. 380. Mr. Preston has been assistant city engineer for the past five years.

U. A. G. DEY, assistant engineer of construction of the Canadian Pacific Ry. at Montreal, has been appointed assistant engineer of the Toronto terminals, succeeding G. H. Davis, who is promoted, as noted elsewhere.

PERLEY F. WALKER, dean of the School of Engineering, University of Kansas, has been promoted to the rank of colonel and given command of the 219th Regiment of Engineers now being organized at Camp A. A. Humphreys, Virginia.

R. MONTFORT, consulting engineer of the Louisville & Nashville R.R., has been appointed chief engineer for the corporation, with headquarters at Louisville.

A. W. NEWTON, chief engineer of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer for the corporation.

ABRAHAM GIDEON, superintendent of the city water-supply and sewer system of Manila, P. I., has been appointed city engineer, succeeding Fred L. Patstone, who has entered the army.

R. C. WATKINS, division superintendent of the Texas lines of the Southern Pacific Co., at San Antonio, Tex., has been appointed maintenance of way engineer in Texas and Louisiana for the Southern Pacific corporation.

G. H. DAVIS, resident engineer of the Toronto terminals of the Canadian Pacific Ry., has been appointed assistant engineer maintenance of way, with office at Montreal.

HARRY G. CLARK, assistant to the vice-president of the Chicago, Rock Island & Pacific Ry., has been appointed chief engineer, succeeding C. A. Morse. Mr. Clark was born in 1875 at Leavenworth, Kan., and was graduated from the University of Kansas in 1898. The same year he entered railway service as chainman on the Atchison, Topeka & Santa Fé Ry. In 1900 he went to what is now the Choctaw district of the Rock Island system as resident engineer. From 1905 to

1909 he was district engineer of the Choctaw district. In the latter year he was made trainmaster, and in 1912, assistant to vice-president.

O. VON VOIGTLANDER, architect and engineer, Jackson, Mich., has closed his office for the duration of the war to enter the Engineer Officers' Reserve Corps with the rank of captain. He has been assigned to duty at Camp A. A. Humphreys, Virginia.

L. G. CURTIS, recently made chief engineer of the western lines of the Baltimore & Ohio R.R., has resigned to enter the service of the Baltimore & Ohio corporation.

F. W. VORMELKER has been appointed efficiency engineer for the Russel Motor Axle Co., North Detroit, Mich.

ROBERT S. BEARD, acting city engineer of St. Louis, has been ordered to report for duty in the Construction Division at Washington, D. C. It is expected that he will be commissioned with the rank of captain.

B. O. BENDIXON, engineer of Jefferson County, Washington, with headquarters at Port Townsend, has resigned.

F. E. MORROW, assistant chief engineer of the Chicago & Western Indiana R.R., and the Belt R.R. of Chicago, has been appointed chief engineer. Mr. Morrow was graduated from Purdue University in 1904. After a few months with the Illinois Steel Co. he entered the engineering department of the Chicago & North Western Ry. He remained with that company three years as rodman, instrumentman and assistant engineer successively, and was then appointed field engineer in the Division of Track and Roadway of the Board of Supervising Engineers, Chicago Traction. In 1910 he entered the Chicago & Western Indiana organization as office engineer. Three years later he was promoted to principal assistant engineer, and in 1915 to assistant chief engineer.

ROBERT H. FORD, engineer track elevation of the Chicago, Rock Island & Pacific Ry., has been appointed principal assistant engineer.

K. B. DUNCAN, valuation engineer of the Eastern lines of the Santa Fé system, has been appointed bridge engineer of the Gulf, Colorado & Santa Fé Ry. and other lines in Texas.

R. H. PINKHAM, assistant division superintendent of the Pennsylvania R.R. at Cresson, Penn., has been appointed superintendent of the New York, Philadelphia & Norfolk line of the Pennsylvania system. Mr. Pinkham, after graduating from the Massachusetts Institute of Technology in 1899, entered the service of the Pennsylvania in 1901 and was successively levelman, transitman, assistant supervisor, division engineer and assistant superintendent.

J. L. STARKIE, office engineer of the Gulf, Colorado & Santa Fé Ry. at Galveston, Tex., has been appointed assistant engineer for that road, the St. Louis, San Francisco & Texas and other lines under the same Federal manager.

WARREN H. BOOKER, for five years chief of the bureau of engineering and education of the North Carolina Board of Health, has been granted indefinite leave of absence to take up special work in France under the Commission for the Prevention of Tuberculosis in France.

ROBERT P. GARRETT, vice-president and treasurer of the Missouri Bridge & Iron Co., has been commissioned as captain in the Ordnance Department, and assigned to duty in Washington, D. C.

LEON C. GRAY, engineer in charge of field work for the public service department, Grand Rapids, Mich., has resigned to become associated with the Portland Cement Association, with headquarters at Detroit.

J. M. SILLIMAN, resident engineer of the Canadian Pacific Ry. at London, Ont., has been appointed division engineer of the Delaware & Hudson Co. at Oneonta, N. Y. He succeeds H. S. Rogers, resigned.

W. H. AMOS, deputy county engineer of Whitman County, Wash., with headquarters at Colfax, has resigned to enter the Corps of Engineers.

OBITUARY

JOHN HOWE PEYTON, president of the Nashville, Chattanooga & St. Louis Ry., died Sept. 14 at his home in Nashville, Tenn. Mr. Peyton left the post of assistant to the president and chief engineer of construction of the Louisville & Nashville R.R. late in 1913 to take the presidency of the Nashville, Chattanooga & St. Louis Ry. He was born Mar. 17, 1864, in Missouri, and studied at Roanoke College, West Virginia. He entered railroad service in 1881 as rodman on the Richmond & Louisville R.R. In 1889 he became assistant to the chief engineer of the Charleston, Clendennin & Sutton R.R. From 1892 to 1898 he was in private practice in general contracting. He served in the Army during the Spanish-American War. In 1900 he reëntered railroad service as resident engineer of the Chesapeake & Ohio Ry. Two years later he went to the Louisville & Nashville R.R. as locating engineer. The following year he was appointed construction engineer of the Atlanta, Knoxville & Northern Ry. From 1904 to 1909 he was again locating engineer of the Louisville & Nashville. In the latter year he was made consulting engineer of the North Coast R.R., but in the following year returned to the Louisville & Nashville as assistant to the president. The additional title of chief engineer of construction was given him in 1912, and he had charge of the extensive grade-revision and double-track program carried out by the Louisville & Nashville about that time, building lines that he had previously located. Mr. Peyton was a member of the American Society of Civil Engineers and of the American Railway Engineering Association.

CAPT. E. H. ANNEAR, Co. B, 43rd Regiment of Engineers, U. S. A., who recently arrived from France, died in Hoboken, N. J., Aug. 28. Captain Annear had studied as a cadet at West Point some years ago, but was compelled to resign on account of the ill health of his father. At the time of receiving his commission last January he was serving his third term as surveyor of Stanislaus County, California. He enceived two months' training at American University, Washington, D. C., and was sent abroad in April. Captain Annear had returned to the United States to act as military instructor.

WILLIAM WILLIAMS CREHORE, consulting engineer, of Westfield, N. J., and New York City, died Sept. 12 in Los Angeles, Calif. Mr. Crehore was born in Cleveland in 1864 and was graduated from Yale University with the degree of A.B. in 1886, and, from the Sheffield Scientific School with the degree of Ph. B. in 1888. A year later he became inspector of erection in the bridge department of the Pennsylvania R.R., and shortly afterward entered the service of the Baltimore & Ohio R.R. as a draftsman. During 1891 and 1892 he was chief draftsman for the Wallis Iron Works at Jersey City, N. J., and entered private practice in 1892 as a consulting engineer in construction work with headquarters in New York City. He became a member of the firm of the Structural Engineering Co. in 1896, and was in charge of design and supervision of fire-resistive buildings, factories, power plants and other structures. Mr. Crehore's work also included specialization in reports on the safety of bridges, power stations, factory buildings and storage houses, and testimony in court on questions of construction, and interpretations of contracts. He was the author of "Tables and Diagrams for Use of Engineers and Architects" and other architectural books. He was a member of the American Society of Civil Engineers and the Authors' League of America.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Building Industries Active at Washington

Holding of Future Construction to Very Close Limits Evident in Conferences with War Industries Board

By William B. King
of King & King, Attorneys and Counsellors at Law, and Washington Representative, National Federation of Building Industries

Reference was made in *Engineering News-Record* of Aug. 29, p. 429, to the District of Columbia labor regulations apparently effecting a stoppage of construction in the district. It is gratifying to know that the organization of the National Federation of Building Industries established at the convention held under the auspices of the Chamber of Commerce of the United States at Atlantic City, July 16, has vigorously undertaken the work thus advocated. It has had a formal hearing before Chairman Baruch and informal conferences with other officials of the War Industries Board.

The policy of the board, impelled by the necessities of the war for labor, material, fuel and capital, continues extremely restrictive of construction enterprise, and makes it evident that, if construction, except for the United States, is not to be practically stopped, it will only be because the board may be convinced that certain private construction, such as farm improvements, is necessary to the war, or that some labor and material are available in certain localities, which would be idle and unused if construction were not locally permitted. The very difficulty of present conditions is the strongest reason why the construction interests should unite in keeping a central organization on watch to see that the restrictive policy is not carried so far as to defeat itself and result in local idleness and widespread business disaster.

All Construction Projects To Be Licensed

The War Industries Board has just issued orders requiring licenses to be obtained for all construction projects, whether building, roads or of other character, except five specified classes, as noted on page 516 of this journal for Sept. 12.

The representatives of the War Industries Board have informed the National Federation that they would be glad to receive any suggestions from them for the proper administration of this new responsibility. The board recognizes the very great responsibility involved in the stringent restrictions promulgated, and great regret has been expressed that it should seem necessary to issue them. It should be understood that the board has no desire to hinder construction except as this policy is held to be required by war needs. It will be the purpose of the National Federation of Building Industries to gather all the information possible in regard to the best method of securing in the granting of licenses, fairness, equality and just consideration of the construction needs of the country.

Conditions necessarily vary in different localities. Local needs and local opportunities for labor and material will greatly differ. Considerable farm construction for the care of crops seems absolutely necessary. Sanitary needs can not be neglected. Community changes require housing, even in localities where direct war construction is not going on. Destruction of buildings by fire demands reconstruction. Factories must be built for the imperative needs of the civil population. The central representatives of the construction interests need to take all these conditions into consideration and to help the War Industries Board to avoid the evils that will surely come, if restriction be carried too far.

Danger is to be apprehended that the unguided grant of discretion for licensing to many local aids of the State Councils of Defense will lead to widely different standards of license or refusal. Instructions by the War Industries Board would seem essential.

It has been definitely promised that the views of the National Federation will be carefully considered and that a full hearing will be given to its representatives upon any point involved in the administration of the regulations restricting building.

Army Educational Service Asks Catalogues for Soldiers

A need for catalogues and supplementary literature for work among returned soldiers is announced by Maj. Fred T. Reagle, Sanitary Corps, U. S. A. He asks that manufacturers send pamphlets describing their lines which may touch upon the various phases of the work of the educational service, used in the courses given to disabled soldier patients. The courses are those given in any polytechnical school, covering forty or more subjects. Major Reagle states that the need is urgent, and requests as early action as possible.

Supplying Army Centered in General Staff

Purchasing, Storage and Traffic Under One Director—Corps Makes Up Own Requirements

(*Washington Correspondence*)

Reorganization of the Army supply system, whereby the entire process of purchasing, storage and transportation is concentrated in a branch of the General Staff, continues to progress. As stated in *Engineering News-Record* of Aug. 1, p. 246, the purchasing of the many different commodities required by the Army was shifted early this summer so that each branch of the War Department purchases all of the material about which it has special expert knowledge, regardless of whether it will use this particular material or not. Thus, the Ordnance Department, being expert on machine tools, was delegated to purchase all the machine tools for the Army, even such tools as were required by the Corps of Engineers in some of its overseas shops or by the Aviation Corps for repair work. This allocation of materials to specific corps has continued beyond the stage in which it was when reported six weeks ago in these columns, and now embraces all the commodities noted in the accompanying table. In this table the various products bought by the Army are given alphabetically, together with the bureau which purchases the product.

More Power for the Division

Under date of Aug. 27 the purchase, storage and traffic division of the General Staff received more power in regard to supplying the Army. Under this new order this office, which is directed by Maj. Gen. G. W. Goethals, assistant chief of staff, has "the responsibility for and authority over the supply of the Army, including analysis and computation of requirements, purchase, production, inspection, acceptance, transportation, storage, issue within the United States and embarkation," and further is "in charge of the relations with all other agencies, Governmental and otherwise, in regard to Army supply, including representation of the War Department on the War Industries Board in business with the representatives of the allied governments." A radical feature of the order is the statement that the chiefs of all other bureaus, corps and departments of the Army shall report to the Director of Purchase, Storage and Traffic on all matters enumerated in the preceding quotations.

Under this order it is probable that

as soon as the details can be arranged the various purchasing departments of the various corps will be taken over intact by the General Staff. In many cases this means that the officers of these corps will be recommissioned in the General Staff—that is, for instance, the Engineer Depot will become a branch of the Division of Purchase, Storage and Traffic of the General Staff and entrusted with the purchase of all supplies of which the engineers have expert knowledge. Such a move, of course, is in line with the procedure in large commercial establishments where the provisions for purchasing are centralized.

Divisions of the Supply Corps

Under the scheme which is being worked out the supplies for the Army will be passed through a routine of six separate heads: namely, requirements, engineering, purchase, production, storage and embarkation. The requirements section will be centralized in each of the respective corps. Each corps, knowing its own necessities, will establish its requirements on the basis of the size of the Army laid down by the General Staff, and will report these requirements through a centralized requirements bureau in the Division of Purchase, Storage and Traffic. The same applies to engineering, which will be taken care of in each of the separate corps. Purchase and production form a separate branch, consolidated, as stated in the preceding paragraph, in the General Staff, except for such highly technical details as require the special attention of the separate corps.

Storage becomes a General Staff matter. Quartermasters' signal, engineers'—all stores in fact—pass out of the hands of the respective corps when once purchased and into general storehouses, where they are held at the disposition of the Division of Purchase, Storage and Traffic to be turned over, when wanted overseas, to the embarkation service, which is under the same direction.

Organization Committee of Zinc Institute Holds Meeting

The organization committee of the American Zinc Institute meets in Chicago Sept. 20. The seven members will select 14 others to form the board of direction of the institute for the coming year. The aim of the institute, as outlined at the St. Louis convention in July, is to stabilize the zinc industry. It is the opinion of the officers and members that a better understanding between miner, smelter and consumer is desirable and possible, and to accomplish this the following tentative program will be followed: (1) To educate the public in new uses of zinc; (2) to establish a statistical bureau; (3) to increase the exportation of zinc, and (4) to improve organization and management throughout the industry.

The action of the organization will be subject to ratification by letter ballot, and it is believed that Washington prefers to deal with the industries through such organizations.

DISTRIBUTION OF MATERIALS TO BE PURCHASED BY WAR DEPARTMENT

Articles	Procuring Bureau	Articles	Procuring Bureau	Articles	Procuring Bureau	Articles	Procuring Bureau
Aeroplane cloths	Aircraft	Engines, fire, motor drawn	Motor transport	Leather goods	Quartermaster	Searchlights, arc	Ordnance
Alloys, chrome	Ordnance	Engines, gas	Engineers	Linen	Quartermaster	Shovels, steam	Engineers
Alloys, ferro	Ordnance	Engines, gas, airplane	Aircraft	Linen fabric, balloons and airplanes	Aircraft	Silk, fabric	Quartermaster
Alloys, manganese	Ordnance	Engines, steam	(See boilers)	Linen thread	Quartermaster	Silk, thread	Quartermaster
Aluminum	Ordnance	Equipment, electrical	Construction	Linseed oil	Engineers	Silk, yarn	Quartermaster
Ammonium, nitrate	Ordnance	Equipment, forging	Ordnance	Linters, cotton	Ordnance	Sisal rope	Quartermaster
Antimony	Ordnance	Equipment, refrigerating	Construction	Locomotive cranes	Engineers	Soaps	Quartermaster
Balloon cloths	Aircraft	Extinguishers, hand, fire	Quartermaster	Lumber	Construction	Soaps (surgical)	Medical
Barbed wire	Engineers	Fabric, silk	Quartermaster	Lumber, airplane	Aircraft	Sodium nitrate	Ordnance
Barometers	Ordnance	Fencing	Construction	Machine tools	Ordnance	Spirits, mineral	Engineers
Bars, reinforcing	Construction	Fiber hull	Ordnance	Machinery, refrigerating	Construction	Sprinkler system	Construction
Batteries, dry	Ordnance	Fire apparatus	Construction	Machinery, structural and iron workers	Engineers	Staples, barbed wire	Engineers
Blast furnace and steel mill products	Ordnance	Fire apparatus (automotive	Motor transport	Machinery, wood working	Engineers	Steel mill products	Ordnance
Bleaching powders	Chemical warfare	Fire extinguishers (hand)	Quartermaster	Manganese alloys	Ordnance	Steel fence posts	Engineers
Belts (for engineers)	Engineers	Fire hose	Engineers	Manila rope	Quartermaster	Steel hangars	Aircraft
Brass tubing	Aircraft	Flashlights, dry cell	Ordnance	Materials, building	Construction	Steel, structural	Construction
Building materials	Construction	Forging Equipment	Ordnance	Metals, non-ferrous	Ordnance	Structural steel	Construction
Bunks	Quartermaster	Gantry cranes	Engineers	Mica	Aircraft	Supplies, electrical equipment	Construction
Burlap	Quartermaster	Garment workers' power tools and machinery	Quartermaster	Mill products, steel	Ordnance	Surgical needles	Medical
Cable, electric	Aircraft	Gases, acetylene, hydrogen, oxygen	Chemical warfare	Mineral spirits	Engineers	Tanks, water-supply	Construction
Cartons	Quartermaster	Gas, coal products	Ordnance	Needles	Quartermaster	Tanks, gasoline	Quartermaster
Cement	Construction	Gas, containers	Chemical warfare	Needles, surgical	Medical	Tanks, oil	Quartermaster
Chain	Engineers	Gas electric generator sets	Engineers	Nitrates	Ordnance	Tar, coal products	Ordnance
Chain, artillery	Ordnance	Gages, oil, air, gasoline	Aircraft	Optical glass	Ordnance	Telephone equipment	Signal
Chain, automobile drive	Quartermaster	Generator sets, gas electric	Engineers	Optical instruments	Ordnance	Telegraph equipment	Signal
Chain, non-skid	Quartermaster	Glass, laminated	Chemical warfare	Paint, all	Engineers	Thermometers	Aircraft
Chemicals	Ordnance	Glass, optical	Ordnance	Paper	Quartermaster	Thermometers, medical	Medical
Chemicals, medical	Medical	Goods, cotton	Quartermaster	Phosphorus	Chemical warfare	Thread, silk	Quartermaster
Chemicals, organic	Quartermaster	Goods, rubber	Quartermaster	Pig tin	Ordnance	Time-interval recorders	Ordnance
Chemicals, special	Aircraft products	Goods, rubber mechanical	Engineers	Plate tin	Ordnance	Tool chests	Quartermaster
Chemicals, toxic	Chemical warfare	Goods, woolen	Quartermaster	Platinum	Ordnance	Tools, hand	Quartermaster
Chests, tool	Quartermaster	Gravel	Construction	Plumbing equipment and supplies	Construction	Tools, machine	Ordnance
Chlorine (liquid)	Chemical warfare	Gray goods	Medical	Pontoon wagons	Engineers	Tools, power, garment workers and saddlers	Quartermaster
Chrome alloys	Ordnance	Hangars, steel	Aircraft	Posts, steel fence	Engineers	Tools, power, iron and structural workers	Engineers
Clay products	Construction	Hardware, builders	Construction	Poultry wire	Engineers	Tools, power, woodworking	Engineers
Clocks, etc	Aircraft	Hardware, general	Quartermaster	Powders, bleaching	Quartermaster	Tubing, brass	Aircraft
Cloth, cartridge	Ordnance	Hardware, rough	Construction	Powders, washing	Quartermaster	Tubing, copper	Aircraft
Cloth, cotton	Quartermaster	Heaters, room	Construction	Products, blast furnace	Ordnance	Tungsten	Ordnance
Clothing, aviators	Aircraft	Heating equipment and supplies	Construction	Products, coal gas	Ordnance	Turpentine	Engineers
Coal gas products	Ordnance	Horse masks	Gas defense	Products, steel mill	Ordnance	Turpentine, medicinal	Medical
Coal tar products	Ordnance	Hose, fire	Engineers	Pumps, gasoline	Quartermaster	Varnishes (all ingredients)	Engineers
Compasses	Aircraft	Ice boxes	Quartermaster	Pumps, oil	Quartermaster	Varnish, spar	Aircraft
Containers, paint, etc	Engineers	Instruments, optical	Ordnance	Pumps, general	Engineers	Vehicles, animal or handdrawn, wood	Quartermaster
Containers, gas	Chemical warfare	Instruments, surveying and topographical	Engineers	Pumps, tank car	Engineers	Ventilating equipment	Construction
Copper tubing	Aircraft	Japans (all ingredients)	Engineers	Pumps, water supply	Construction	Wagons all	Quartermaster
Cots	Quartermaster	Jute	Quartermaster	Radio equipment	Signal	Watches, stop	Ordnance
Cotton goods	Quartermaster	Lacquers (all ingredients)	Engineers	Railway contractor plant	Engineers	Washing powders	Quartermaster
Cotton linters	Ordnance	Lanterns, portable cap	Ordnance	Railway equipment	Engineers	Water-supply equipment	Construction
Cotton rope	Quartermaster	Lanterns, portable hand	Ordnance	Recorders, time interval	Ordnance	Water-supply fixtures	Construction
Cranes, gantry	Engineers	Leather	Quartermaster	Refrigerating equipment	Construction	Wire, barbed	Engineers
Cranes, locomotive	Engineers			Refrigerating machinery	Construction	Wire, carts, steel	Ordnance
Distillates, wood	Aircraft			Refrigerators	Quartermaster	Wire, electric	Aircraft
Dressings, surgical	Medical			Reinforcing bars	Construction	Wire, fencing, woven	Quartermaster
Driers, paint, etc	Engineers			Rope, cotton	Quartermaster	Wire netting, poultry	Engineers
Dyestuffs, organic	Quartermaster			Rope, manila	Quartermaster	Wire, products, except as noted	Quartermaster
Elastic tape	Chemical warfare			Rope, sisal	Quartermaster	Wood distillates	Aircraft
Electric cable	Aircraft			Roofing materials	Construction	Wooden goods	Quartermaster
Electrical equipment and supplies	Construction			Rubber	Quartermaster	Zinc	Quartermaster
Electric, gas generator sets	Engineers			Rubber goods	Quartermaster		
Electric wire	Signal			Rubber goods, mechanical	Engineers		
Electric wire, heavy power	Construction			Sand	Construction		
Enamels (all ingredients)	Engineers						
Engines, fire	Construction						

Engineering News-Record

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AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Save Paper!

EVERY one can do a little, many can do much, all together can do a great deal in answer to the appeal of the War Industries Board to save paper. Three pounds of coal are released for every pound of paper conserved. What can *you* do to save paper?

Penalties for Impure Water Supplied on Lake Steamer

WARNING to owners of lake steamers that if they supply polluted water to passengers it will be at the risk of heavy money penalties for typhoid is afforded by the decision of the Federal District Court at Detroit, noted on p. 581. The fault was one which could not be overcome by the supervision of railway and steamship water-supplies exercised by the United States Public Health Service unless the service were to place an inspector on each train and boat to guard against the taking on of any polluted water in case the certified supply fails.

Joint Use of Special Railroad Equipment

ANNOUNCEMENT has been made by the Southern regional director of the Railroad Administration that the all-steel dynamometer car owned by the Nashville, Chattanooga & St. Louis Ry. has served its purpose on that road and is now available for use on any of the railroads under Federal control. This illustrates one of the incidental opportunities of unified operation. There is much in the way of test cars and other special equipment that, while it must be provided on certain occasions, is not in anything like constant demand. There has been some lending around of this equipment in the past, but also much duplication. Such lending around and the elimination of unnecessary duplication become the natural thing under Government operation.

Municipal Strikes and Automatic Wage Changes

MUNICIPAL strikes have not yet become numerous, but they show which way the wind blows. The general cause is a demand for higher wages to meet the increased cost of living. This was the case recently at Albany, N. Y., when about 40 water-works employees, including laborers, calkers and meter inspectors, went out. The Board of Estimate promptly raised wages and the men resumed work. This and other incidents, notably the recent strike of 20,000 London policemen, suggest some more rational and less disturbing plan of insuring wage readjustment. The cost of living as a wage basis has been put into effect for certain employees of Cuyahoga County, Ohio, as described in *Engineering News-Record*, Aug. 1, 1918, p. 238. Industrial employers may also note with possible profit the example set by a private company at Cleveland, mentioned in *Engineering News-Record*, Sept. 5, p. 432. Automatic wage readjustments resting on a scientific basis deserve widespread attention on the part of public and private employers, laborers and all who have the general welfare at heart. In war time nothing which can reasonably be done to avert strikes should be left undone.

More Ships!

SHIPBUILDING progresses rapidly, but the need is greater than the speed. This is apparent from the official shipping figures printed on p. 598 and from our program to send 250,000 men overseas every month for nine months to come so as to increase the 1,750,000 already sent to 4,000,000 by June 30, 1919. Food Administrator Hoover has just announced that the military program calls for a movement of 17,550,000 tons of foodstuffs and feed grains during the year, or 5,730,000 tons more than during the year 1917-18, which excess is 197,000 tons above the average yearly total shipments in the three years before the war. This takes no account of munitions and other materials which bulk large. If we can move the men and supplies to fill this program and thus end the war in 1919 instead of 1920, a million American lives may be saved. That is why we must have more ships and one of the reasons why on every hand industries not essential to the war must be shut down. Steel, coal, other materials and labor must be devoted to shipbuilding and to other war industries.

Let the Good Work Continue

THE justice of highway contractors' claims for increased compensation is being recognized by the public. While officials, in the fulfillment of their constitutional duties, have found it necessary to order that work be done as if times were normal, and while it has too often been the custom to brand the contractor as a grafter, it is refreshing to see the public, which after all is the final court, step forward and make up the losses which would otherwise be suffered. An instance of such action is set forth on page 588 of this issue, where the farmers of Vermilion County, Ill., donated teams and money to finish roads which were shut down on account of the bankrupting war conditions.

As has been pointed out before by this journal, relief of the contractor in these abnormal times is the only just and logical course for a community to pursue which does not wish to be put in the position of "getting something for nothing." Let the good work continue; it is in harmony with that new day of coöperation which appears on the after-war horizon.

Personality

CHARLES SCHWAB has in full measure the technical qualities required of the head of our great shipbuilding program. On the solid foundation laid down by his predecessors, he has utilized his knowledge of the steel business, his marvelous organizing faculty and, not the least, the confidence he has inspired in his fellow citizens to build a machine which functions better every day. But with all these his greatest success has been with the workmen themselves. Almost daily he appears at some shipyard for a talk with the men. Not then is he the millionaire organizer and executive; he is Charley Schwab, steelworker. Man to man he meets them. Workman to workman he talks to them. From rivet heater to works manager they feel that here is one of the boys, one of the thousands who by brawn and skill are building Pershing's bridge of boats. If ever a man has not "lost the common touch" in growing rich, it is Schwab. And this is success beyond millions of dollars.

Efficiency of Government Operation of the Railroads

PUBLIC answer to a newspaper criticism of Government operation of the railroads, as shown by comparative statistics for the first five months of 1918 and 1917, is made on behalf of the Railroad Administration by Theodore H. Price, actuary to the administration. He points out that while the ton mileage decreased only slightly (0.6%) in 1918, the loaded-freight-car mileage decreased 8.6%. The difference in percentages he attributes to better loading of cars, and the running of longer trains. The newspaper had condemned the administration for having failed, with all its money available, to add materially to the number of locomotives and cars. Mr. Price states that the 4,000 locomotives and 100,000 cars that have been under order a long time could not be turned out in a day, but holds that it is evidence of efficiency that more complete loading is being got out of existing equipment. He shows that this better loading has produced the equivalent of 211,200 freight cars and 1750 locomotives.

As to the slight decrease in ton mileage in the face of what is supposed to be the greatest demand for transportation that ever existed, he attributes it to reduction in the necessary mileage through better routing. In several cases, he states, the distance that freight in transit between two important cities formerly traveled has been shortened from 200 to 500 miles, and one instance is cited where 8999 cars were so rerouted as to effect a saving of 195 miles per car, which at 6c. per car-mile means $105,278. More data of this sort would be extremely interesting. A somewhat better idea of the total saving effected by better routing could be had if the table on which the discussion is based showed, as it does not, the total of tons moved; and a still better index to how much more useful transportation was provided in 1918 than in 1917 would be available if each shipment could be translated into ton mileage on the basis of straight-line distance between shipper and consignee.

In support of his argument that Government operation has proved more efficient than private, the use of two figures is more surprising than convincing. These are the average car mileages per day in 1917 and 1918. While the former figure was 26.4, the latter fell to 23.7. Mr. Price holds that this falling off is directly due to the heavier car load and train load, necessitating slower running of trains, and is therefore another indication of efficiency. This would hold if the 26.4 and 23.7 represented anything like the number of miles per day a car should run while in a train on the road. They do not; they represent what the car should make in only two or three hours of the 24-hour day. On that basis the average lost mileage per car per day, due to standing time for loading and unloading, time in the shops for repairs, switching delays at yards and terminals, etc., is something like 200 miles. To reduce this lost time the Railroad Administration is able to impose far more drastic penalties than the private owners were for failure to load and unload cars promptly; to pay considerably more for shop labor and send bad-order equipment to shops best able to handle it; to route shipments with a view not only to minimum mileage but to avoidance of congested lines and yards. Apparently it would not have been a great feat under the circumstances to take up the 2.7 miles per day attributed to the slowing down of trains, and an additional 5, 10 or 25 miles.

In the main, however, Mr. Price's argument is convincing. Surely there is no warrant for broadcast condemnation of Government operation on the basis of the figures to date. *Engineering News-Record*, while believing that the private managers did as well last year as was possible under circumstances not under their control, sees no reason yet to withhold commendation of Government operation as a war measure.

A New Engineering Education

REORGANIZATION of engineering courses along the lines dictated by the needs of the practicing engineer is strongly advocated by Prof. F. H. Bass on p. 582. There will be full sympathy with his point of view on the part of practitioners. But more than sympathy is needed. There must be action, the exercise of influence upon those who design and direct engineering courses. Obviously, the engineering societies are in the best position to crystallize the views of the profession and present them to the college. For years they failed signally to perform that obvious duty. Not until Dr. Mann undertook a survey was anything worth while done. His report, certain to be of great value, is anxiously awaited.

Educational reorganization is one of the problems of reconstruction. At this minute the standards of the past have been rudely cast aside. This year there are no regular engineering courses. The army dominates everything—and it will continue to dominate the colleges as long as the war continues. When peace

comes we can start with a clean slate. May the new writing better serve the end than the past. Professor Bass is thinking straight; so also we are sure is Dr. Mann. On their ideas can be built a new engineering education fitted to the larger conception of engineering which recent years have been developing and which the war has accelerated.

What British Labor Wants

LAST winter a subcommittee of the British Labor Party prepared a reconstruction report making drastic demands. It was drafted, we were told in the United States, by the high-brows, the Fabians, with Sidney Webb at their head. Predictions were that the rank and file would repudiate the radical recommendations. The event has proved otherwise.

In June the labor party held a general conference. The sub-committee's recommendations were adopted practically in full. One expected that labor would demand a minimum wage, restoration of trade union conditions, unemployment insurance and similar measures contemplating the restoration of the status quo ante or in line with the tendencies of British labor's demands in the years before the war. But the resolutions adopted go further. They demand the retention in public hands of the railways and canals, public control of super-power stations for the generation of electricity, nationalization of the coal and iron mines, and government control of capitalistic industry, organizing, controlling and auditing processes, profits and prices. In a word, they demand that the socialization brought about by the war shall be made permanent. They argue that what is good for the nation—for its citizens—in war is good in peace. But not satisfied with this socialization, they ask for the "equitable" conscription of accumulated wealth, exempting fortunes below $5000, the basis for the demand being that income taxes alone will not be great enough to discharge in a reasonable time the enormous war debt. In this connection they decry taxes on food and other necessities of life.

Can we draw from this British experience any conclusions of value to ourselves? Obviously, the conditions are different; the labor movement here has not developed in the same way England's has. But we have socialized our industrial systems, too. Much of the coöperative result is good and should be retained. Shall we, in trying to keep the good, let unwise counsel prevail and handicap initiative? The answer is with the future.

As to accumulated wealth, is the attitude of our Congress much different from that of British labor? We fear that it is not. There is in Washington a distinct lack of sympathy with the industrialism that has builded this nation. And that lack of sympathy does not stop with mere—and proper—protest against the abuses of the system. It extends so far even as to deprecate the initiative that is the root of all our pioneering, whether in the subjugation of our West or in launching new industrial enterprises.

Unfortunately, we are not preparing for the troublous times that must decide these issues. This journal has urged the formation of a great reconstruction commission. If the President does not act we may go into peace as poorly prepared for it as we were for war.

Safety Engineering Demanded in the Construction Industry

SAFETY engineering, by the enthusiasm of its followers, by its clear purpose and by its material accomplishments, commands a distinguished place among the specialties of the professional engineer. Last week several hundred of these men met in convention at St. Louis to present and discuss the problems of their work. A full week of meetings was required to dispose of the program. At periods half a dozen sections were holding sessions simultaneously. There was work done at every session, practical accomplishment in forwarding the methods and practice of preventing industrial accidents.

Realization of the toll which accidents are taking steadily from our workmen has come slowly to the people. Even the factory manager has been tardy in grasping its immensity. The civil engineering constructor, broadly speaking, has not given it even cursory attention. How many construction men realize that death or injury by accident removes from our industries for some loss of working time one man every 13 seconds, 277 men every hour, 2,500,000 men every year?

One must go to the battle fields of Europe for figures of comparable size with our accident lists in the destruction of man power. And the greater number of these industrial casualties are absolutely preventable. Furthermore, of these casualties civil engineering construction contributes in proportion to the number of workmen engaged a greater percentage than any other industry. Still again, this is the industry which has done least in developing and practicing safety engineering or accident prevention measures.

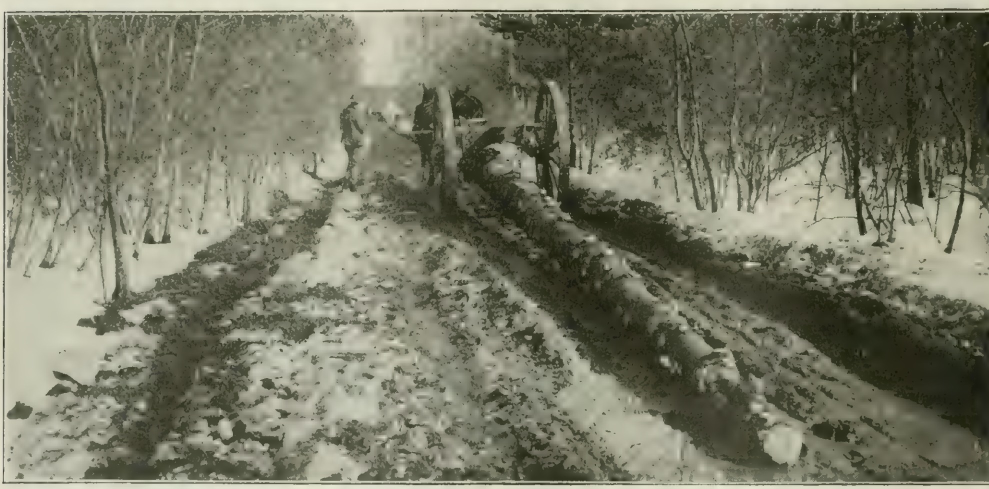
Construction is a hazardous industry. We cannot escape this fact, reason however we may. Our great fault as construction men is our tendency to consider construction hazards as not practicably avoidable, to accept accidents as inseparable from the kind of work that we perform. These are great errors. By far the greater number of the accidents which occur in construction work are entirely avoidable. Of those that occur despite precaution the greater number can be prevented from becoming serious in the way of human suffering and lost working time. These assertions are not visionary. They have behind them the proof of actual experience. Construction firms which have systematically developed accident prevention methods in prosecuting their work have greatly decreased the number of accidents and still more greatly reduced the cost of accidents.

Active coöperation of construction works' managers with the newly organized Construction Section of the National Safety Council, whose organization is announced in this issue, is urged. Study of accident prevention in construction is being forced upon contractors and builders by the multiplication of workmen's compensation laws, by increasing liability insurance rates, by the growing demands of workmen. The National Safety Council provides a source of information eleswhere unequaled in means of accident prevention. Construction men can make this service more active and efficient by membership and support. By so doing they will help themselves while helping others.

American Forestry Units Are Working Fifty-Three Tracts of French Timber Land

Big Organization of Trained Men Is Relieving Wood Shortage for Army Construction Purposes—Central Committee Controls Acquisition of Sites—Close Utilization of Lumber

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record
Photographs by Committee on Public Information



At fifty-three sites in France American Army forestry units were operating on June 15. This is the information disclosed by a map which one encounters on entering the main office of the forestry section at the headquarters of the services of supply, American Expeditionary Forces. Plugged so full of long-shanked large-headed pins that it resembles a field of stubble, this map of France tells an interesting story of what our people are doing and planning to do in the matter of relieving the timber shortage for military construction purposes.

The development of the lines of communication for the American forces over here has called for a tremendous quantity of lumber for building construction. To recite in detail the uses of timber which are made by our army engineers would take many columns of space. Let us remember that we are engaged upon a gigantic program of building and timber supply which includes docks at our base sections, thousands of wooden warehouses for the storage of supplies, barracks at cantonments, hangars and shops at aviation centers, poles for telegraph and telephone lines, duck boards and revetment frames in the trenches, and planks for timber road construction near the front. The demand for this material has come not in easy stages, but at one time, creating a peak which, under present conditions of transatlantic shipping, could not possibly have been flattened out by relying solely upon cargoes of lumber brought from the United States.

Soon after our entry into the war, therefore, it became apparent that an entirely new service would have to be created for the American Army in France. We needed lumber in large quantities, and the only way to get it quickly was by going into the French forests for it. The decision was reached to organize two forestry regiments, and with the coöperation of various lumber organizations in the United States the West and South were combed for men experienced in this line of work. They were formed into two units, the 10th and 20th Engineer Regiments, which, reinforced by service battalions, represent now a total of about 15,000 men. Included in this organization are also many specialists obtained from the personnel of the United States Forest Service.

The object of the forestry work is to produce wood products, not only for the American Army, but also, to a limited extent, for those of our British and French allies. It was necessary, first of all, to establish a definite policy concerning the acquisition of timber land for military consumption. To have turned our forestry forces loose in France under instructions to get lumber where possible would have resulted in serious complications. In the first place, both the French and the British are engaged in forestry work, and conflict with their activities would have resulted. As a solution to this problem of allocating the raw materials, there was formed some time ago the *Comité Interallié du Bois de Guerre,* with headquarters at Paris. Its membership

MAXIMUM OF TIMBER IS UTILIZED BY SAWING TREES CLOSE TO GROUND

includes representatives of France, Great Britain, the United States and Belgium. This committee controls the acquisition of timber lands throughout France and the distribution of areas among the forestry forces of the several allied armies. Without it the allied forces in France would have found themselves in the position of bidding against one another for the privilege of cutting lumber, with the probable consequence of steadily soaring prices. All offers on the part of owners of timber land must now go to this committee and be acted upon by representatives of all the allied armies in conference. The committee is also charged with the examination of sites and the matter of price fixing. It is informed regularly of the needs of the several armies, and can thus decide intelligently to whom newly acquired tracts should be turned over.

Like practically everything else in France today, timber resources have long since been mobilized for war purposes. There are various sources of lumber, some of these under state, others under communal and still others under private control. Then, too, there are importations of timber from Switzerland and Portugal, these countries having, for example, supplied a large quantity of barrack lumber and railway ties for the use of the American Expeditionary Forces. It is obvious that without some centralized jurisdiction such as is furnished by the *Comité Interallié du Bois de Guerre*, the forestry units of the allied armies would frequently be working at cross purposes. Acting as the sole medium for the acquisition of the standing timber in France, the committee has been a big factor in coördinating the legal and administrative work involved.

The need for the forestry units serving with the American Expeditionary Forces was shown by the experience of the British and French, who have equipped troops for the sole duty of running mills and producing lumber. The 10th Engineers was organized originally for the purpose of aiding the British. Following the old system of organization, it consisted of two battalions. It soon developed, however, that the bulk of these men were needed for producing timber for the American Army. It was decided, therefore, to defer aid to the British until our own wants could be filled. So urgent was the call for timber products that a second forestry organization, the 20th Engineers, was formed. It did not follow the old system, but was expanded to 10 battalions, in addition to a number of service battalions attached to it. I am informed that the 20th Engineers is the largest "regiment" organized by any army. With the arrival of the 20th Engineers in France, it became possible for us, on account of the large number of men at our disposal, to give some aid to our allies, and accordingly one battalion of the 20th was assigned to work for the French and one for the British. In the makeup of our forestry regiments men with experience in woods work, sawmill work or the technical features of forestry are mainly required.

OF ROUND LUMBER THE BIG DEMAND IS FOR PILES AND TELEGRAPH POLES

UNLOADING TREE TRUNKS AT ONE OF THE NUMEROUS AMERICAN ARMY SAWMILLS IN FRANCE

The duties are largely specialized, and the only type of men who can perform them adequately are those who have had years of training in civil life.

Before our forestry units left the United States, it was foreseen that work in France would probably involve certain changes from our own methods. In order that our units might be sent over here properly trained and properly equipped for the work to be done, the chief of the United States Forest Service made a trip to France, studied local conditions thoroughly and organized the work of the forestry section of the Army during its initial stages.

Conditions affecting the production of timber from French forests are in some respects different from those in the United States. In the first place, no such large scale operations as are common in America can be conducted here. As a general rule, our forestry forces must work small tracts of timber—small, that is, in comparison with some of the vast timber resources of the American Northwest. Thus, at the beginning, it was necessary to organize crews and secure machinery and equipment suitable for medium-scale operations. The program resolved itself, therefore, into one of working many small tracts, often widely separated, instead of one large centralized forestry project.

From the physical standpoint forestry operations in France present no very great difficulties to American lumbermen. The important point is to adapt equipment and machinery to the varying conditions found at the sites selected for working. Then, too, our methods must be altered somewhat to conform with French forestry practice, which is far more conservative in the utilization of timber than our own. In normal times the French cut only about as much timber as the forest produces and these cuttings are much lighter than those of American practice. Inasmuch as we are on foreign soil, we must adapt our work of forestry to the wishes of those who control the rights to the timber lands. French practice insists upon a very close utilization of materials in its logging and milling operations, much more so than is usual in the United States. For example, the cut is made very low down on the stump of the tree, and in order to meet French requirements our foresters, as one of their officers expressed it to me, are "getting down on their knees to cut trees."

THIS IS TYPICAL OF THE AMERICAN ARMY SAWMILLS

While most of the work, as noted above, presents no remarkable difficulties more elaborate plant layouts are called for in the regions in the vicinity of the Vosges and the Jura Mountains. Here special methods are employed. Among them is the use of an incline at 35% grade down which logs are lowered, by means of a donkey engine, from a plateau to the mill.

At most of the sites where our forestry units are working all types of machinery common to United States prac-

tice are used, except that there is no steam logging involving cable haulage by donkey engine; this scheme of operation is considered too destructive for the French forests. The method employed generally is to bring the logs in by team haulage, motor trucks, log wagons or narrow-gage railways. In a few cases, floating of logs on watercourses is possible. The felling of trees is accomplished both by sawing and chopping. Saws are used for the felling of the pines and firs while the small hard woods are chopped, for chopping insures a better subsequent sprouting of the tree.

PLANK IS IN GREAT DEMAND FOR BUILDING CONSTRUCTION

Our lumber mills, as shown in one of the photographs, are set up and operated like those employed in the United States. In fact, practically all of the mechanical equipment in service in our forestry work was shipped from home. At these plants, steam power is universally employed. The fuel is sawdust fed into the firebox of a Dutch oven, and other material such as slabs and refuse are burned. The Dutch oven is not common in France, and its operation over here by our troops is said to have created a very favorable impression.

The mills are provided with carriages, on which the logs ride against the saws, and roll ways and benches over which the sawed material travels. Then, too, there are edging machines and special mills for the production of railway ties.

RAILROAD TIES FOR THE USE OF THE AMERICAN ARMY

Because of the present enormous demand for lumber by the American Army our mills are being forced far beyond their rated capacity; for example, mills having a normal output of 10,000 ft. per 10-hour day have been producing nearer 20,000 ft. of lumber in 10 hours, or 38,000 ft. in two shifts per day.

Among the species of trees which we are cutting are pines—by far the most common, and including a Scotch pine similar to our own Norway pine and a maritime pine resembling the Southern yellow pine—fir similar to our Western white fir, oak, beech, ash, hornbeam, spruce, poplar and basswood. The pine country is in the south of France. Most of the trees in this region have been tapped for resin. The pine lumber is being furnished largely for the construction of buildings of various kinds required by the Army. The big demand for spruce comes from the airplane manufacturers. The Red Cross has called for basswood with which to make artificial limbs for the wounded.

Not all of the lumber has to be sent through the mill. The forestry units are supplying large quantities of piling, prop material, telegraph poles, posts and stakes for supporting barbed-wire entanglements, cordwood and fascines. Railway ties can be produced by hewing and need not go to the mills. These are the main uses of the so-called round timber which requires no milling.

Of the mill products, plank for road construction in the shelled areas behind the front and lumber for sheds and buildings are important items. A number of various sizes, including runners for trench boards, are in demand.

A big project in connection with our forestry operations will be the installation of excelsior plants to produce material for mattresses needed at army camps. Excelsior is considered preferable to straw and hay which have been employed up to the present. The power demands at the excelsior plants are so great that they cannot be made accessories to existing lumber mills. Separate installations for the production of excelsior will become necessary and forest areas will be taken over to supply raw material for this specific purpose.

Our total output during the month of June was 26,727,500 ft. b.m. of sawed material, 265,151 railroad ties, 150,359 ties for light railways at the front, 190,702 poles, 7518 piles for new dock projects and 67,500 steres of fuel wood.

The following instance illustrates the pressure under which our men are working, and what it is possible to do to meet military necessity: The 10,000-ft. mill operated by C Company, 10th Engineers, in southern France

had to be moved recently to a new site on account of the exhaustion of the timber supply at the point where it had been operating previously. The whole outfit was moved 35 kilometers and began cutting the first log at the new operation 47 hours after the last log was cut at the old operation. The boiler and engine of this mill weigh about eight tons. The problem of quick moves is one of our most important ones, because of the small size of most French forests.

Baltimore Area and Waterfront Doubled by Annexation

New Boundaries Being Tied Into Old Triangulation — Topographical Survey and City Plan for New Area To Follow

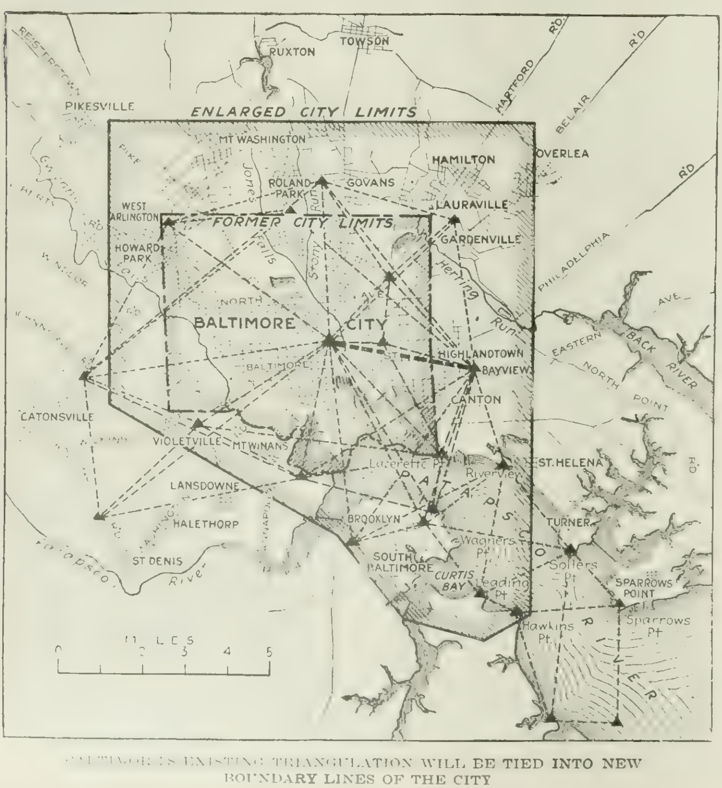
BY JOSEPH W. SHIRLEY
Chief Engineer Topographical Survey Commission, Baltimore, Md.

COUNTING land and water, the area of Baltimore was increased by 52.83 square miles, to a total of 95.32 square miles, by the annexation act which went into effect June 1 last. No time was lost in starting surveys to establish the new boundary lines.

The passage of the annexation act was the result of several years' effort on the part of the citizens of Baltimore to add to the city a number of outlying settlements which were practically a part of Baltimore, but not included within its corporate limits. The act was prepared by a committee of citizens known as the Non-Partisan Greater Baltimore Extension League. The census of Baltimore of 1910 was 558,000, and it is estimated that the old city has grown to 632,000. The estimated population of the area recently added is 65,000, assuring Baltimore of a population of about 700,000 at the next census. The waterfront of the new addition adds approximately 15 miles to the 15 miles already within the city limits, and offers a wonderful opportunity for development upon a comprehensive scale.

The task of surveying and staking out the new boundary was, by the act of the legislature, placed upon the Topographical Survey Commission of Baltimore, and requires the running of about 40 miles of boundary line and setting up approximately three hundred boundary stones or markers.

In 1888 Baltimore extended its limits about two miles to the north and about the same distance to the west. Shortly thereafter the Topographical Survey Commission was appointed and an appropriation was made for a complete topographical survey and map covering the entire city. In making this survey and map the most accurate methods were employed. As a basis of control, a triangulation system, composed of 18 primary stations, was established, having for its center the Washington monument. This system was based upon the surveys made by the United States Coast and Geodetic Survey, and the methods used by that organization were employed. About 7000 points were placed upon the ground, and their positions, relative to the Washington monument, were computed. These traverse stations were used to obtain all field data for the preparation of the final plat. This plat was made on the scale of 200 ft. to 1 in. with 5-ft. contour intervals, and shows all existing highways, houses, railroads and other improvements. With a map of this character it was possible to plan, in a comprehensive way, for the development of the territory over which the city had control. The locating of the new boundaries for Baltimore calls for the employment of the most careful and accurate methods. The Topographical Survey Commission has been carrying on this work for a few months, and has based its surveys upon the triangulation work previously done. New stations have been established in the vicinity of the boundaries, and their locations have been fixed by observations taken from at least three of the older stations. A traverse line has been run over the boundaries and will be tied in



BALTIMORE'S EXISTING TRIANGULATION WILL BE TIED INTO NEW BOUNDARY LINES OF THE CITY

with these new triangulation points. When this is done the relative location of the traverse points to the points along the boundaries can be computed and the boundaries staked out.

It is proposed to mark the new boundary line with concrete markers with bronze centers, set below the surface of the ground, accessible through a concrete box and metal cover. Each of these markers will be made a precise level bench mark.

Upon the completion of the marking of the boundary line surveys will be made to extend the topographical map previously made to cover the entire area now belonging to Baltimore, and a plan for the proper development of this area will be prepared.

Draw Pier of Portland Bridge Settles Three Feet

Bridge in Maine City Put Out of Service Temporarily by Sinking of Concrete Pier Resting on Piles

ON AUGUST 27 the southern draw pier of the Portland bridge, in the harbor of Portland, Me., settled about 3½ ft. and moved longitudinally downstream about 20 in. Although the cause of the trouble has not yet been determined, the engineering interest in the occurrence is sufficient to warrant the following statement of what has happened, furnished at the request of *Engineering News-Record* by J. R. Worcester & Co., consulting engineers, Boston, who had charge of the design and construction of the bridge.

This bridge was completed in the summer of 1916 and opened to the public on July 20 of that year, and has been in constant operation ever since. It was described in *Engineering News* of Oct. 28, 1915, p. 824, and Nov. 4, 1915, p. 319 and *Engineering Record* of Mar. 4, 1916, p. 319. The bridge over the harbor is a deck girder bridge carried by steel girders supporting a concrete floor with wood pavement for a wearing surface. The steelwork rests on masonry piers supported on spruce piling. The drawspan consists of a double-leaf Scherzer rolling lift draw. The pier which failed is on the southern side of the channel and carries one leaf of the Scherzer span together with a truss span.

The pier was constructed in the following manner: The bottom of the harbor was dredged for a depth of 10 or 12 ft. at the location of the pier, after which piling was driven to a satisfactory resistance and piles cut at El. —41. A concrete scow 4½ ft. deep was built on ways on the shore in the immediate vicinity. This scow was built on a 3-in. plank platform on which were constructed the forms to receive the concrete. Around all sides of the scow there was a projecting flange through which projected hooked bolts. On this flange wooden sides of 12 x 12-in. hard pine posts, with 4-in. hard pine planking on the outside, were built up about 18 ft. high. The whole structure was then calked and launched. In order to give the boat more stability a certain portion of the concrete scow was filled with concrete near the site of launching, and the scow was then towed to its correct position and the concrete filled in until the scow had settled onto the piles at low tide. Water was then pumped into the caisson between the sides of the caisson and the shaft of the pier, until the caisson became heavy enough to remain in position at high water. The work of building up the concrete to El. —2 was then carried on and the upper portion of the pier, which was of granite, was completed. After all the masonry was completed the sides were freed at the hooked bolts by a diver and were floated to the surface.

Last spring the draw showed signs of difficulty in locking and unlocking and considerable power had to be applied to operate the locks. Upon making measurements it was found that the pier had moved downstream, that is, transversely of the bridge, about 5 in., but no appreciable settlement had taken place. Measurements were taken from time to time to ascertain if this motion was increasing. It did not seem to show any material increase, but at the same time the draw was operated with increasing difficulty from week to week. It was finally deemed advisable to attempt to jack up the ends of the truss span which carried the Scherzer leaf and place rollers underneath these end bearings and push the end of the truss span back into line. Owing to the impossibility of getting sufficient jacks to jack both ends at the same time, each end was lifted independent of the other about 1½ inches.

Bearing plates were inserted on top of the masonry and rollers inserted between the bearing plates and the under side of truss shoes. After this operation had been completed on both ends the leaves were closed, and when locks engaged the leaf which was out of line rolled back about 2 in. of its own accord; after a day or two jacks were placed against the sides of the truss shoes and the span was moved back very close to alignment. After this had been accomplished all difficulty in opening and shutting the drawspan ceased. This operation of lifting and jacking over the trusses to line was completed Wednesday, Aug. 21.

Pier Moved Downstream Again

Four days later the draw tender commenced to notice a recurrence of the difficulty in locking and unlocking the draw, and after an examination of conditions it was ascertained that the pier had moved downstream in the same direction as before, about 3 in. more, up to Aug. 25. On Aug. 27 the motion of the pier became very noticeable, and in the afternoon of this day it was considered wise to close the bridge to traffic. At this time the pier was moving downstream at the rate of about ⅛ in. every ten or fifteen minutes. As this motion of the pier was multiplied at the center of the drawspan it was considered wise to open the draw at this time to prevent any damage to the other leaf. The leaves of the draw were therefore opened sufficiently to disengage the jaws, and almost immediately thereafter the pier started to move downstream and settle at the same time.

The movement of 20 in. downstream and 3½ ft. settlement took place within 15 or 20 sec., after which the pier brought up, and the settlement became very slight for the next few hours. In fact, during the first night the pier settled about 2 in. and moved downstream 1¼ in. During the second night it only settled ½ in. more and moved downstream about ¼ in. The motion has now practically ceased, and the pier has come to rest.

It was found impossible to raise the leaf of the drawspan resting on this pier by electric power, because the electric feed cables pulled out and short circuited. Also, the two tracks upon which the Scherzer leaf rolled were at different elevations, the eastern one being about 15 in. higher than the western one, and both inclined toward the channel. The steelwork of the truss span was not badly affected, although the lateral bracing was badly bent in one instance and there was also a slight distortion of the bottom chords in each panel. The drawspan seemed to be intact. The pier above water showed no evidences of distortion, as all joints were solid and free from cracks.

Since the accident the floor of the Scherzer span has been stripped of all paving and planking and the load materially reduced, and the two tracks supporting the Scherzer span have been brought practically to the same elevation. After this was completed the workmen were able to raise the draw by the hand mechanism, thereby freeing the channel for water traffic. The southern half of the ship channel was obstructed by this leaf from 4 p.m., Aug. 27, to 6 p.m., Sept. 5. Only small craft could pass.

Work has been commenced on dismantling the Scherzer leaf and the truss span, and in all probability these will be floated away on large lighters to temporary piers nearby.

A series of borings have been started about the pier, and up and downstream from the pier, to verify the original borings. It is the intention to carry these borings somewhat deeper, in order to detect any possible poor strata which may be situated at a greater depth. As yet no conclusion has been reached as to the probable cause of the movement of the pier.

City Planning is Closely Related to Public Safety

By Thomas Adams and Harland Bartholomew
Town Planning Adviser, Commission on Conservation, Ottawa, Canada
Engineer, City Plan Commission, St. Louis, Missouri

Extracts From Paper Read Before National Safety Council, St. Louis, Sept. 17—Street Circulation, Widths, Curves, Grades, Building Heights and Zoning, Open Spaces and Playgrounds May Be Planned to Keep Down Accidents—Illustrations From Conditions and Experiences Incident to Defective Planning at St. Louis

CONSTANT increase of population in large cities has been accompanied by an ever-increasing danger to human life and health. This danger is not caused by the growth of the large cities, but by the haphazard and unregulated manner in which the growth takes place. Few cities in America, if any, are not provided with ample space in their streets and surrounding their buildings. As a whole, they are amply provided with street space and air space, but in spots they are badly congested both in respect to population and traffic. The fault lies in the lack of proper distribution and control of the density of building, on the one hand, and on the other hand in the lack of scientific planning of the street system to secure the best means of circulation of the traffic. For instance, St. Louis is far from being a congested city, but it has badly congested spots; its streets are more than adequate in their total capacity for traffic circulation, but they are not of adequate width in the right place.

Street Circulation and Building Density

In a properly planned city consideration has to be given not only to the needs of through circulation of traffic between its different parts, but also to the building density on the lots fronting on the streets. Both these things have to be regulated together, or planning will prove ineffective as a means of preventing congestion. Many European cities with comparatively narrow streets have better and safer means of circulation for traffic than some American cities, because of the lower density and height of buildings. City planning is needed to govern, among other things, the relation between the width of street and the height of buildings, and the ideal to aim at, however difficult of attainment it may appear to be, is making the height of a building correspond to the width between its front wall and the front wall of the building facing it. Until we can reach that seemingly difficult standard we shall not be able to obtain space in our streets to enable us to get rid of congestion of traffic and consequent dangers to life and loss of valuable time to citizens.

Plan for Future Generations

Accidents caused by street cars and automobiles and untimely deaths from diseases which result from unplanned street systems and congestion of population account for a considerable proportion of any city's death rate. The admirable and extensive methods of handling traffic, and the various public health campaigns, are responsible for the conservation of many thousands of lives each year, and the unabated continuance of these methods and campaigns is highly essential, for even had we been permitted to foresee present conditions, we could scarcely have been able to forestall entirely their attendant dangers. In the light of present conditions, however, we can at least remedy for future generations some of the fundamental defects of our present city growth. This is the task of the city planner.

In planning, replanning and reconstructing cities an effort should be made, as far as practicable, to carry out the following objects, among others, in regard to streets, buildings, and open spaces for recreation:

Heavy traffic streets should be wide, and those which carry street railways should not be less than 100 ft. in width. Directness of route should be sought for main highways, free from the right-angled turnings, abrupt endings, irregular crossings and collision points caused by rectangular planning. On hilly sites, reasonable curves, with a clear vision of a hundred yards at all

points, should be substituted for straight, steep grades. Sharp curves should be avoided and those existing should be done away with. Bad grades should be avoided, particularly at intersections. More than four streets should not be made to converge at one point unless large traffic space is provided at the point of convergence. Frequently the rounding of sharp, angular corners at street junctions will do more to relieve congestion and prevent accidents than widening of the interior of the street. The street railway systems of cities should be planned or replanned with the object of securing general convenience, and not for the interest of a few property owners. New bypass streets should be created in many cases; this is preferred to widening existing streets, so that traffic is distributed rather than concentrated. Main radiating routes should be supplemented by wide, circular routes at the inner and outer circumference of the city, so as to cause traffic distribution before it reaches the center. In residential areas narrow streets should be designed and restrictions made limiting the height of the residences to two or three stories and preventing change in character of buildings. The narrow streets should be so planned as to discourage through traffic. The whole street system should be planned for various widths in relation to building use and density and prospective traffic requirements.

Intersections should be planned to make it certain that all traffic may move either at right angles or in a gyratory form in a circle of ample radius (not less than 100 feet).

Building set-back lines should be fixed on all streets, but particularly where streets of comparatively narrow width cross, so as to permit of a better view of the intersection and all approaching vehicles.

Building Heights and Zoning

The ideal to be aimed at in regard to height of buildings should be the limitation of the height to the width of the street in the front and to the width of the space between the rear walls of buildings. Only thus can we give effect to our measures to prevent congestion and obtain the benefit of street improvements. The amount of superficial area of a lot to be built upon should not exceed 75% in the business area and 50% in residential areas, except on corner lots.

These standards may seem to be so much in advance of present-day practices that they are not likely to receive the sanction of public opinion, but the time is approaching when they will be adopted and enforced. Cities should be zoned for purposes of limiting different heights and densities in different districts, and prescribing manufacturing, business, residential and other uses of property—the street system having been simultaneously planned to suit these different uses. This has been done in New York, St. Louis and other cities, but the standards so far attainable are not yet adequate to reduce possible congestion. The spreading out of cities on a more even basis, less congested in some parts and less blighted or scattered in other parts, is not only essential to relieve congestion and obtain safety, but is needed for a more equitable distribution of property values in the interest of owners.

American cities are, generally speaking, adequately provided with open spaces for recreation, but those rare instances where these spaces are in the right place and are properly distributed to be accessible to the population have been the result of accident and not of design. The reduction of street space in residential areas, and the lessening of building density on lots, will be made more practicable and beneficial if they are accompanied by the provision of playgrounds in every district. Such provision is necessary to reduce the use of the street as a playground. Large parks are of great value to a city, but they do not lower the need for recreation spaces in close proximity to the homes of the people. City planning schemes should not only have regard to the placing and designing of playgrounds and parks, but should lay down some principle under which the provision of a percentage of all land to be subdivided in future should be set apart for recreation. In some provinces in Canada and in certain schemes in England it is provided that one-tenth of any area subdivided for building purposes shall be left as a public open space. This is required in the same way as street space is required to be left free of building, as a condition on which land is subdivided for building purposes. Land which is least adaptable for building is often best suited for playgrounds, and the giving of such land to the public by the owner does not necessarily mean that he loses its value. The fact of its being given as an open space adds to the value of the surrounding land for building purposes, and makes it practicable to have less space devoted to streets. It is well known that one of the chief causes of loss of life on public streets is the fact that many city children have no other places on which to play.

What Is Being Done in St. Louis

A few illustrations of what St. Louis is doing in city planning may serve to show what can be done to increase public safety. There has recently been adopted a zone plan for regulating the height, area and use of all buildings. While the regulations apply principally to new structures, except where a change of use in an existing building is made, it is confidently believed that in a very few years there will become well defined lines of demarkation between the residential, commercial and industrial districts. As a result, industries and stores will be eliminated from the residential districts and, particularly in the congested sections, children will be more free to play without the danger of accident from the teams and trucks which serve the industry or store. Furthermore, the separation of residential from commercial and industrial districts will produce more desirable homes free from noises, smoke, dust and odors of the commercial or industrial institutions, and the danger to public health will thus be greatly diminished. Today the industries are spread promiscuously throughout the whole city. Eventually, under the zone plan, it is believed that industries will group themselves into certain natural districts which will simplify their own methods of transportation and prevent much of the present intermingling of commercial and pleasure traffic. This should serve to increase greatly the safety of both kinds of traffic.

St. Louis is gradually developing a system of major streets so located and of such width as to accommodate the greater part of all traffic throughout the city. This

system will considerably simplify the traffic movement and hence greatly increase the public safety. Congestion of traffic at any one place, in any one district or on any one street will be eliminated, thus avoiding one of the greatest contributing causes to frequent accidents. The major streets will be so planned as to avoid sharp curves, irregular intersections and bad grades. Where feasible a separation of different kinds of traffic will be made. By this development of major streets it becomes possible to reduce traffic on the minor residential streets, decrease the roadway width, lay less expensive pavement and thus discourage anything except local traffic, all of which increases the public safety.

In the matter of public recreation, the new playgrounds, so far as practicable, are being located on minor streets and in accordance with the distribution of children who will use them, thus reducing the distance children must travel to the playgrounds and the consequent danger of accident.

Considerable attention to questions of public safety has been given by the police department of St. Louis, the Division of Streets and Sewers and the Chamber of Commerce. The police department has a traffic squad of 42 men. Where traffic is densest certain "congested zones" have been designated by ordinance, by which the parking of vehicles is regulated, traffic lights are placed, traffic police are stationed and all street intersections are marked off for vehicular and pedestrian movement.

Street Accident Map Is Useful

An interesting study was made in the form of an "accident map" which shows by black circles of proportional size the number of accidents which occurred at various points in the city throughout an entire year, as reported by the police department and the street railway company. This map has been quite useful in determining particularly dangerous points, acquainting the motormen and police with them, in locating traffic lights and traffic police, signs, etc. In several cases the cause of accidents has been determined by special study and a change of curb radius, a different pavement, a change in the crown of the street or improved lighting has served to reduce the danger.

From a city planning standpoint, however, this map teaches one of the most graphical lessons possible. It shows, for instance, that more accidents occur within a short distance of Grand Ave. than any other street in the city. This is not because certain other streets do not carry more traffic, but because within a comparatively short distance five of seven streets cross Grand Ave. irregularly, and Grand Ave. is an unusually busy street only 80 ft. wide and carrying a much used car line. More accidents occur at Grand Ave. and Washington Ave., in this district, than at any other point in the city. Unquestionably this is due to a collision point created by the jog of about 200 ft. which Washington Ave. makes at this point, forcing all of its great volume of through traffic to traverse Grand Ave. for that short distance of 200 ft. Fortunately, this irregular offset is now being remedied by the removal of the northeast corner of the intersection, making possible a direct crossing of Grand Ave. for all Washington Ave. traffic. The cost of correcting this intersection is about $200,000. The correction is part of the Washington Ave. widening project, the total cost of which is $552,000.

Another interesting illustration from the "accident map" is Locust St., the most intensively used traffic thoroughfare in St. Louis, which carries about 1,700 vehicles per hour during the rush hours. East of Jefferson Ave. to 12th St., a distance slightly less than one mile, it has a width of 72 ft. West of Jefferson Ave. it is 60 ft. wide for about an equal distance. Where the street is narrow there were accidents at every street intersection, there being 93 in all. Where the street is wide there were accidents at only two points—at 18th St., a car line crossing, and at 13th St., where there is a bad curve at the Public Library. This is more or less conclusive proof of the desirability of using wide streets for heavy traffic thoroughfares if accidents are to be avoided.

Need Permanent City Planning Organization

There are other problems connected with public safety which are incidental to the planning of streets and regulation of buildings, but which can only be touched upon in this paper. The relation between the plan of the city and the plan of the interurban tramway tracks is an important problem. The proper development of interurban transportation helps to relieve congestion in the center but it adds new dangers to life because of the careless disposition of tracks and crossings. The city planner has to consider the desirability of separating the space used by these tracks on existing highways, how to avoid dangerous crossings, and how to plan routes on private rights-of-way to obtain high speed. The mixture of fast moving and slow moving traffic in central areas is a cause of serious difficulty. This prevents free movement of fast traffic, and thereby is one of the chief causes of congestion and danger. It cannot be entirely obviated, but may be greatly lessened by proper planning of the street system of the city.

The whole question of reservation of rights-of-way for street cars and interurban tramways, separation of slow and fast moving traffic, needs to be studied and investigated more carefully. Indeed, every aspect of the question dealt with in this paper needs to be investigated scientifically by a permanent city-planning organization in each city engaged in continuous study of the problems of city growth, and helping by plans and schemes to create cities of the future that shall be worthy of Western civilization.

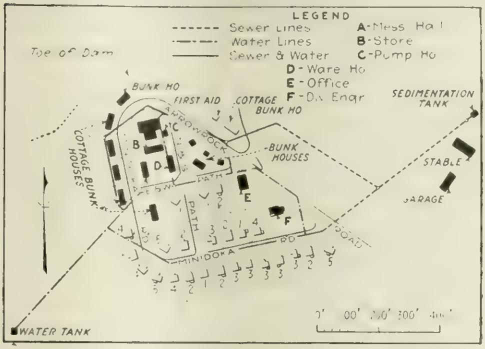
Must Lift Road Drags at Railway Crossings

In the use of road drags and scrapers over grade crossings care should be taken to avoid filling the track flangeways, states a circular issued to county superintendents of highways and local highway authorities in Illinois by the Public Utilities Commission. It has been found that operators often fail to raise the drag or blade, and loose earth thus filled in along the rails may cause derailment of light motor section cars and speeders, while stones or packed earth may endanger trains. The circular suggests that road men take care to raise the drag or scraper, and that they also examine the crossing and remove earth or other obstructions as quickly as possible.

Construction Camps Model Towns on Miami Flood Works

Villages of Homes, With Schools, Community Halls, Markets, Water Mains, Lights and Sewers, House Workmen at the Five Large Dams Being Built

WORKMEN will live mentally and socially as well as physically on the construction work of the Miami Conservancy District. They will not be merely tenants of construction camps; they will be residents of village communities. Indeed, few dwellers in permanent villages possess the conveniences of public service, roads, schools and markets which these construction workmen will enjoy during their temporary residence of a few years at the great dam structures



BUILDINGS ATTRACTIVELY GROUPED WITHOUT SACRIFICING COMPACTNESS OF PLAN

being built for flood protection in the Miami River Valley of Ohio. And, let the fact be emphasized, these unusual provisions of a construction camp have first of all the very practical purpose of holding men on the job. The humanitarian element has, of course, not been absent from the thoughts of those who have planned these unique communities, but, when all has been said that can be said of this influence, the impelling motive in their creation has been reduction of labor turnover.

Construction camp practice was for several reasons a problem of prime importance on the Miami Valley flood protection work. As a notable example of community construction it was felt that a model in camp practice should be established. The work involved, as planned, construction by machinery to an extent not often witnessed on works of similar character. To a greater extent than usual, therefore, the workmen employed would be skilled machine runners and artisans, the kind of workmen whose standards of living were good, and also the kind of workmen whose frequent loss would most interrupt the construction schedule. Attractive living conditions on the job were needed if workmen of this class were to be retained. This was particularly the case since industries connected with the war were offering unusual inducements in the way of high wages and excellent housing to every sort of skilled workman which they could reach.

Besides the channel improvement work, largely in the cities of Dayton and Hamilton, the flood protection plans called for five large dams. These were scattered over an area of many square miles at places remote from towns and from one another. Each required three or four years to complete, including construction plant installation and removal. Even if any of the existing villages had been near enough for workmen to get readily to and from the nearest dam, none was large enough to provide living quarters for any considerable number of the two or three hundred men, many with families, employed at each dam. Also, since their sites were widely separated from one another, a central camp, within ready reach of all the dams, was impracticable.

It was obvious that there must be a construction camp at each dam, and this was the decision made. Another conclusion was that each camp must be of such a character and so conducted that workmen would be attracted and would remain satisfied residents. Here the decision was not so easy. Merely to conceive, design and build a fine camp, or even a luxurious camp, was not the problem. A camp had to be designed and built which would meet the requirements for attractiveness and for which the *net investment* would not burden the work with too heavy an item of construction cost, nor, on the other

CAMPS ON MIAMI VALLEY FLOOD WORKS SPICK AND SPAN IN APPEARANCE AS SUBURBAN VILLAGES

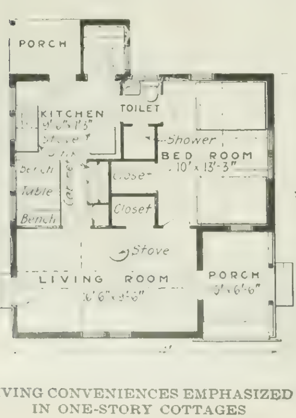
COTTAGE BUNKHOUSES PLANNED TO ACCOMMODATE A FAMILY AND SIX BOARDERS

hand, put so high a housing charge on the workmen that they would refuse to pay it. Only by the prospect of realizing a high salvage on the camps after construction had been completed could the condition be met.

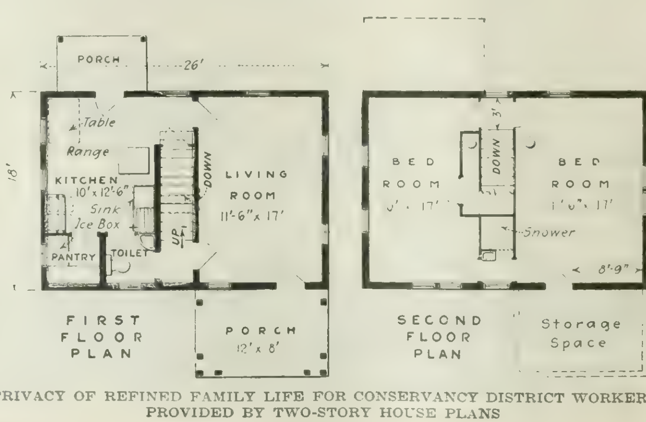
Ordinarily, much salvage from a construction camp is not possible. Furnishings and utensils, perhaps windows and doors, and to some degree the lumber in the buildings, can be saved in part for reuse, but the camp structures have no value as buildings. On the Miami flood work conditions made more comprehensive salvage methods appear possible. The dams are situated in really beautiful hilly country. When grassed over and cleared of débris, and with roads constructed along the crests of the dams, the dam structures will add to rather than detract from the scenic attractiveness. At all but one of the dams the great borrow pits in the river valley from which the embankment material is to be pumped will form beautiful lakes of living water. All of the sites are within easy automobile rides of cities of considerable size, and most of them are on or near railways or interurban lines. In every respect the situations and surroundings are such as might well attract persons who seek country residences for their families in summer or who, working at gardening or in the many industrial works of Dayton, prefer year-around residences away from the crowded living quarters of the city. It seemed reasonable to those directing the flood works that construction villages of inexpensive, well built, attractive cottages, with plenty of yard room, and bordering graveled streets and walks, would find purchasers and tenants after they had been vacated by the dam builders. The prospect of such a market, it was thought, warranted placing a considerable salvage value on the camp buildings. This in turn made it possible to provide for the workman a type and quality of housing accommodations which under ordinary construction conditions could not be accorded.

Villages were laid out on the hills above the dams, and advantage was taken of the topography to secure variety in location and frontage of buildings and alignment of streets and walks, without departing from the compactness of plan which would make the sewerage and water-supply systems simple and inexpensive and afford easy communication from one place to another. The plan reproduced illustrates a typical arrangement, and the views show the general appearance of villages most nearly completed.

Camp buildings are of two classes; first, general service buildings, such as mess halls, stores, etc., and, second, dwellings for the workers and their families. The second class includes individual cottages, cottage-bunkhouses, separate-room bunkhouses, and common-room bunkhouses, each providing a distinctive character of accommodation.



LIVING CONVENIENCES EMPHASIZED IN ONE-STORY COTTAGES



PRIVACY OF REFINED FAMILY LIFE FOR CONSERVANCY DISTRICT WORKERS PROVIDED BY TWO-STORY HOUSE PLANS

CAMP MESS HALLS IN PICTURESQUE SURROUNDINGS

Cottages are designed to provide family homes and are built in five styles. Variety of style provides both the difference in rental cost necessary to meet different incomes and the individuality which is essential to the attractive group appearance of the buildings. Dimensions and rental prices are indicated in the following tabulation:

Style	No. Stories	No. Rooms	Size	Rent per Month
1	1	3	24x24 ft.	$13
2	1	4	24x26 ft.	16
3	2	4	18x26 ft.	18
4	1	5	24x32 ft.	19
5	1	5	26x34 ft.	21

Rents are fixed on the basis that the cost of the cottage, less 40% salvage, shall be paid for in monthly installments during the period of the construction work.

Altogether, there are 125 cottages of all styles. Outside they are appropriately painted; inside they are cieled and stained. All are equipped with kitchen range and water heater, water closets, shower baths and laundry tubs. The heating will be by stoves. Windows and doors are screened. Each cottage has water and sewer connections and is wired and has fixtures for electric lighting. Light and water are included in the rent.

Cottages have been occupied about as fast as completed, and where the tenants have had time to clean

TWO-STORY HOUSES ATTRACTIVE HOMES FOR WORKMEN IN HIGHER SALARIED POSITIONS

up and get settled they present most attractive homes, with flowering vines and graded front and rear yards where another season will see grass and gardens.

Bunkhouses provide lodging for the men without families. There are three styles; one called a cottage bunkhouse provides for a family and six single men boarders. These are so arranged that the family quarters are shut off from the bunkroom for the boarders. Another type provides for men who prefer to board themselves. It has one large bunkroom, a kitchen and a mess room, and is equipped by the district with cooking range, sink and tables, and cots with springs and mattresses but with no blankets. No rent is charged the men occupying these quarters.

Main bunkhouses have a porch, a sitting room, a wash and toilet room with a shower bath, and sleeping rooms accommodating two or four men each. A window at the head of each bunk gives light and ventilation, and heat when needed is provided by steam pipes running lengthwise of the building under a floor grating. Cots, springs, mattresses and blankets are furnished. These bunkhouses are built in several sizes to accommodate 8, 12 or 24 men each. The rental charged is 50c. per man per week when two or four men occupy a room. A man can get a small room alone for 75c. a week or a

ONE-STORY, THREE-ROOM COTTAGES HOUSE WORKMEN AND THEIR FAMILIES

larger room for $1 a week. Generally the men eat at the camp mess hall.

Camp buildings for general service comprise a mess hall, a general store, a schoolhouse, a community hall and a first-aid hospital.

Mess halls will provide for about 200 men at a meal. Each is equipped with a bake oven, a range, an electric griddle, a vegetable steamer, a meat block, a steam serving table, a dish-washing machine, refrigerators and all necessary minor appliances and utensils. Meals cost 35c. each. It is planned, however, to introduce a cafeteria service in connection with the regular meals, or perhaps to supersede regular meal service altogether.

Each camp mess hall receives daily supplies of meat, bakery products and ice from a central ice-making and cold storage plant and a bakery located at the Taylorsville Dam. Delivery is by motor truck. The bakery is equipped to turn out bread, pies and smaller bakery products in quantities necessary for the several camps. Meat in all the cuts and forms common in modern markets is prepared at the central meat shop both for the mess halls and on order from the cottages and the bunkhouse messes. The camp stores are also an important factor in the provisioning of the camps. Here canned and boxed provisions, cereals, flour, etc., besides

various household articles, are for sale. These stores are run by the district, which keeps the prices as low as market conditions permit.

War gardens are further aids in provisioning the camps. Several acres at each camp are divided into 30 x 100-ft. plots, and a plot is allotted to any cottager who will guarantee planting and cultivation. Seeds are furnished by the district. Next season, when the cottages are all occupied, it is expected that many backyard garden plots will be under cultivation. Many of the war garden plots planted this year are now showing good crops.

Provisions Made for Children

Outstanding among the services which the district renders to its construction camp tenants is free schooling for the children. There are from 30 to 50 children of school age at each camp. At four camps school houses are built; the fifth camp is near an existing school which will be attended by the children living there. Attempts will be made to introduce a measure of vocational training. It will be arranged so that some of the skilled artisans on the work will give the boys instruction in carpentry and perhaps other trades, and some of the cottagers' wives will teach the girls sewing and the simple lessons of domestic science. At Taylorsville the teacher will be a man who will also act as superintendent of all the schools. Women teachers will have charge at the other camps. It is hoped that school buildings and other buildings suitable for assemblies may serve as community centers, and that a spirit of interest and loyalty to the community and to the job may be developed.

Water-supply and sewerage are such commonplace requirements of modern construction camp operation that their provision at the camps of the Miami flood works scarcely deserves mention. Each camp has a driven well and deep well pump delivering to a tank on higher ground, whence distribution is by gravity to fire hydrants and to all buildings. The system of sewers with which all buildings are connected discharges into a combination septic and sedimentation tank and thence, where necessary, through a sand filter bed to an adjacent stream.

Camps Kept in Sanitary State

Camp sanitation is looked after by inspectors who see that rooms and bedding, sinks, closets, etc., particularly in the bunkhouses, are kept clean. Garbage is collected and disposed of in a sanitary manner. In fact, full measures of every necessary sort have been provided to preserve healthful living conditions. For the care of hurts received on the work there is at each camp a first-aid hospital, with competent attendance. A district physician and his aids watch after sickness and see that necessary medical attention is received in every case.

Credit for the high standards of construction camp practice is due to many. Chief among those who have given their thought to the work is Arthur E. Morgan, chief engineer. Mr. Morgan has made the camps in a manner his personal interest, and the results stand high to his credit.

Great Britain Is Building Concrete Ships

THE yards in which reinforced-concrete ships and barges are being built are multiplying in the British Isles. A recent issue of the *Times Engineering Supplement* states that in the west and south and on the northeast and northwest coasts of England, on the Clyde and Aberdeen in Scotland, and near Belfast in Ireland, yards are under way where some 220 vessels are in course of construction. These represent a total of about 200,000 tons of shipping and a capital outlay estimated at nearly £4,000,000, apart from the cost of the land and the shipyard plants. On the designs adopted the saving of steel is about 70,000 tons, as compared with the amount which would be required for steel ships of the same carrying capacity.

The British Admiralty gave every encouragement to the private firms which were undertaking this new industry. Following the announcement of Government aid, seventy or eighty ways were laid down immediately. On many places waste land and bare stretches of shore were rapidly converted into busy centers. Matters have advanced so far that at the present time several vessels of 1000 tons dead-weight carrying capacity are on the point of completion.

The vessels at present in course of construction for the Controller-General of Merchant Shipbuilding comprise barges of 1000 tons dead-weight carrying capacity and steam tugs of 750 hp. In addition, six cargo steamships of 1150 tons dead-weight are being built for private ownership, and designs have been prepared for steamships of much larger size, which it is understood will be constructed after the pressing needs of the Government for smaller craft have been sufficiently met. All the barges and steam tugs, 187½ ft. and 125 ft. in length, respectively, now under construction in controlled shipyards, are being built in accordance with the specifications and general drawings issued by the Admiralty Department of Merchant Shipbuilding. The details of the hull and of the reinforced-concrete construction are, however, in accordance with working drawings prepared by or for the various shipbuilding firms.

Most of the vessels are being molded on the monolithic principle embodying systems of reinforcement which have been used extensively for land structures. In some cases, however, the precast-slab method of hull building has been adopted, and novel systems of reinforcement have been designed. Again, in some instances, the bottom or the whole of the hull is being built on the cellular principle, while in others the hull consists of a single shell stiffened by transverse frames at frequent intervals.

Chloramine Holds Down Bacterial Count

Filtered water of the Denver Union Water Co., sterilized by hypochlorite of lime and plated immediately, showed seven bacteria per cubic centimeter on gelatine. When the water was plated again after being held in a bottle four days the count was 2600. Another filtered supply treated by chloramine showed counts of 14 immediately and 4 after four days' storage. This influence of chloramine on after-growths is most helpful in warm weather, says D. G. Thomas, chief engineer.

Puzzling Variations in Important Building-Law Clauses

Requirements as to Stresses Specified Wall Thicknesses Often Wasteful—Wind Bracing Neglected—Interesting Special Features

BY R. FLEMING
American Bridge Company, New York City

STRIKING lack of uniformity in building codes regarding floor loads for the design of buildings, to which the writer called attention in *Engineering News-Record* of June 27, 1918, p. 1227, is paralleled by equally puzzling variations in other parts of such codes. These variations are more than merely puzzling, however; each requirement that departs from the normal, whether too loose or too rigid, may give rise to dangerous conditions.

The danger residing in loose or carelessly-drawn requirements is obvious; experience has amply demonstrated that they result in defective construction and frequently produce accidents. Excessively rigid requirements, on the other hand, hamper building construction and retard the growth of the city. For instance, provisions regarding structural steel may be so exacting as to put a premium upon non-fire-resistive building. When carried out such provisions waste money for the owner and do not benefit the city.

Some of the remarkable variations of building-code clauses will be here discussed. The writer's object is to illustrate the need for further efforts toward securing uniform and reasonable requirements.

STEEL STRESSES FREQUENTLY NOT UP TO DATE

A dozen different column formulas for medium steel and more than twenty for cast iron may be found in city codes. The straight-line type predominates over the Rankine type. New York, Chicago and many others use $16{,}000-70l/r$ for steel, which may be considered the normal. The cumbersome and erratic formula of the Cleveland code is in a class by itself. A few codes contain nothing more than the meaningless general statement, "every column is to be of sufficient strength to bear safely its intended load." Others use the term "factor of safety," and others make the still more unsatisfactory statement that "standard modern authorities are to be followed."

Medium steel in almost all codes is allowed 16,000 lb. per sq.in. (net section) in tension and the same in bending stress on extreme fibers of rolled sections. Most codes also allow this unit stress in tension flanges of riveted girders, but a few restrict such girders to 15,000 lb., and some to 14,000 pounds.

Shop rivets in many codes are assigned a value of 10,000 lb. per sq.in. in shear and 20,000 lb. in bearing; good practice allows 12,000 lb. and 24,000 lb. and these values are being adopted in new codes. Shear in webs of plate girders is variously taken at 7000 lb. (Buffalo), 8000 lb., 9000 lb. and 10,000 lb. per in. of gross section; the latter value is largely used in present bridge and structural practice. Several codes of the smaller cities, though giving floor loads, make no mention of working stresses to be used in proportioning members.

The old New York code specified that brick enclosure walls between iron and steel columns, supported wholly or in part on iron or steel girders, must be not less than 12 in. thick in the upper 75 ft. of the height, and in each 60-ft. section below this, 4 in. thicker than in the section next above. This clause is now entirely obsolete, yet about 25 cities retain it, either in the original wording or with slight variation. For high buildings it places an unnecessary cost upon the owner because of the additional brick and steel required and the loss in rental due to lost floor space. There is no compensating gain in lateral stability, because the walls are cut up by windows where stability is most needed. Moreover, lateral and wind forces should be resisted by the steel frame. The engineer who designed the steelwork of the Hotel McAlpin, New York City, estimates that 800 tons of steel could have been saved had it not been for this foolish requirement.

The present New York code reads, "Masonry walls supported at each story by girders may be 12 in. thick for the entire height of the building." This practice is followed by 40 or 50 other cities.

Duluth and Portland (Ore.) specify, "Curtain walls supported at every floor level may be 1½ bricks thick for the uppermost 150 ft. and 2 bricks thick for the balance of the height down to the grade." Grand Rapids specifies that walls be not less than 10 in. thick. Davenport allows 9-in. walls when the panel does not exceed 16 ft. in width or 12 ft. in height; otherwise walls are to be 12 inches.

Lawrence, Milwaukee and Sioux City require only an 8-in. thickness. Providence allows the 8-in. thickness to be used for the upper 35 ft., Detroit and Flint for panels not more than 16 ft. in width and 12 ft. in height, Syracuse for walls not more than 15 ft. high between supporting girders, and Worcester for walls whose area between all supports does not exceed 300 square feet.

Fireproofing Around Exterior Columns.—The New York code reads, "Iron or steel columns placed within exterior walls shall be encased with approved masonry not less than 8 in. thick on outer and side surfaces and 4 in. on inner surfaces." The same requirements are given in 30 or 40 other codes. In addition to the 8-in. and 4-in. masonry, 8 or 10 codes call for a space of not less than 2 in. between the enclosing brickwork and the columns, to be filled solid with liquid cement grout as the courses of brick are laid. In contrast herewith, the Chicago code and 20 others call for 4 in. of brick on the outer face of exterior columns. San Francisco requires but 2¾ in. of fireproofing.

A demand of 8 in. seems unduly severe as a fireproofing requirement. If rain-protection is needed a provision for waterproofing can be inserted. Rain-protection is assured by the codes that call for liquid cement grout around the columns. There is no reason why a greater thickness should be needed on the outer than on the inner face of an exterior column. (The Poughkeepsie code requires 3 in. on the outer face and 4 in. on the inner

face of exterior columns.) Not only does 8 in. require additional material but it brings the columns 4 in. farther from the building line than would otherwise be necessary. This adds to eccentric loading from the spandrel beams, thus increasing the column sections.

A Proposed Specification for Wind-Bracing

In no other particular of building codes is there such wide variance as in the requirements concerning wind-bracing. A number of codes make no mention of the subject. In others the requirements are ambiguous. Boston and New Orleans simply say, "Provision for wind-bracing shall be made wherever it is necessary."

In a previous article, "Wind-Bracing Requirements in Municipal Building Codes" (*Engineering News*, Mar. 11, 1915), the writer dealt with the subject in detail. He now suggests for building codes the following section on wind pressure:

1. Wind shall be assumed blowing horizontally in any direction. The surface exposed to wind pressure shall be measured vertically from the ground to the top of the structure, including the roof.
2. All steel buildings belonging to the class known as "mill buildings" shall be designed to carry wind pressure to the ground by steel framework. For buildings not more than 25 ft. high to the eave line the wind pressure shall be assumed at not less than 15 lb. per sq.ft. on the sides and the corresponding normal component on the roof. For buildings more than 25 ft. to the eave line the wind pressure shall be assumed at not less than 15 lb. for the lower 25 ft. and 20 lb. on the side surface above 25 ft. and the corresponding normal component on the roof.
3. The steel framework of all buildings belonging to the class known as "office buildings" in which the height is more than 100 ft., or more than two times the minimum horizontal dimension, shall be designed to resist a wind pressure of not less than 20 lb. per sq.ft. on the sides and the corresponding normal component on the roof. Wind-bracing shall be provided by making the connection joints between girders and columns sufficient for the bending due to side pressure as well as for the vertical load; or diagonal bracing shall be placed between columns, proportioned to transfer the shear of the side pressure to the footings. Details shall be designed to carry the stresses in the main members.
4. When the overturning moment due to wind pressure exceeds 75% of the moment of stability the structure shall be securely anchored. The anchors shall be of sufficient strength to carry the excess overturning moment safely, without exceeding the allowable unit stresses given in this code.
5. When the stress due to the wind in any member or connection amounts to less than 50% of the total live- and dead-loads it may be neglected. When the stress due to the wind exceeds 50% of the stress due to the combined live- and dead-loads, all these stresses shall be added together and the allowable unit stress for the total may be taken at 50% in excess of the values stated elsewhere in this code. In no case shall the section be less than that required if wind forces be neglected.
6. Circular chimneys and water tanks shall be designed to resist a wind pressure of not less than 20 lb. per sq.ft. on the diametral area.
7. Sky-signs on tops of buildings shall be designed to withstand a wind pressure of not less than 30 lb. per sq.ft. of surface.

It may be noted that paragraphs 3, 4, 5 and 7 agree (except that "two" is used for "three" in par. 3, and 75 for 50 in par. 4) with the building code recommended by the National Board of Fire Underwriters.

How far should a building code enter the subject of structural steel detailing? Schneider, in summing up the discussion of his paper, "The Structural Design of Buildings," makes the statement that "Building laws have failed to protect the public from disasters caused by poor designs made by inexperienced men. They generally go too much into details, thereby assisting incompetent men to design the structural steelwork of buildings without a knowledge of mechanics, statics or even the first principles of designing." If the omission of details from building codes would keep incompetent men from attempting to design there would be much to be said in its favor. But the writer has not found this to be the case. Incompetent designers are unhampered by rules in accordance as they are *not* stated in the building code. Moreover, a great many questions of detail must be settled by somebody and if the code can decide such questions why not have it do so?

Many Questions Arise Concerning Steel Detailing

The plate girder is a fruitful theme of regulation. Why should a building code prescribe whether its strength shall be calculated by moment of inertia or by flange area, when either method is perfectly legitimate? But it may properly specify the limiting ratio of web-thickness and of unsupported flange width. The stiffeners might well be located by the code. Incidentally, the writer would suggest that the requirement in the New York and other codes for web thickness not less than 1/120 of the unsupported distance between the flanges ought to be revised by changing the ratio to 1/160, as given in most codes.

It is hardly to be expected that building codes should agree regarding the unsupported width of compression flanges of rolled beams when even the steel manufacturers' handbooks differ widely on this subject. The writer recommends that where the unsupported length is more than 12 times the width of the compression flange the unit stress in bending shall not exceed $19{,}000 - 250\ l/b$, where l is length of span and b is width of flange, both in inches. The Newton, Mass., code specifies, "Separators shall not be considered as rendering the flange of a beam supported," a caution often necessary though perhaps not always applicable.

The familiar phrase, "No part of a steel column shall be less than $\frac{1}{4}$ in. thick" is in an occasional code found to be modified by having "$\frac{1}{4}$ in." changed to "$\frac{5}{16}$ in." or "$\frac{3}{8}$ in." This change is clearly unwise. The upper-story columns generally support only the roof, and for this light load even the $\frac{1}{4}$ in. minimum often gives an excess of metal. The more general clause found in some codes, "No metal shall be less than $\frac{1}{4}$ in. in thickness," if taken literally would exclude the light weights of all channels under 12 in. The clause is almost never applied in this way, but for the sake of clearness, if it is not the intention of the compiler to throw out the lighter rolled shapes, the words "except in webs of rolled beams and channels" should be added.

Comment on Special Clauses of Building Codes

Unless a code is slavishly copied in every particular from other codes, the personal equation of the compiler will at times show itself in the form of special requirements. For this reason the structural engineer should read carefully any building code or regulation that affects the design of his building. Tabulations and abstracts are not sufficient. A few special requirements will be given, though they all do not originate in the particular codes from which they are quoted.

Auburn (N. Y.) specifies, "The slope of composition

roofs shall not exceed two inches to the foot." This was probably written after observing how a heavy rain caused composition roofing to wash from a roof. However, 2-in. pitch is rather steep for ordinary tar and gravel, and on the other hand there is composition roofing material that can be laid on 3- or 4-in. pitch.

Baltimore—"The working section of beams, columns or other important members shall not be cut or punched by other contractors without the approval of the inspector of buildings." It would be interesting to know how this requirement is enforced.

Cleveland—"The latticing of compression members shall be proportioned to resist a shearing stress equal to 2% of the direct stress in the members." This provision, an echo of the discussion following the Quebec Bridge disaster of 1907, might well be adopted in other cities.

Des Moines—A commendable premium is put on fire-resistive construction by the clause: "All buildings of fireproof construction shall be exempted from 20% of their value for assessment purposes for a period of five years after the erection thereof." This clause is recent, being an amendment adopted Jan. 5, 1917.

Erie—"Every panel in a curtain wall shall be proportioned to resist a wind pressure of 30 lb. per sq.ft." This sentence is found in several codes. How shall the calculation for strength be made?

Grand Rapids—Instead of a quotation being given an omission will be noted; the Grand Rapids code makes no mention of cast-iron columns. The wisdom of this is doubtful. The use of cast-iron columns may be restricted or prohibited but should not be ignored.

Oakland—"Where columns have milled end bearing the splice shall be of sufficient strength to take at least 30% of the column load." This is impracticable, or nearly so, for heavy loads. Column splices should be designed to hold the column securely in place and to take bending stresses due to the wind. It is also well to have direct loads of less than 40,000 lb. transmitted through the splice plates. But a general requirement such as quoted is not necessary.

Spokane—"The main idea, however, shall be preserved, i.e., about one-half the columns should be spliced at every second floor and the remainder at the adjacent floors." A similar provision is in the Oakland code. Such a requirement is very annoying to the detailer, the fabricating plant and the erector. The object is to secure stiffness, but this can be obtained by proper splices.

South Bend—"When loadings on steel, wrought-iron or cast-iron columns are eccentric the column areas shall be increased in accordance with the following formula: $A' = \frac{Pdx}{Sr^2}$." This is an interesting example of how a code can trespass upon the province of the textbook. Moreover, the Rankine formula does not apply to all cases of eccentric loading.

Terre Haute—"Structural members carrying elevators and elevator machinery shall be proportioned to carry twice the actual moving dead or live loads." Such extra provision of strength should be made by the structural engineer whether specified in the code or not.

Washington—Under the head of bolting structural steel and wrought-iron members the Washington code says: "When bolts are used for suspenders, the working stresses shall be reduced for wrought iron to 10,000 lb. per sq.in. and for steel to 14,000 lb. per sq.in." These values, found in 30 or 40 other codes, are entirely too high. They were taken by most compilers from the New York code that was in force from the '90s until 1915. The New York code now in force assigns a value of 9000 lb. to steel bolts in tension and makes no mention of wrought iron; the writer uses this value in his own specifications and adds a clause:

"In cases where it is necessary to carry loads subject to shock by bolts in tension, check nuts shall be used. When bolts go through bevel flanges, bevel washers to match shall be used so that head and nut are parallel. In general rivets and bolts in tension shall be avoided as far as practicable."

Newark—A noteworthy special requirement, also found in the codes of Atlanta, Paterson, and several other cities, provides that the floors and roofs of fire-resistive buildings "shall be constructed with rolled wrought-iron or steel floor beams, spaced not more than 5 ft. on centers for stores, warehouses and factory buildings, and for all other buildings not more than 8 ft. on centers." This provision eliminates so-called long-span construction. For cities with well-organized and competent building departments it is an unjust discrimination, but for cities where little or no engineering supervision is exercised over building construction it gives a needed "factor of safety."

Damages for Illness Caused by Polluted Water on Steamer

Damages totaling $50,462 on account of typhoid and other sickness alleged to have been caused by drinking polluted water on the lake steamer "South America," sailing from Detroit, have been awarded to eleven plaintiffs. The damages were fixed by William S. Sayres, Jr., standing master in chancery, Detroit, Mich., after decision in favor of the plaintiffs had been rendered by Arthur J. Tuttle, judge of the United States District Court. Other claims are pending. An appeal has been taken to the Federal Circuit Court of Appeals. In his decision Judge Tuttle held that the evidence submitted proves beyond question that the typhoid cases were contracted while on the trip already mentioned. He referred the question of damages to the master in chancery.

It is alleged in the claims that after the steamer was 13 hours out from Detroit it stranded in the Hay Lake channel of the Sault Ste. Marie River, and that after using up the water in the tanks aboard impure water from the river was supplied for drinking purposes. The awards range from $16,045 to $305, some of the alleged victims having suffered from complications or sequelae, and damages being granted to some for loss of time. The highest award was to Charles P. Moore, as follows: For gallstones, $1500; pain and anguish, $2000; medical expenses, including trip for recuperation, $1546; business loss from June 15 to Dec. 15, $7500; business impairment after return, $3500. To W. A. Malotte the award ran as follows: Medical attendance, $721; pain and anguish and impaired health during sickness and in future, $4000; business loss $7000; total $11,721. The award of $306 was for doctors' bills, nurse and drugs for the infant daughter of Frank J. Campbell.

Broader Foundation Demanded for Engineering Education

Higher Aims Also Needed — Students' Longings Not Met — Vision of Great Practitioners Should Guide Educators

By Frederic Bass
Professor of Municipal and Sanitary Engineering, University of Minnesota

An EDUCATED man is one who has developed his soul, mind and body harmoniously and fully, with the purpose of doing his work in the world as well as his nature permits. He is a man who is always growing, even to his death; who recognizes his limitations and seeks constantly to surmount them, that he may realize the freedom which is the birthright of all humanity.

If this definition is a true one, the educated engineer has work to do which should become one of the greater factors in the progressive social program now appearing in Western civilization. He is not necessarily limited to perfecting himself in the details of technical accomplishment, important as that may be. He is limited only by his conception of the relations which he and his profession bear to other human groups as to position and functions.

Engineering practice is in reality a part of industry and government; it is concerned with capital and labor, with the methods of commerce and business and with human material and forces as much as with inanimate materials and their reactions to physical forces.

In the formal education of engineers it has been assumed that engineering is founded upon the application of physical law, and that mathematical ability is its most important manifestation. This assumption has until recently been unquestioned among educators, while practicing engineers have long since rejected it. Practicing engineers who have risen to heights of professional attainment often have never received formal education in the schools; the "University of Hard Knocks" has been their source of wisdom. But whether practicing engineers hold degrees or not, they have not formulated their ideas of education of engineers in a manner which has made possible any considerable headway against academic tradition.

Educators Overburdened by Routine

Many engineering educators have been for years overburdened by routine, so poorly paid that they could not avail themselves of opportunities of observation by travel, and engaging in private practice only under unfavorable conditions. Detail has clouded their vision and warped their perspective. Social demands have conflicted with inadequate compensation, and the general environment has not been such as to establish in the schools that peculiar type of leadership which, remaining in touch with existing conditions and tendencies, yet has a comprehensive, penetrating and rational vision and definite plan for the future. That educators have not taken hold vigorously of the academic problem has been due partly to the lack of systematic supervision and coordination of departments. It is in the nature of teaching and research that the teacher should be allowed to follow his individual tendencies more than in a commercial organization, but that does not offer an adequate excuse for the prevailing exclusiveness of university departments.

School men are now conscious of some of the defects of engineering education and of the difficulties in removing them. The usual engineering school curriculum in its early years includes instruction in mathematics, drawing, chemistry, physics, shop work or surveying, rhetoric and language. The student is given instruction in these subjects by different departments which, jealously guarding their integrity in the school organization, often hold rigid ideas as to the content of their courses, irrespective of equally unyielding ideas in other departments. The teachers of engineering students in the first two years of the course are rarely men of experience in engineering practice, and almost never men of extended experience; their affiliations are academic and their methods colored accordingly. They live in an intellectual region far removed from that which the men whom they teach will occupy in their life work.

If the Student Could Do It Over Again

The junior student reviews and applies the mathematics and physics of his earlier years and is introduced to courses in elementary design; he then gets the first taste of the food for which he has hungered, and often it has not the attractiveness that it had in anticipation, before the edges of youthful enthusiasm had been dulled by formal routine. An athlete who trains too long without the stimulus of a real game becomes "stale"; he has possibilities which may be developed by discipline but which may be atrophied by an overdose of the same medicine.

When the student reaches his senior year he may indulge his intellectual powers without limit in the interesting problems which are given to him to solve, through the use of his previous training and his originality. He finds at the end that if only he had it to do over again he would have many things otherwise

After graduation he goes into the busy world and begins his education by his own efforts. Usually he has never known just why he was taught as he was, and he vaguely wonders why it could not have been different, but is content to allow that to remain a mystery since new problems force themselves upon his attention.

So the army of technical students goes on. There has not been time to place before them in their school life the many social and economic foundations upon which the superstructure of engineering has been reared, and the foundations now being constructed which will determine the engineering of the future. All educators recoil with horror at the suggestion of superficial instruction, yet many engineering educators have failed even to recognize the nature of engineering practice—that it is essentially a superstructure, built not upon a foundation of mathematics but upon political economy. That is why the engineer so often asserts that much of his time in the technical school was wasted. He was provided with the superstructure, but when he came to deal with the real problems of practice he found that it was built in the wrong place and he had to build another, as well as an extension of the foundation.

Engineering education must be very considerably modified, and that soon, if engineers are to begin their

careers with the outlook upon life which will embrace their future, guide it through the period of technical preparation which will form their early experience, and on to that later one in which their work will deal with the greater affairs of government, finance, industry and business, largely dependent upon engineering skill and method. Engineers may confidently look forward to the time when it shall be the ordinary thing for them to occupy the posts of railroad presidents, industrial manager, city manager and high political office, provided that the foundation on which they build is designed to support that future.

Still another feature of engineering education is that of contact with practice during the school training. Aristotle taught that the best way to learn anything well that had to be done after it was learned was to be doing it while learning it.

Engineers have long analyzed physical forces and then distributed the materials of construction so that these forces might be most economically countered. This same problem must in practice confront the engineer on the human side. Modern psychological methods of determining the vocational aptitudes of men have been developed to such a point that the present or future employer of men cannot afford to remain neglectful of them, choosing his subordinates and helpers by rule of thumb as engineers chose materials when engineering was an art more than a science. Scientific engineering of the future must include the scientific analysis of human nature, so far as that is possible.

Must Foster Interest In Studies

What is necessary? First, the interest, already formed, of all the entering engineering students must be fostered rather than suffered to die or atrophy. This does not involve the excitement of the student by shallow wonder at the marvels of engineering accomplishment, but it does mean the presentation of typical engineering works to the attention of the beginning student, with an analysis which will enable him to grasp the real play of forces active in every structure and piece of machinery of man's making, and to express the meaning of their action in the beautiful shorthand of mathematical language. The study of physics may also be introduced in this same way. It is more than a suspicion that lines and forces in bare diagrams and the accompanying mathematical expressions may be transformed from objects of insipid attention to problems compelling the liveliest interest by taking them from examples in actual existence. Mechanics and strength of materials may then be introduced simultaneously with mathematics and drawing, and the practice of engineering as it really is, with all of its larger problems of economics, may be provided for in the later years of the course.

So the engineering schools need guidance by the vision of the great practitioners, the resolution to bend college procedure into a form adaptable to the changes in practice, and the introduction of examples from modern practice into the early years. Thereby time may be economized, and the introduction of human studies into the later design and management courses made possible. When this has been done the various engineering collegiate departments may feel that wave which is now sweeping through the active engineering professions, carrying the message of unity and portending an era of high accomplishment for all engineers. But the main problem is to devise a campaign under the proper auspices, based on careful analysis of observed conditions prevalent in the various schools of engineering, in the light of the statements already made herein. It should be so conducted as to enlist the interest of the great practitioners in the rising generation of engineers and in their proper and adequate training. More than this, the attention of university and college presidents and boards of trustees and regents must be drawn to the need for coördination of departments, correlation of courses and sufficient financial support, without which no results may be expected. Presidents and governing boards will listen carefully to a well considered program, carefully arranged and forcibly presented by the leaders of a profession whose main object is to contribute its service to the cause of a higher civilization.

Spring Valley Water Company to Charge Meter Rates

A NEW schedule of rates based on metered service was put into effect in San Francisco Sept. 5 by the Spring Valley Water Co. Authority for this action was given by the State Railroad Commission upon the request of the company. The new rates require the payment of a service charge from 65c. a month for each ¾-in. meter to $40 a month for 8-in. meters.

The charge for the water delivered is fixed at 24c. per 100 cu.ft. up to 3300 cu.ft., 21c. up to 33,300 cu.ft., and 18c. per 100 cu.ft. for all above 33,300 cu.ft.

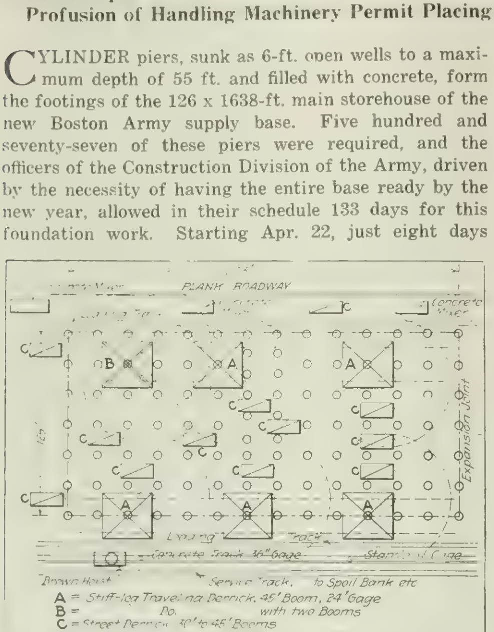
The new schedule established by the commission is a compromise between that proposed by Allen Hazen, the company's water expert, and R. W. Hawley, hydraulic engineer for the commission, and is designed to provide a gross income of $3,632,252, the return earned by the company in 1917. The rates are tentative and are expected to maintain an equilibrium between the amount of revenue that would be produced by the flat-rate system and that produced by meter charges. Should there be an excess produced by the meter rates, the amount is to be impounded and retained subject to the orders of the railroad commission. The purpose is not to increase the gross revenue of the company but to maintain it regardless of the change to measured service.

Approximately 90% of the domestic consumption of the company has been metered, but the meters have been used only to check excess use and as a basis for computing meter rates. The primary purpose in charging for water on a metered basis at this time is to conserve water and to put the cost of waste—the burden, in other words—upon those who are wasteful. The subnormal water-supply for the past two years has brought about an immediate necessity for conservation, and the possibility of a third year of shortage brings the water consumers of the city face to face with an emergency. The necessity for conservation is shown in the statistics of the rainfall compared with the normal rainfall, for the past five years: 1912-13, 109%; 1913-14, 112%; 1914-15, 102%; 1915-16, 71%; 1916-17, 41%. The normal rainfall is taken as the average per season for the past 40 years.

Sinking Six Cylinder Foundations a Day On Boston Army Supply Base

Concrete Open Wells of 6-Foot Outside Diameter and From 33 to 55 Feet Deep—Careful Planning and Profusion of Handling Machinery Permit Placing of Nearly Six Hundred in Less Than Three Months

CYLINDER piers, sunk as 6-ft. open wells to a maximum depth of 55 ft. and filled with concrete, form the footings of the 126 x 1638-ft. main storehouse of the new Boston Army supply base. Five hundred and seventy-seven of these piers were required, and the officers of the Construction Division of the Army, driven by the necessity of having the entire base ready by the new year, allowed in their schedule 133 days for this foundation work. Starting Apr. 22, just eight days after they were notified that they were to take the contract, P. McGovern & Co., contractors of New York and Boston, turned over the cylinder pier foundations complete Aug. 10—that is, 20 days ahead of schedule and in an elapsed time of 110 days—making an average of 5.34 footings per 24-hour working day, deducting eight days—holidays, Sundays and rainy days—when no work was done. The Government schedule called for a progress of 5.51 per day after the first month, or an average of 4.33 per day.



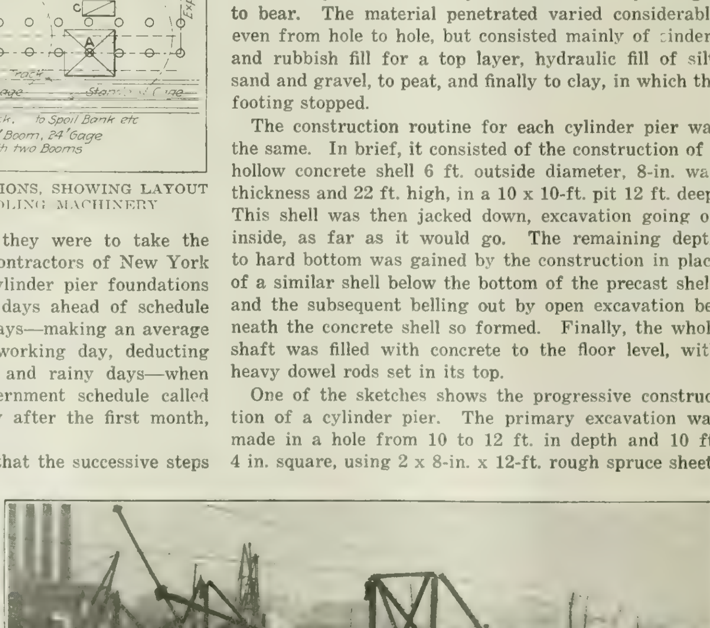
ONE OF THE SIX SIMILAR SECTIONS, SHOWING LAYOUT OF CYLINDERS AND HANDLING MACHINERY

Planning the work ahead so that the successive steps in the construction operations could proceed smoothly, and providing enough construction equipment so that no operation would be stopped for lack of machinery to go ahead with it, were largely responsible for the good speed made. Planning was complicated by the narrowness of the area of operations and by the unavoidable congestion forced by the close spacing of the holes and the restriction to the plot itself of practically all of the equipment. Roads and railroads on both sides of the 126-ft. area could not be trespassed upon because they were necessary for the construction operations going on over the whole supply base area. Furthermore, the machinery and equipment used were limited by the inability to procure more in the market. With more derricks available, for instance, the contractor feels that he could have made better progress.

The main storehouse is made up of six sections, each 126 ft. wide and 273 ft. long, forming a continuous structure 1638 ft. long. The columns foot on concrete cylinder piers, spaced 21 ft. c. to c. in both directions. The line of piers at the section joints carries the columns from each of the adjoining sections with an expansion joint between. Each cylinder pier is 6 ft. in diameter and bells out at the bottom to a circle from 11 to $17\frac{1}{2}$ ft. in diameter, depending upon loading, a safe bearing value of $4\frac{1}{2}$ tons per square foot being assumed for the clay in which the cylinders were finally brought to bear. The material penetrated varied considerably even from hole to hole, but consisted mainly of cinders and rubbish fill for a top layer, hydraulic fill of silt, sand and gravel, to peat, and finally to clay, in which the footing stopped.

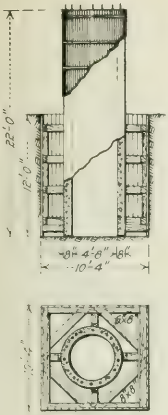
The construction routine for each cylinder pier was the same. In brief, it consisted of the construction of a hollow concrete shell 6 ft. outside diameter, 8-in. wall thickness and 22 ft. high, in a 10 x 10-ft. pit 12 ft. deep. This shell was then jacked down, excavation going on inside, as far as it would go. The remaining depth to hard bottom was gained by the construction in place of a similar shell below the bottom of the precast shell, and the subsequent belling out by open excavation beneath the concrete shell so formed. Finally, the whole shaft was filled with concrete to the floor level, with heavy dowel rods set in its top.

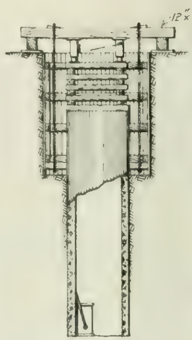
One of the sketches shows the progressive construction of a cylinder pier. The primary excavation was made in a hole from 10 to 12 ft. in depth and 10 ft. 4 in. square, using 2 x 8-in. x 12-ft. rough spruce sheet-

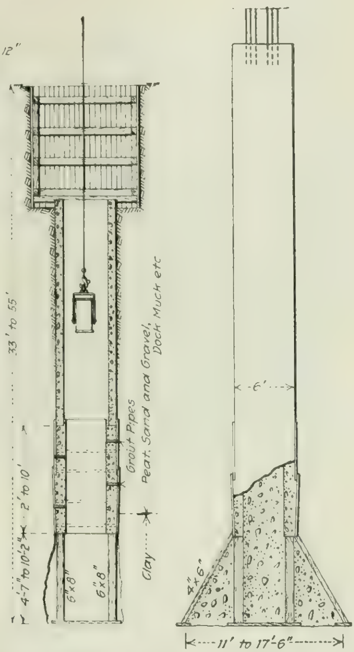


LOOKING ALONG THE FOUNDATION WORK AT THE HEIGHT OF PROGRESS. TWO-BOOM DERRICK CONTROLS CYLINDERS UNDER CONSTRUCTION

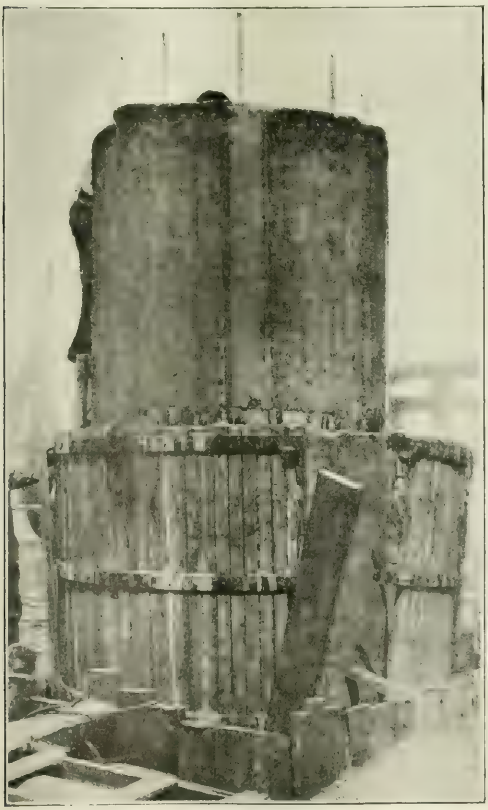
ing and 6 x 8-in. braces spaced vertically about 2½ ft. In this hole were set up the forms for the precast shell on top of a circular steel cutting edge. Two forms of cutting edge were tried. In the beginning of the work a heavy structural steel edge was made up of one plate ⅜ x 8 in. and one angle 3 x ⅜ in. This was laid out in three lengths and was designed for removal and reassembling for repeated use. It was found, however, that it was extremely difficult to remove these edges, and a cheaper cutting edge, to be left in place, was devised. This consisted of an annular steel plate $\frac{3}{16}$ in. thick and 12 in. wide, bent with one edge down. The flat section had holes punched for anchoring it fast to the concrete shell and also for fastening a wooden ring on the inside of the bottom of the concrete form. The structural steel edges cost about $41 apiece. The steel plates cost about $23.







DIAGRAMS SHOW DIFFERENT STEPS IN THE SINKING OF THE CYLINDER PIERS

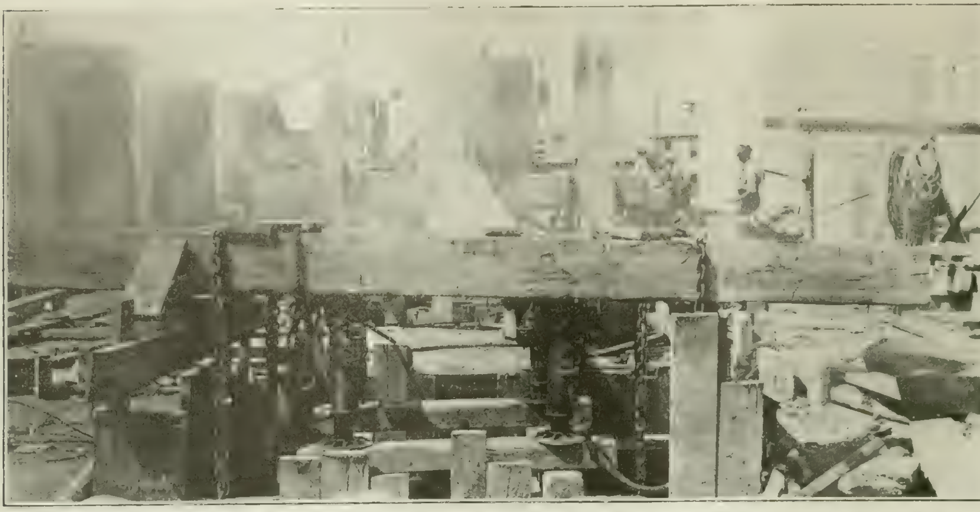


FORMS FOR PRECAST HOLLOW CYLINDERS OF VERTICAL WOOD STRIPS BOLTED TO IRON BANDS

The concrete forms in which the cylinder sections were cast consisted of radially sawed strips of wood bolted in vertical rows to ⅜ x 3-in. iron rings, which gave the form sufficient stiffness. The same type of form was used for both inside and outside. It was built in three sections, for ease in erection and removing. Enough forms were provided for 30 complete 22-ft. sections and a number of shorter sections. These forms stood up very well in the work but required considerable repair in the shop. The contractor is of the opinion that if there had been time to prepare metal forms they would have proved cheaper and more expeditious in the long run.

As soon as the forms were placed the concrete was poured to form the shell. The forms were stripped in about 24 hours and the excavation was started. It was carried on by two men, working inside the cylinder, who emptied the spoil into small "coffee pot" buckets 18 in. in diameter and 30 in. high.

Usually the concrete shell sank by its own weight about 10 ft. into the ground so that the top of the 22-ft. bell was about level with the original ground surface. At this point jacking was started by placing two 12 x 12-in. timbers across the top of the cylinder and building up cribwork of similar timbers. These timbers were fastened with ⅜-in. log chains to the bottom of the sheeting of the pit, using 8 x 8-in. timbers across the corners under the lower waling piece. Two or four jacks with a capacity from 15 to 40 tons, according to the situation, were then placed on top of the



IN FOREGROUND, JACKS ARE PLACED BEFORE OPERATION TO PUSH CYLINDER PIERS INTO THE GROUND

concrete shell and under the 12 x 12-in. timbers, and the jacking down of the cylinders began, the excavation being removed as the jacking continued.

This operation was continued until the length of the cylinder was reached or the resistance of the sheeted bulkhead overcome—that is, until the sheeting as a whole began to pull out of the ground. This point was termed the "jacking limit." The force exerted by these jacks was estimated to be from 100 to 125 tons,

WAGON DERRICK LIFTS COFFEE-POT BUCKET FROM CYLINDER PIER DURING EXCAVATION

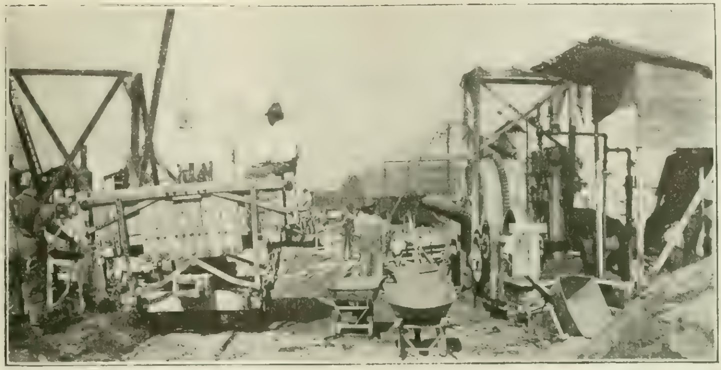
although this is only problematical, as the 40-ton jacks never worked to their capacity. Many times the length of the concrete shell was not sufficient to reach solid clay; in such cases a concrete extension was placed on top of the section already sunk, and later the jacking was resumed.

In many of the piers the jacking limit was reached before solid clay was encountered, so that it became necessary to place an extension on the bottom. This was done by continuing the concrete shell in an open cut behind poling boards. These boards varied from 1 to 5 ft. in length, the upper end being placed behind the concrete shell and the lower end held out by flat steel insert rings $\frac{3}{8}$ x 3 in., built in three sections, for ease in placing. Sometimes it was necessary to use pieces of board, oakum and even hay to keep out the soft mud and silt while the concrete was being placed. After the poling boards were in place a form 4 ft. in diameter was put in the bottom of the hole, extending 1 ft. above the bottom of the concrete fill. This was then poured with a $1:1\frac{1}{2}:3$ concrete through the 4-in. annular opening between the inside of the shell and the form.

A wooden lid or cover was used as a landing platform for the concrete, which was dumped from wheelbarrows into vertical metal chutes. Sand to a depth of 1 ft was placed in the bottom of the hole to prevent the concrete from being forced into the working space. After the forms had been moved from this section holes were drilled through the concrete shell and grout pipes placed. Later the space behind the concrete and around the board was filled with cement grout which shut out the water from passing into the working chamber. Owing to the presence of soft mud, sand and gravel encountered in various holes, it was difficult to set the poling boards and shut out the water, so that at times it became necessary to make two operations of placing the concrete and the grouting.

After the concrete shell had been either jacked down or extended into solid clay, the belling operation was

started by digging down vertically a hole about the diameter of the concrete shell. Temporary props were used to hold up the shell while the excavation was being made. At the required depth three 6 x 8-in. permanent props were placed with foot blocks to distribute the load on the clay. After the props were in the bell the hole was excavated in sections and 4 x 6-in. lagging placed as close as was needed to hold up the sides of the bell until the hole was an acceptable size. In certain holes, when the clay was softer, the props were strained to a breaking point and had to be increased in number and size, while 6 x 8-in. lagging was used. Even extra bracing was not sufficient to prevent the clay from squeezing up into the floor and in between the lagging so that it worked into the bell hole about as fast as it could be removed. In one instance the settlement was so great that the surface of the ground sank about 3 ft. and adjoining completed piers settled vertically about 2½ in. and shifted out of line about 5 or 6 inches.



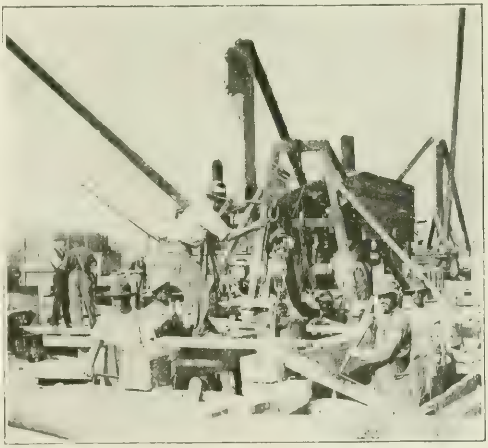
ALONG ONE SIDE OF FOUNDATION AREA AT RIGHT, ONE OF THE SMALL CONCRETE MIXING PLANTS AT LEFT. THE CYLINDER FOUNDATION WORK

Ground water caused great difficulty in the pier work. It was encountered almost from the surface of the ground, and pumps had to be constantly used until the cylinder was the regular distance down. Hand and gasoline diaphragm pumps were used within pumping limits and below this steam ejectors proved very practicable. All the water from the pumps was carried off by square wooden troughs laid out in gridiron fashion over the whole warehouse area.

It will be seen that the speed of the cylinder sinking is dependent on the coefficients of friction between the cylinders and the earth, and between the sheeting of the pit and the earth. As worked out on this job, a depth of 12 ft. of sheeting required about 22 ft. of concrete cylinder to balance it—that is, as a rule the 22-ft. cylinder could be sunk about to the bottom of the pit before the uplift began to move the sheeting. A deeper pit would have permitted the use of a longer precast cylinder, and would in some cases have avoided the extra cast-in-place concrete in the lower section of the cylinder. However, it was estimated beforehand that the average depth of the holes would be about 33 ft. and the cylinder forms were fixed on that basis; the average depth turned out to be 43 feet.

Pit excavation was practically all hand work, assisted by some gin poles and hand derricks. It proceeded well ahead of all the other work—so far ahead that there could be assurance that the pit would be ready for the cylinder operations in plenty of time. Both excavation and concreting were controlled by a group of derricks consisting of six large derricks and 14 small street derricks. The large derricks were of the stiff-leg platform type, traveling on a 21-ft. gage track. These tracks run along either side of the lot, two derricks with their 45-ft. booms covering the entire width of 126 ft. One of the six was provided with a boom at each corner, giving a somewhat larger radius of action. Had fittings been procurable all would have been so equipped.

Owing to the fact that these large derricks could handle material for a maximum of but three holes at a time, the groups of street derricks were provided. These consisted of an ordinary hoisting engine and A-frame derrick mounted on heavy truck wheels. The booms ranged from 25 to 40 ft. in length, and some were equipped with bull wheels. The smaller derricks were spotted all over the foundation area, taking care of holes wherever the large derricks could not reach or which were beyond their capacity to handle.



ONE OF THE SMALL WAGON DERRICKS LIFTING DIRT FROM CYLINDER BEING JACKED DOWN BY FOUR MEN

Narrow-gage tracks were laid down along both sides and the end of the lot to carry dump cars of 4-cu.yd. capacity pulled by a dinkey engine. These cars were spotted opposite each of the traveling derricks and replaced by others when filled with excavated material.

The loaded cars were then hauled to the spoil bank on a separate track.

This whole outfit to handle the excavation and the concreting moved ahead from one end of the foundations to the other. Wherever difficulty was anticipated or met in preliminary excavation far ahead, one of the smaller derricks was readily moved up to the work to speed it up so that the whole could be ready for the concreting operations and would not retard the surrounding construction. The main difficulty in planning the layout of these derricks was to move them ahead in such order as not to cover up any adjoining hole which was under construction. Each derrick, wheel or traveling, attended a maximum of three holes at a time.

Concrete for the piers was mixed in two separate plants. The first was a permanent plant equipped with a three-bag mixer with storage bins above for sand and gravel. This plant was located on the site at the Government sand and gravel dock, to which sand and gravel were supplied direct from barges or from storage piles at the side. Cement was hauled by flat-cars and dinkey locomotives from the Government storehouse on the site. Concrete trains, of two flat-cars, were hauled to movable distribution hoppers stationed alongside of the foundation area. From there the concrete was distributed to the various holes by steel wheelbarrows. The second concrete plant consisted of a battery of 3 two-bag steam-driven mixers, located in the foundation area alongside of the service road paralleling the lot. Material was supplied to these plants by motor truck, and the concrete was wheeled direct from the mixers to the holes.

The maximum number of holes completed in 24 hours was 17 on July 27, twelve being in one section and five in another. Other record days were one of 16 holes, three of 14 holes and four of 12 holes each. The labor employed made up a daily average of 1106 men working 11 hours per day for a period of 112 days. Two shifts of 11 hours each were carried. The total quantity of excavation was 50,143 cu.yd., or about 87 cu.yd. per hole, this being the quantity computed from the original ground surface to the bottom of the bell hole and not including the rehandling, which was considerable.

The Boston Army supply base is being built by the Construction Division of the Army under the direction of Brig. Gen. R. C. Marshall, Jr. Maj. C. R. Gow is constructing quartermaster in charge of the work. For P. McGovern & Co. Andrew A. Cohill, chief engineer of the company, was in immediate charge of the work, with George I. Oakley as supervising engineer.

Illinois Farmers Aid Contractors in Finishing Road Work

Appreciation of Good Roads Leads to Provision of Means for Completing Jobs Checked by War Conditions

By P. C. McArdle
Superintending Engineer, Danville, Ill.

FARMERS have made it possible for the contractors to finish their roads in Vermilion County, Illinois, by supplying teams for hauling materials and gathering subscriptions to complete the work without charging it against the construction. While work by volunteer labor on the roads of the state is not new, it is decidedly new for the public to donate money and labor to a contractor or bonding company for the purpose of completing contracts. It seems to indicate that the experience of the past year or two, in driving over the roads already built, has convinced the most skeptical that good roads are a necessity in these war times, and that, while they pay in taxes for the contracts, they are willing to pay still more rather than wait for the roads until after the war. Thus they are endeavoring to close up the gaps in the road system.

Contracts for the construction of bond-issue roads in Vermilion County were let Apr. 7, 1916. Work was started on practically all the nine divisions about the middle of May, but as time went on prices of labor and materials began to rise. Progress on the nine divisions in 1916 averaged only 5.6 miles per contract, which was reduced to 4.4 miles in 1917. After war was declared men were withdrawn from industry still more rapidly. The car-service order and priority order which went into effect Apr. 26 and Oct. 28, 1917, respectively, stopped work for at least two of the best working months of the year and resulted in the production of only 92.43 miles of road, out of a total of 166 miles under contract to be completed by November, 1917.

County officials, being aware of the added costs of labor and materials, hesitated to enforce the forfeiture and penalties clauses of the contracts and relet the work, because of the defense which might be raised that the war automatically prevented their successful execution. All were notified, however, that the county expected them to complete the work at the earliest possible moment.

Only two contracts were started in the spring of 1918, and investigation proved that, by more or less concerted action, the contractors and bondsmen for the others had determined not to proceed. After the railroads had been taken over by the Government the higher freight rates and rigorous rules regarding switch tracks and freight movements further complicated matters, and as a result the two remaining contractors withdrew from their work.

Appeals of citizens, deeply interested as abutting property owners and moved by other considerations, offered inducements to the contractors to take up the work again. On division 6 committees were formed in each of four small towns through which the road passed, and in a short time had obtained guarantees of sufficient free teams to haul all of the material for 5½ miles of road. Work is progressing very well under this arrangement. Two outfits, working at opposite ends of the job, are each making about 400 ft. per day.

On division 8, without any such committees, but at the request of prominent farmers, sufficient teams were obtained to move the camp and equipment 11 miles. Farmers also agreed that if the contractor would provide the shoulder material at the siding they would haul it to the job free of charge, provided he would place the concrete slab. It is proposed to carry out this second part of the agreement after the concrete slab is completed.

Work on this job is progressing perhaps as well as in the previous two years. The county agreed to furnish the services of its division engineer as superintendent, thus relieving the contractor of the cost of his highest paid employee and reducing his overhead expense.

As a result of these two examples, farmers in other sections of the county are gathering the necessary subscriptions to get work started before the end of this working season, and it seems probable that the balance of the work may be completed in this way, if further war exigencies do not prevent such completion.

Drivers and Garage Clerks Keep Contractor's Motor Truck Costs

Daily Reports Entered on Individual Monthly Sheet for Each Truck — Total Operating Cost of New 7-Ton Trucks 23 Cents per Mile

A SYSTEM of motor-truck operating records kept with no other help than the truck drivers and regular garage clerks, and employing only three printed blanks, provides the Timroth Motor Trucking Co., Chicago, with data sufficient for analyzing truck performance and costs in as many ways as are needed in haulage operations, and to any degree of exactness. Tabulations given further on indicate one sort of analysis possible. Emphasis, however, belongs on the fact that the records kept provide all the data needed for any line of investigation, without involving much labor or expense.

The bases of the system of records are a brief and simple daily report card turned in by the driver and a more complete daily report card made up from this and from data available at the garage by the office force. The driver's report card, besides the truck number, the date and the name of the driver, bears the amount of gasoline and oil consumed, the distance traveled, the destination of each trip and the load carted, and any remarks as to delays or repairs. All this information is transferred to the card made out daily for each truck at the garage, to which is also added the revenue earned by the truck during the day. A separate file of these cards is kept for each truck, and at the end of the month the information is transferred by days to a large regular record sheet kept for each truck, which balances the earnings of the truck against the cost of its operation. Under earning data this sheet shows the number of miles and the number of loads per day, the character of material carried, and its weight, the rate at which it was billed, and the total revenue derived from its transportation.

The operating cost is divided into five heads: gasoline, oil, grease, operating labor, and repairs and replacements. Under each of the first three of these are entered both the quantity of material and its cost, while the labor cost of driver and helper is entered under the fourth. The heading for repairs and replacements is divided into columns for the cost of materials, the cost of repairs and renewals to batteries, the cost of tires, and the cost of labor. The daily cost is totaled, and in addition there is entered on the monthly sheet from the daily report card the number of hours the truck was in actual operation, and the number of hours it was idle. Under the latter heading the time is split into "plant delay," which includes delays for loading and unloading; delays due to repairs to the truck; and delays on the road. A very accurate check on these items is obtained from a service clock placed on each truck, which records graphically on a paper disk the time the truck is running and the time it is standing.

Exemplifying the practical use of this system of records is the table of truck operating costs given herewith. Keeping the records began May 1, 1917, and so the cost data cover only nine months' operation to Jan. 31, 1918. Twelve trucks were operated in May, 15 trucks in June and 17 trucks for the remainder of the time; all the trucks were new 7-ton Sterling trucks. Totals only are given in the tabulation; averaging some of the main items the following figures are obtained:

Miles per load	8.25
Miles per hour	4.77
Weight per load, tons	5.54
Miles per quart of oil	9.45
Miles per gallon of gasoline	2.52
Repairs and replacements per mile, cents	2.04
Total operating cost per mile, cents	23.00
Daily mileage per truck	34.43
Daily operating expense	$10.03
Working hours per day	7.27

All of the trucks were new when put in service, and the tire cost was based, for the purpose of figuring the total cost per mile, on the maximum rate of replacement necessary under the guarantee of the maker. The actual amount of money spent each month for tires, however, was less than the estimate, because the tires were new.

The table as compiled shows the average length of haul, the average speed and the average weight per load, in addition to the length of time run and the cost of the various items of operation. Other tabulations, however, of more value in estimating the cost of work, can readily be obtained from the monthly record sheet of each truck. It is possible, for instance, to go through the sheets and tabulate the performance

OPERATING COSTS OF 17 SEVEN-TON STERLING MOTOR TRUCKS OWNED BY TIMROTH MOTOR TRUCKING CO., CHICAGO FROM MAY 1 TO DECEMBER 31, 1917

Month of Operation	Miles Traveled	Number of Loads	Total Weight of Loads, lbs.	Gasoline Gals.	Gasoline Cost	Oil Qts.	Oil Cost	Grease (Estimated)	Driver	Repairs and Replacements (b) Tires	Repairs and Replacements (b)	Total Operating Expense (a)	Hours Run
May	8,931	1,378	16,611,370	3,519	$695.88	864	$69.60	$30.00	$757.20		$25.28	$1,577.96	1,782
June	10,503	959	14,745,830	4,004	800.80	1,036	94.86	37.50	947.70		116.37	1,997.23	1,959
July	15,144	1,737	23,576,765	5,357	1,076.32	1,525	131.35	42.50	1,478.85	$121.66	184.66	2,913.68	3,014
August	16,487	2,043	20,212,166	6,061	1,223.59	1,729	142.08	42.50	1,661.30		212.88	3,282.35	3,615
September	18,989	1,696	24,570,445	6,313	1,335.26	1,472	143.06	42.50	1,665.06	257.72	378.28	3,564.16	3,538
October	13,715	1,882	27,092,830	5,264	1,111.87	1,268	114.74	42.50	1,596.65	135.64	379.30	3,245.06	3,034
November	19,463	1,566	22,531,100	7,647	1,661.37	2,043	178.68	42.50	1,956.29	538.22	457.19	4,296.03	3,677
December	10,708	2,123	26,469,110	4,544	955.39	1,290	103.20	42.50	1,161.00	271.26	375.07	2,637.16	2,012
January	11,736	4,279	19,802,500	7,069	1,518.06	2,070	170.26	42.50	2,155.19	189.90	433.62	4,319.63	3,721
	125,676	17,663	195,612,126	49,778	$10,378.54	13,297	$1,147.83	$365.00	$13,379.24	$1,514.40	$2,562.65	$27,833.26	26,532

(a) Does not include cost of tires; (b) Includes labor cost for making repairs and replacements.
Table should be studied with appreciation of the fact that since the dates named prices of oil, gasoline, grease and wages of drivers have advanced.

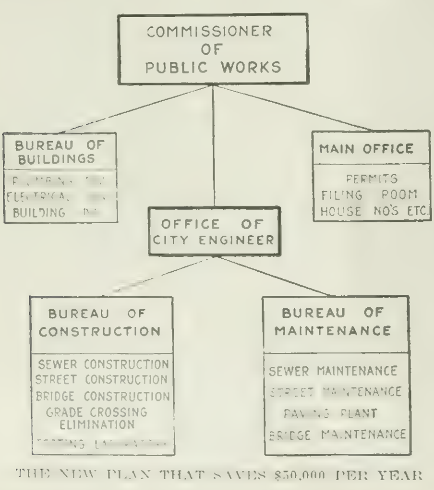
of several trucks in the hauling of certain kinds of material, or in covering a certain length of haul with a certain class of freight. Thus, when the conditions of loading and discharging, the character of freight, and the length of haul are known, it is easy to determine accurately the cost of a piece of new work. It is also easy to determine the effect, upon the cost, of new methods of supervision or of new devices. For instance, a large number of trucks were employed, during the period covered, in transporting asphalt. The company had them fitted with false metal-lined bodies, so that the time required for dumping the load was considerably reduced. The cost system could be readily used to show the actual money value of this saving in time, and at once demonstrated the economy of buying false bodies.

During the period covered by the tabulation the trucks were employed mostly on road work, hauling asphalt and concrete materials, and to some extent for transporting general freight in and about Chicago.

Wartime Reorganization Reduces Overhead in Public Works Department

REDUCTION of the force of the Department of Public Works of Portland, Ore., from a total of 185 to 129 employees, with a reported increase in efficiency and a large decrease in the payroll, was recently effected by a reorganization. The department previously consisted of a rather elaborate system of bureaus which made the overhead heavy. In making the change as many of the employees as could be utilized to advantage under the new plan were retained, but even so there were eliminated five engineers, three chief inspectors, six inspectors, two instrumentmen, four computers (whose duties were assumed by draftsmen), three supernumerary clerks and 33 other employees, or 56 in all.

Under the old arrangement the city engineer had charge of four bureaus, each with its own subdivisions. The Bureau of Highways and Bridges, for example, had a sidewalk division, a bridge maintenance division, a pavement construction division and a pavement maintenance division. There was also a Bureau of Sewers, which had both maintenance and construction divisions, each with its own system of handling office matters, inspection, etc.



THE NEW PLAN THAT SAVES $50,000 PER YEAR

Under the new plan all work done under the direction of the city engineer is handled by one of two bureaus, the Bureau of Maintenance and the Bureau of Construction. Each of these is in direct charge of a competent engineer. This brings into one office all records of new work and into another single office all records of maintenance work. City officials say this has greatly simplified office routine. The Bureau of Buildings is taken out of the hands of the city engineer and, like the main office work (including filing of records, permits, etc.), is under the direction of the Commissioner of Public Works. This official is provided with a capable assistant so that detailed attention can be given to such matters.

With this reduced force and a more compact organization, the amount of construction now being handled is equal to that previously done under the old organization, and the maintenance work is greater, as the Bureau of Maintenance now operates its own municipal asphalt repair plant. In anticipation of this reorganization, the current annual appropriation for this department was reduced from $308,000 to $258,000. The latest report is that the department will this year require only about 90% of the appropriation.

Concrete Computations Simplified by Standard Blanks

Original Work Is Made Easier and Checking Is Facilitated by Systematic Recording of Design Figures

By Walter W. Clifford
Structural Engineer, Hyde Park, Mass.

WHILE many of the larger structural engineering firms realize the need of system in recording computations, fear of multiplying expensive forms often deters men with smaller practices from attempting any standardization of computation records. As a rule, this fear is not well founded in concrete work. Rarely will some such system as the one proposed here be anything but a saving in time and money.

In deciding on a standard design form, the first consideration is, "Which items do we wish to make plain?" The first use of design sheets is to give information to the draftsman. The results then must be clearly indicated (and frequently they are the only thing that is plain), but for the benefit of checkers and executives all the assumptions of stress and loading should be equally well indicated. Also, a year later another structure may be desired with the same stresses or same loads; or information may be required as to the ability of the structure to withstand different loading conditions from those originally planned for. All this information should be easily available.

The assumed data goes logically at the head of the sheet, and a consideration of the problem of concrete beams and slabs will give a heading of the type shown on the following page, which should be on a quadrilled sheet.

Firm Name and Address

Job No.

BEAM AND SLAB COMPUTATION SHEET

			Final Sheet No.
	Computed by	Checked by	Prelim. Sheet No.
Remarks			Date

Mix					Member		
Allowable fc =	fs =	n =					
Allowable v =	R =	p =			Clear span		
					Bearing span		
Uniform load =	x	x	=	Lbs.	Panel width		
Self "			=	"	Live load		Lbs.
Partition load			=	"	" in slab		"
"			=	"	Plaster & grano		"
"			=	"			"
Total "				Lbs.	Load per sq. ft.		Lbs.

This accounts for the data. Then should follow a space, preferably quadrilled in the interest of neatness. for the computation of moment, flange width, steel area, shear, bond, etc. If—as should be the case in most offices—computation methods are standardized, such things as M = ———, V = ———, etc., may well be printed in convenient places on this portion of the sheet. If this be done every step in the design can be easily noted and checked.

At the bottom of the sheet will be shown the results. If a standard beam section be printed on each sheet it will save hours of drawing. With this section a form for tabulating data on "Straight Bars," "Cambered Bars" and "Stirrups" will complete the information. A definite space in which to note all this data will minimize mistakes of draftsmen and omissions of designers. A standard column design sheet can be worked out on similar lines with a place for everything. These two sheets will cover the major part of the concrete members.

There will always remain some special members which are not amenable to standard forms. Footings are perhaps the largest group in this class. Such special members are best treated by using a plain quadrilled sheet with a heading similar to that suggested for the beam sheet, and following a standard routine. This standard routine or method of arrangement for each type of design should be embodied in complete computations for typical examples neatly worked out. These sheets should then be posted or furnished in office data books so as to be readily accessible at all times. If these standard computations are followed in method and as closely as possible in arrangement, all the advantages of the printed form are attained except the economy of printing.

Changes in Concrete-Road Practice in Wayne County, Michigan

Slab Width and Thickness Generally Increased—Two-Mix Construction Proves Satisfactory—One-Way Roads Established

PRACTICE on concrete-road construction in Wayne County, Michigan, has passed through many changes since it was inaugurated, and while the majority of these changes have not been drastic, in the aggregate they bulk large. Thus Edward N. Hines, chairman of the Board of County Road Commissioners, summed up the situation in an address before the Michigan State Roads Association at Detroit Sept. 3. During the past year the minimum width of road has been increased to 18 ft., and a width of 20 to 24 ft. is being recommended for the sections adjacent to cities. The slab thickness has also been considerably increased, and two-course construction, which was tried out a year or more ago. has been permanently adopted. Regulation of traffic on Sundays and holidays has been effected by establishing one-way roads in certain sections. A brief abstract of Mr. Hines' paper follows:

While all parts of the country report that the roads are going to pieces under heavy motor-truck traffic, brought about by railroad congestion and the desire of the public to move merchandise, in Wayne County, which on July 1 had 57,633 licensed passenger motor cars and 9988 motor trucks of various capacities, not to mention thousands of motor trucks built for war purposes in Detroit and vicinity which use the roads, traffic has been carried over concrete roads seven, eight or nine years old, without any appreciable sign of wear. This experience emphasizes the wisdom and economy of building roads to fit the traffic, rather than restricting traffic to fit the roads, and it is against progress to regulate traffic to save a weak road, as such action will ultimately result in the destruction of the road itself.

To accommodate the increasing traffic the county road commission has increased the thickness and width of its roads during the past year, and believes that it is necessary to have a greater volume of concrete, irrespective of the mix, in order to withstand vibrations set up in the road by heavy, fast-moving motor trucks. It is the opinion of the commission that a well built concrete road will be eventually worn out not so much by abrasion as by vibration.

The road thickness has been increased from an average depth of $7\frac{1}{3}$ in. to an average depth of $8\frac{1}{4}$ in., being 7 in. at the edges and having a flat subgrade and a crown of $\frac{1}{4}$ in. to the foot. This gives $8\frac{1}{4}$ in. at the center for an 18-ft. road.

While 18 ft. is the present standard width, the county commissioners are advocating to the Board of Supervisors, the body in which final control rests, the adoption of a 24-ft. concrete road which will be 32 ft. over all for roads built 10 miles out from the limits of cities. Some progress in this direction has been made on one of the principal jobs, connecting the Jefferson and Mack roads, which is being built 24 ft. wide. The main roads are already so congested with motor trucks and trailers that travel has become difficult and dangerous to the passenger car and horse-drawn vehicle, and it has been found advisable on Sundays and holidays to make the Jefferson and Mack roads one-way roads for 12 miles out from the center of Detroit and through a number of small villages, the traffic going out by the Jefferson road, crossing by the Vernier road to the Mack road for the return trip. A further advantage of the widening is the economy effected by eliminating the large expense of macadamizing and graveling the shoulders, together with the necessity for continual maintenance and oiling to keep down the dust.

Recently the county changed its specifications to two-course construction, substituting crushed Wisconsin granite or trap rock for pebbles in the wearing course.

Despite the greater cost, the new construction is believed to be justified by the quality of the finished job. Fewer cracks develop in the roads built with crushed stone in the top course than in those built from pebbles. The use of the term "two-course" is somewhat of a misnomer, as the wearing surface is laid when the base is still wet, and it is compacted and becomes an integral part. A "two-mix" road would be a better term.

Several changes have been made in the use of expansion joints. While these are still placed at 25-ft. intervals, the thickness of the asphalt composition joint filler has been increased from $\frac{3}{8}$ to $\frac{1}{2}$ in., and the filler is placed just below the finished roadway, the concrete being carried over it with the strikeboard. Steel armored joints have been discontinued, owing to the scarcity and high price of steel and the difficulty in getting absolutely even joints. Excellent results have been obtained with submerged joints in eliminating irregularities, and when the film of concrete which covers them finally breaks, they can be maintained with Tarvia and coarse sand. The entire elimination of expansion joints is not considered good practice in Wayne County; rather, the county has increased the joint $\frac{1}{8}$ in. in width.

The county has established a minimum of 100-ft. radius for curves, and, where necessary, extra right-of-way is acquired to obtain this radius. A policy of superelevating all curves of 700-ft. radius or less has been established. This superelevation is obtained gradually so as not to be disagreeable to the rider. On sharp turns the pavement is widened out and the outer edge is banked 18 in. higher than the inner edge. Twenty-five miles per hour, the highest legal speed in Michigan, is the speed taken for computing superelevation.

Signposts of reinforced-concrete 10 ft. high and placed in a suitable concrete foundation are being erected at all important intersecting roads and are designed not only to be a permanent ornament to the road, but also to furnish useful and accurate information. They replace advertising signs and boards tacked on telephone posts or elsewhere, which are not allowed on the right-of-way of Wayne County roads. Provision is also made for placing electric lights on each post as soon as funds are made available, so that the traveling public may obtain distances and directions at night.

While it has been the practice of the county to keep all roads under its jurisdiction open for travel in winter as well as in summer, the importance of this work had not been fully appreciated until forced on the attention of the country at large during the severe weather and heavy snowstorms of last winter. This was particularly so on account of the congested freight-traffic conditions. No trouble was experienced at any time with snow on Wayne County roads, thanks to the efficient organization. Three superintendents have charge of road construction in the summer and have districts to take care of in winter. They are furnished with snow plows, scrapers, graders and shovels. Each superintendent is required to inspect his road and to have lists of men and team owners who will turn out for road cleaning. When a big snowstorm comes he gets at work in the shortest possible time. This method of taking care of the roads enables travelers to proceed in the usual manner and also prevents snow and ice ruts which concentrate traffic in one or two ruts.

Twenty-Mile Sewage and Reclamation Channel Proposed

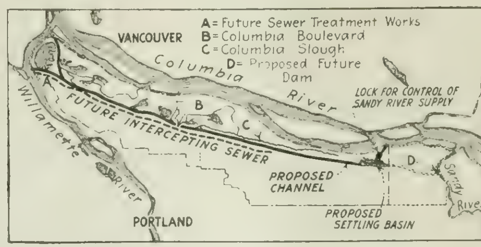
By R. G. McMullen

Department of Public Works, Portland, Ore.

Sewerage and land reclamation for the peninsular district of Portland, Ore., the city engineering department concludes, can best be effected by dredging the Columbia Slough for 20 miles. The sewage would be discharged into the channel until the growth of population would warrant the building of a long intercepting sewer.

Some 20,000 acres of land outside the city could be included in the drainage and reclamation district. The peninsular district proper includes 10,000 acres of land between the Columbia, and Willamette Rivers, in which is located the Columbia Slough.

It is proposed to dredge a channel with a depth of 12 ft. at low water, bottom width of 200 ft., top width of 300 ft. and length of 20 miles. The dredged material would be used to form a roadway or boulevard embankment and to fill in low areas. The two natural lakes at



DREDGING COLUMBIA SLOUGH WOULD SOLVE SEWERAGE AND DRAINAGE PROBLEM

the upper end of the channel would retain silt from the Columbia River water; or by building a dam across the Sandy River and a channel therefrom to the lakes clear water could be obtained for dilution and channel flushing.

The dredging cost for the 20-mile channel is estimated at $1,000,000. Of this it proposed to request $500,000 from the United States, $200,000 from the State of Oregon and to raise $300,000 from the port of Portland and from sewerage and drainage assessments on the property benefited.

O. Laurgaard is city engineer and O. E. Stanley engineer of sewers of Portland.

Water-Supply Costs Show High Increase

Before the Public Service Commission of Indiana the Terre Haute Water-Works Co., in asking for increased rates, recently presented data, on increased costs of operation and maintenance, that varied from 5% to 207% above those of 1914. The percentage increases noted were as follows: Coal, 161%; alum, 44; bleach, 207; white lead, 85; waste, 88; cylinder oil, 5; envelopes, 40; order blanks, 29; average wages paid clerks, inspectors, engineers, firemen, filtermen and station helpers, 16%, and common laborers, 25%.

Rectangular Engine House Avoids Use of Turntable

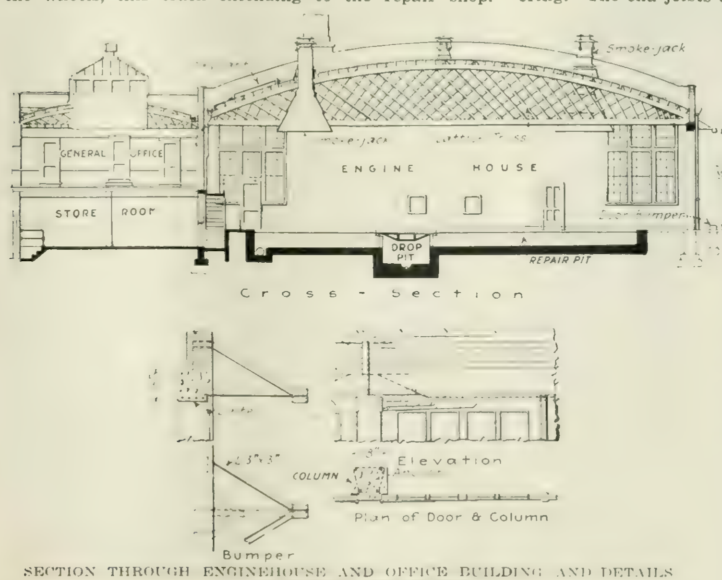
Reinforced-Concrete Building Has Arched Roof On Timber Lattice Trusses—Engine Stalls Have Swinging Doors

An UNUSUAL type of locomotive engine house built recently at South Chicago, Ill., for the Chicago Short Line Ry. is a rectangular building with parallel tracks and direct switch connections, in place of the usual segmental roundhouse with radial tracks served by a turntable. This design was adopted on account of the high cost and uncertain delivery of a turntable, while plenty of yard space was available for the track approaches. The building includes also the general offices and accommodations for the convenience of the employees. The railway is a 15-mile switching and terminal line serving a group of blast furnaces, steel mills and industrial plants, and having seven locomotives. The engine house proper is about 83 x 120 ft., divided into eight bays. Seven of these have tracks spaced 14 ft. on centers and the eighth forms a machine shop for repair work. The engine pits slope to an end drain and two of them have deep drop pits for handling locomotive driving wheels. In the drop pits is a track of 24-in. gage for a truck with a hydraulic jack for lowering and raising the wheels, this track extending to the repair shop.

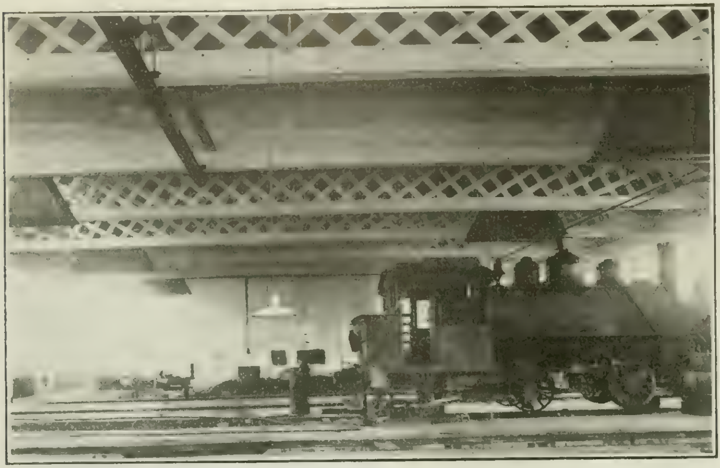
Mill-type construction and brick walls were used for the building. The track side consists mainly of concrete columns and a heavy lintel, the openings being fitted with swinging doors which have glass in the upper panels. Each door is carried by four heavy strap hinges anchored to the concrete columns. The doors are prevented from swinging beyond a 90° arc by means of steel bumper frames anchored to the lintel, and by 12 x 12-in. concrete posts set in the ground.

The barrel-arch roof is of a type new for engine-house construction. It consists of seven timber lattice trusses of the McKeown patented type, of 83-ft. span, so that the entire floor space is left clear. The trusses have curved top chords, and some of the web members project above these to supports joists upon which is laid the diagonal plank sheathing with composition covering. The end joists are carried by the walls. A line of struts or sway braces extends between the trusses. Similar construction is used for the roof of the general office, but with a flat ceiling carried by the bottom chords. The middle truss has the web planked solid to form a fire stop. Over the drop pits is a 12-in. I-beam with a trolley hoist for handling driving wheels. This is suspended from the top chords of the trusses by hanger rods. Exhaust ventilators are placed on the crown of the roof, and cast-iron smoke jacks are placed over opposite ends of alternate tracks. The general offices are on the upper floor of a two-story annex in the rear of the engine house. There are private offices for the general superintendent and treasurer, also a vault, locker room, toilet rooms and a

RECTANGULAR ENGINE HOUSE HAS PARALLEL TRACKS FOR SEVEN ENGINES



SECTION THROUGH ENGINEHOUSE AND OFFICE BUILDING AND DETAILS OF DOORS AND BUMPERS



INTERIOR OF HOUSE—WOOD LATTICE TRUSSES CARRY THE ROOF

rest room for the women employees. The first floor is used as a storeroom, with a three-stall fireproof garage at one end. The smaller two-story annex has on the upper floor a yardmaster's office and a large room for entertainments and meetings. This is about 32 ft. square and has a kitchen adjacent to it. Beneath this is a boiler room and a washroom with toilets and showers for the use of the yardmen and shopmen.

This combined engine house and office building was designed and built by Freyn & Co., engineers and contractors, Chicago. J. Fred Sheehy is president of the Chicago Short Line Ry. and W. F. Booth is general superintendent.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Proposes Caterpillar Mountings for Highway Motor Trucks

Sir—Perhaps the greatest problem that will confront this country in the reconstruction period, and in new construction to follow the war, will be the necessity for providing for a maximum of heavy highway traffic at a minimum of cost. In the consideration of this problem truck manufacturers generally, if thoughtful, must feel somewhat despondent, shippers more or less dubious, and highway engineers well nigh desperate. The appalling cost of providing highways generally, such as would sustain the expected traffic along present lines, may be assumed as prohibitive. What, then, must be the solution, if the traffic is to be accommodated?

The most obvious treatment would seem to be in legislation which would limit to a safe figure the load per inch of tire width, or per unit of bearing area, and perhaps the speed for the heavier loads. In this treatment, in the writer's opinion, lies the real remedy, in that it would force the practice in truck design to meet the requirements. It must be accepted as the only remedy, if it is admitted that on account of excessive cost the remedy cannot be found in road construction alone. The heavy wheel-mounted trucks of today, with their heavy loads, are nothing more nor less than engines of destruction to our highways and city pavements, and are not to be tolerated permanently. Are highway engineers sufficiently concerned in the question of the possibilities of traffic regulation and truck design, and are truck manufacturers and shippers sufficiently concerned in the question of the cost of highway construction, maintenance and preservation?

The writer suggests that, if such loadings are to continue as those for which the heavier trucks now in use are planned, the caterpillar or multipedal mounting must eventually come into universal use on these trucks. The cost of maintenance of trucks so mounted would be greater, perhaps, but would it not be better to place a moderate burden of that nature directly where it belongs, rather than have the cost of road construction doubled or quadrupled or made prohibitive, solely because of the specific needs of that particular interest?

The larger-sized trucks of today should not travel our highways at a speed in excess of 10 or 12 miles per hour, as a matter of safety to the traveling public, as well perhaps as a matter of economic operating speed. This is a limit easily within the reach of recent developments in caterpillar or multipedal design and practice. Such a mounting can easily be designed for a given load to meet any requirement that may be made with regard to the proper protection of any highway. Trucks so mounted would ordinarily be able to operate readily over more or less unimproved roads as well, making the desired schedule, and at the same time without destroying such roads.

After seeing what is proposed in the recent design of a large-capacity motor truck with multipedal mounting, the writer has made the prediction that, within a few years, in view of what will be demonstrated by the design in question, state and municipal requirements will be generally such as virtually to make compulsory the similar mounting of all heavy-tonnage motor trucks. In the particular design referred to, there cannot be the usual pounding or abrasive action of the links in making contact with the pavement, even at considerable speed, and the whole movement will apparently be as smooth and quiet as that of a rubber-tired wheel mounting.

Usually, all that is necessary for the best solution of any problem is merely to face the known facts squarely. If the traffic of present-type trucks is going to destroy our existing highways, and if the cost of the resulting

maintenance, or the cost of road construction adequate for that traffic, is prohibitive, then must the problem become, by suitable legislation, one for the truck maker and the shipper rather than for the highway engineer. If the shipper then finds, as is likely, that the heavy-tonnage truck is indispensable, the truck maker must take the necessary steps in his design to meet the respective requirements of the shipper and the highway engineer. Sound economic principles may be applied to the regulation of highway traffic, as well as to highway construction; and the facts should be faced squarely before the roads of the country are destroyed.

Greenville, Miss. W. L. THOMPSON.

[The foregoing statements suggest a problem for consideration which warrants careful thought from all interested in motor-truck transportation. If, as the writer suggests, there is a mechanical means available which would allow for motor-truck transportation over unimproved roads, it would certainly be utilized to the limit in this time of transportation shortage. In the absence of other means of transportation it might be used to transport the material for further road-building at this time, for which there is so much need. Coöperation, as *Engineering News-Record* has reiterated, is the only way to settle these problems, and the lack of it emphasizes daily the great need. Let those most interested in the solution stop talking about it and get together.—Editor.]

Heavy Motor Trucks and the Highways

Sir—Referring to Charles F. Dingman's letter in your issue of Sept. 5, p. 462, I would state that the street construction on Murray St., New York City, in 1887 was from the plans of the late Gen. Roy Stone, who was then serving, as I was at that time, on the staff of Gen. John Newton, chief of engineers, U. S. A. Later General Stone was director of public roads in the Department of Agriculture.

At present, it would be impossible to spare the necessary material for the shallow troughs of steel or wide rails.

COL. T. HUGH BOORMAN,
New York City. British and Canadian R. M.

Why Not a Three-Stage Concrete Mixer?

Sir—The effect of water on the strength of concrete, as noted by Prof. D. A. Abrams in *Engineering News-Record* of May 2, 1918, p. 873, is very astonishing in many ways, and yet our experiences of the past few years have been leading us to the conclusion that the amount of water had a greater effect than was formerly thought to be the case. Professor Abrams has some very good evidence as to just what the effect of water is. We have all seen 1:2:4 concrete apparently no better than 1:4:10, and never knew why. We have studied failures of rich concrete without arriving at satisfactory reasons therefor, and we have seen what was apparently a very ordinary concrete perfectly water-tight, when in adjacent work was a very rich concrete which would leak like a sieve. It looks as though Professor Abrams had progressed a long way toward a solution of some of our perplexing questions. The writer has always thought that most of our concrete has been mixed as the Englishman said our cocktails were: A little sugar to make it sweet, a little lemon to make it sour, a little whisky to make it strong, and a lot of water to make it weak.

Keeping the ratio of water to cement at a minimum brings up the question as to how we can hold the ratio down and yet keep the mass fluid enough to be properly mixable.

Are the best results obtained in our ordinary commercial mixers? Is it reasonable to expect the best results by dumping all materials, water, cement, sand and broken stone, together into a revolving box, and expect to take out in a couple of minutes a perfectly mixed concrete?

Would an engineer who had never seen a mixer design one such as those we use, if he were asked to design one from first principles? Possibly he would, but the writer believes that better results would be obtained if we did the mixing in what the writer calls a "three-stage mixer," by first dissolving (not in a chemical sense) the cement in the water in the first stage; then mixing this solution with the sand, in the second stage, and then mixing this grout with previously wetted broken stone, in the third stage. No time would be lost, as by placing two smaller mixing boxes on our machines stages 1, 2 and 3 could be in progress on three batches at the same time.

One reason for the concrete requiring an excess of water to become mixable is to enable the stone to be thoroughly coated with grout; but by obtaining a more nearly fluid grout first, this could be accomplished with less water. Surely segregation would be obviated.

Possibly stages 1 and 2 could be combined so as to make a two-stage process, but it appears that for work of the highest class concrete should be made in a three-stage mixer, for second-class work in a two-stage mixer, and for rough work an ordinary commercial one-stage mixer should be used. Of course, in case of gravel two stages only would be necessary.

In any event, it might be advisable to consider that when writing specifications for concrete the ratio of proportions should include the fourth element, as for instance: $\frac{W}{\frac{1}{2}} : \frac{C}{1} : \frac{S}{3} : \frac{ST}{5}$ instead of $\frac{C}{1} : \frac{S}{3} : \frac{ST}{5}$.

FRANK B. WALKER.

Boston Army Supply Base, Boston, Mass.

[At one of the cement shows, some years ago, there was exhibited a two-stage mixer. It was not a very sturdy machine and was not backed by a strong commercial organization; so far as is known it is not now manufactured.—Editor.]

Typhoid Carrier Delays Water Service

Discovery of typhoid germs at the intake of the new Wilson Ave. water tunnel, Chicago, caused the health commissioner to prohibit the putting of this tunnel into service for several days beyond the date originally proposed. The tunnel and the mains had been thoroughly cleaned by pumping water through them, but shortly before the date set for operation the analyses of water in the well at the intake crib disclosed the presence of typhoid bacilli. Investigation showed that one of the men working at the intake was a "carrier." Use of this new supply system was postponed therefore until conditions were safe. The tunnel is now in service.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Device Eliminates Careless Handling and Saves Empty Cement Bags

BY E. EARL GLASS
Monrovia, Cal.

TWO bars bolted to the platform of a mixer to form a shelf upon which the cement handler piled his empties was the device used on a recent contract to eliminate the usual carelessness in handling and the loss of bags. This method of piling the bags was found much better than the old method of throwing them outside the edging, and also made it convenient for the inspector to keep track of the amount of cement used.

The shelf formed by the bars was about waist high and formed a very convenient place for the cement man to place his bags. For the purpose of keeping track of the number of stacks a stick was placed upon every tenth bag; when fifty had been piled, they were tied into a neat bundle with baling wire and tossed upon the roadside. The inspector in making his day's count marked the bundle with crayon and entered the number and station in his log. A team then picked up the bundles and hauled them to the siding, and an accurate record was kept of the amount of cement used, without the loss of an empty bag and without extra expense to the contractor.

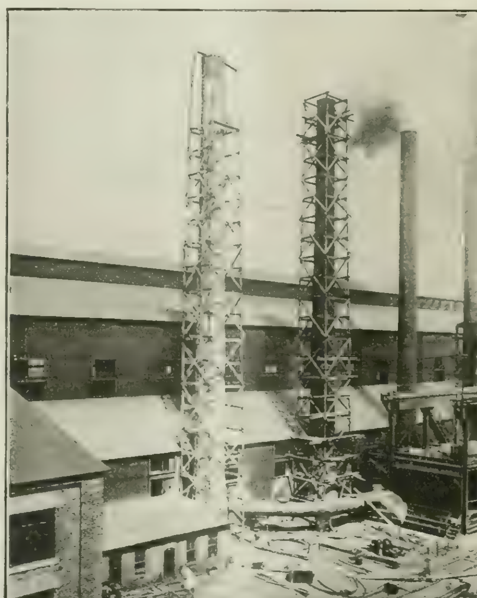
Other Articles of Interest to Contractors In This Issue:

Rusting Steel Chimneys Coated with Concrete by Cement Gun

FIVE steel stacks, at the Pittsburgh Crucible Steel Co.'s Midland works, which had become very badly corroded in service, were recently covered entirely on the outside with a reinforced-concrete shell, at comparatively small expense and without putting the stacks out of service, except for a few days. The concreting was done with the cement gun, operated by a workman standing on a scaffolding in the first two chimneys, and in the more recent work on a hanging scaffold.

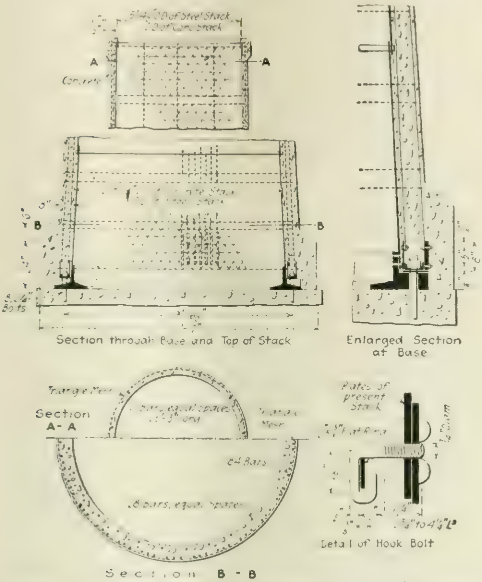
The stacks are 125 ft. high and approximately 6 ft. in diameter at the top, with an outside diameter of 12 ft. at the footings. The steel in the plates was very badly corroded from the gas which found its way through the brick lining of the stack. Corrosion was very general, and in places a man could thrust his forearm through the plates. The coating comprised a self-supporting annular ring of reinforced concrete, varying in thickness from 8 in. at the base to 3 in. at the top, the reinforcement being securely fastened to the steel plates of the stack itself. At each ring of the stack, that is, at vertical intervals of about 5 ft., hook bolts were tapped into the plates of the stack. These bolts carried horizontal steel bands held a fixed distance about 2 to 4 in. away from the shell. These bands in turn carried vertical reinforcing rods of square twisted steel, around which was wrapped the annular ring of wire mesh shown in the views. This mesh varied in spacing and size of wire with the thickness of the concrete to be applied. In the lower 20 ft. two rows of vertical rods were placed, the wire mesh being attached to the outer row. Above the 20-ft. height the one row of vertical rods which carried the mesh was placed near the outer face of the concrete.

The concrete was applied through the cement gun onto and through the wire mesh. A compressor with the cement gun was installed in a near-by house, and the hose with the nozzle was carried up as the work went along. In the beginning the scaffolding shown in the view was used,



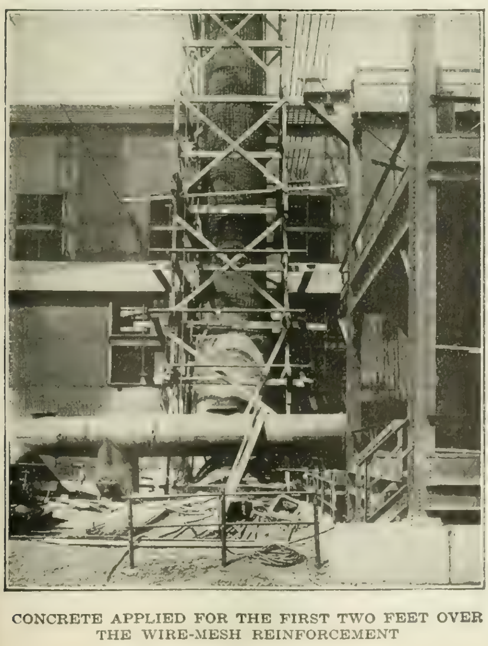
125 FOOT STACKS CORRODED BY GAS ARE REPAIRED BY APPLYING CONCRETE WITH CEMENT GUN

but after the completion of the second stack it was thought that better results could be obtained by the use of swinging scaffolds, and these were installed



DETAILS OF THE REINFORCEMENT FOR THE CEMENT GUN COATED CHIMNEYS

with considerable success. The stacks were kept in operation during the progress of the work, except for a few days on each while the concrete was being



CONCRETE APPLIED FOR THE FIRST TWO FEET OVER THE WIRE-MESH REINFORCEMENT

applied to the upper part. During these few days the stack was cut out of service so that the material would not dry out too quickly, the upper parts receiving less protection from the heat of the gases than the lower section.

About 20 to 25 sq.ft. of concrete was applied a day. Each stack required 11 cu.ft. of finished concrete, reinforced with about 1½% of steel.

The work was done by the Baker-Dunbar-Allen Co. of Pittsburgh, Penn., under the direction of J. P. Clarke, superintendent of construction, and W. F. Glasser, general superintendent.

Adhesive Waterproofs Drawings and Tracings Without Crimping

By John S. Carpenter
Springfield, Ohio

WATERPROOFING of drawings and tracings so that they can be used in wet places, as in mines, is done by the use of a preparation composed of rubber and benzol.

The compound in less dilute form also makes a paste with which to join tracings and maps without the crimping of the joint that commonly occurs when water pastes are used.

The pure gum rubber which is required for this waterproof paste can be bought at wholesale drug houses. The benzol can be obtained at most paint stores.

Benzol dissolves rubber, and the compound thus formed will keep in any climate and under any conditions. As benzol is inflammable, it should be kept in a safe place in a covered jar. If the proper precautions are taken in its use, however, it is no more dangerous than kerosene.

In a quart jar put a piece of rubber about 4 in. square; to this add a half pint of benzol. The rubber will soon swell to three or four times its former bulk and will be ready for use in about 24 hours. To prepare for use take about half the above quantity and put it in another jar for thinning down. If drawings are to be coated use a rather thin solution that will spread well under a brush. The drawing should be coated on both sides. For use as an adhesive, the solution should be fairly stiff, so that if it is desirable afterward to separate the joined parts it can be done more readily than if thin paste is used. There are cases where large tracings and blueprints must be made up of smaller sections, and for this work the paste is invaluable, as the joints will not be crimped out of shape and alignment.

When some of this solution was spilled accidentally on a dirty drawing the benzol was mopped up with a rag and the rubber was rolled up into a ball. The drawing was cleaned very nicely during the operation. This suggested an additional use for the preparation.

Rubber bands instead of pure gum rubber were tried; but it was found that they would not dissolve, merely swelling to many times their former size. Formaldehyde was also tried as a solvent, but its objectionable odor and certain other characteristics have proved it to be undesirable. When diluted as above directed the pure gum paste will not be costly.

NEWS OF THE WEEK

New York, September 26, 1918

American Ship Construction Is Now Overtaking All Ship Destruction

Nearly a Third of World's Pre-War Tonnage Has Been Sunk, But Construction Has Made Up Two-Thirds of Loss

Figures just given out by the United States Shipping Board show that in August the tonnage of commercial ships built in American yards passed the total allied and neutral losses for the month from enemy activities. During that month the Germans sank 259,400 gross tons (about 390,000 dead-weight tons) and the American yards turned out 261,000 gross tons (about 393,000 dead-weight tons). The status of world tonnage on Sept. 1, 1918, is given in the accompanying table, which includes the above noted data.

It will be seen from this that in the fifty months of war 21,404,913 dead-weight tons, or approximately 30% of the total allied and neutral tonnage of July, 1914, has been destroyed. This represents an average of 285,000 tons monthly if distributed over the whole period, but this is not a fair comparison, inasmuch as the German sinkings did not start until 1916. Even on the basis of a general average, however, American construction is beginning to exceed destruction, which is itself rapidly decreasing. The figures also show that two-thirds of the tonnage lost has been replaced by construction, not counting the enemy tonnage captured or seized.

The rapid increase of American shipbuilding is reported by the board as in Table II. The board's statement reads:

"Within the jurisdiction of the United States Shipping Board on Sept. 1, 1918, there were 2,185 seagoing vessels, totaling 9,511,915 dead-weight tons. Of these, 1,294, totaling 6,596,105 dead-weight tons, fly the American flag. Under charter to the Shipping Board and to American citizens there are 891 foreign vessels, totaling 2,915,510 dead-weight tons.

"At the time the United States entered the war the American merchant marine included approximately only 2,750,000 dead-weight tons of seagoing

(Concluded on page 600)

TABLE I—STATUS OF WORLD TONNAGE, SEPT. 1, 1918
(*Germany and Austria excluded*)

	Dead-weight Tons
Total losses (allied and neutral) August, 1914-Sept. 1, 1918	21,404,913
Total construction (allied and neutral) August, 1914-Sept. 1, 1918	14,427,825
Total enemy tonnage captured (to end of 1917)	3,795,000
Excess of losses over gains	3,362,088
Estimated normal increase in world's tonnage if war had not occurred (based on rate of increase, 1905-1914)	14,700,000
Net deficit due to war	18,062,088

In August, deliveries to the Shipping Board and other seagoing construction in the United States for private parties passed allied and neutral destruction for that month. The figures:

	Gross (Actual) Tons
Deliveries to the Shipping Board	244,121
Other construction over 1000 gross	16,918
Total	261,039
Losses (allied and neutral)	259,400
America alone surpassed losses for month by	1,630

NOTE.—World's merchant tonnage, as of June 30, 1914, totaled 49,089,552 gross tons, or, roughly, 73,634,328 dead-weight tons. (Lloyd's Register.)

TABLE II—INCREASE IN AMERICAN SHIPPING

	Number	Dead-weight Tons
Requisitioned American ships	449	2,900,525
Ex-German and ex-Austrian ships taken over	100	644,713
New ships owned by Shipping Board	256	1,465,963
Old lake steamers transferred	31	117,800
American merchant ships not yet requisitioned (of over 1500 dead-weight tons)	377	980,459
Dutch steamers requisitioned	81	486,945
Foreign ships chartered to Shipping Board	291	1,208,411
Foreign ships chartered to American citizens	600	1,707,099
Total	2185	9,511,915

SHIPS LAUNCHED AND DELIVERED

	Wood Ships		Composite Ships		Steel Contract Ships		Requisitioned Steel Ships		Total	
	No.	D.w. tons	No.	D.w. tons	No.	D.w. tons	No.	D.w. tons	No.	D.w. tons
Launched	170	599,450	13	48,500	130	708,300	261	1,660,988	574	3,017,238
Delivered	238	1,186,599	56	347,935	33	117,500	8	66,357	335	2,019,032

Contractors Organize for War Conditions

November 20 and 21 Set as Date For Chicago Meeting to Form Permanent National Association

Finding the organization of the contractors of the United States in a representative national association "necessary and feasible," the temporary executive committee formed to create such an organization met in New York on Monday and Tuesday last and issued a call to all general contractors to attend a national convention to be held in Chicago Nov. 20 and 21 next, at which a national association will be perfected.

The committee, as announced in *Engineering News-Record*, was originally appointed at the convention of the building industries held July 18 in Atlantic City, and was subsequently enlarged to make it representative of all sections and existing organizations. It drafted a tentative form of constitution which was considered and revised at the meeting, and which will form the basis for action of the convention. The main features of this constitution were announced in *Engineering News-Record* of Aug. 1, p. 245.

On account of war work of various sorts it was not possible, it is announced, to select a date on which the entire committee could assemble, but members representing associations of contractors in Buffalo, Memphis, Detroit, Boston and New York undertook to go ahead with the business of calling the convention on authorization, by telegram and letter, from all but four of the committee asked to serve. The absent members, it is stated, presented their views in writing on the proposed constitution and purposes of the organization, and without exception urged that early action be taken.

The committee adopted the following resolution:

"Whereas, it is the sense of the committee that the organization of the general contractors of the United States into a national association is necessary and feasible; therefore,

"Be it resolved that a convention of the general contractors throughout the country be called to meet in Chicago on Nov. 20 and 21 next, for the purpose of forming a permanent organization; and

"Be it further resolved that an invitation be extended to all general contractors to attend, and that the invitation set forth fully the purposes for which the convention is called."

After the passage of this resolution it was decided to call the committee

together in Chicago just prior to the convention, at 10 a.m. on Nov. 18.

War service and the position of the contractor during the remainder of the war, including both means for rendering the most efficient immediate service and means for maintaining the war volume of construction work so far as it will not interfere with the needs of the Government, are understood to have taken up a large part of the discussion, and plans which can be put into effect immediately after a permanent organization is formed were considered.

S. A. T. C. Courses Emphasize Map Making and Sanitation

Sanitation and hygiene, map making, topography and surveying are emphasized in the outline of the curricula for the Students' Army Training Corps, as announced by the committee on education and special training of the War Department. In general, the program for study in the students' training corps are included in the following groups: Group 1, infantry, field artillery; group 2, air service; group 3, ordnance and quartermaster service; group 4, engineer corps, signal corps and chemical warfare service, and group 5, motor transport and truck service. In all of these groups hygiene and sanitation and surveying and map making are included as essential subjects. For instance, in group 1 (infantry and field artillery) sanitation and hygiene comprise 9 hours of the prescribed 53 hour a week training, and surveying and map making comprise 12 hours. In group 2 (air service) map reading and navigation comprise 12 hours a week.

The course so far prescribed for the Engineer Corps under group 4 is as yet designated only as "an approved program in any branch of engineering studies," and for the Signal Corps "an approved program of studies in electrical engineering."

General Morrow Chief Engineer of First American Field Army

Official announcement just made of the personnel of the command of the first American field army in France shows that the chief engineer is Brig. Gen. Jay J. Morrow, one of the best-known officers in the Corps of Engineers. General Morrow was graduated from West Point in 1891 and passed the early years of his service in the corps at Willets Point and in the New York City fortification work. He was for a number of years connected with the engineering work at Washington, D. C., both as engineer commissioner and as officer in charge of the Washington Aqueduct. Later he was on the Alaska Railroad Commission, which made the recommendations followed later in the construction of a Government railroad there. His last position before the war was that of maintenance engineer on the Panama Canal. General Morrow commanded the 4th Engineers in France

Regional Highway Transport Directors Meet

Form and Discuss Definite Program for Utilization of Highways—Officials Co-operate

Regional directors of highway transport from all parts of the United States met in Washington Sept. 16-18 to discuss the problems of organization of highway transportation in the various States. The meeting was held under the auspices of the highways transport committee of the Council of National Defense. A definite program of specific use of the highways, in support of both the war plan and the reconstruction policy for post-war times, was developed at the conference of the 11 chairmen representing the regions into which the country has been divided.

Some time ago the Highways Transport Committee appointed the regional directors, each to have charge of one or more states, according to the size of the problem. Under this plan each state has its own highway transport committee, each county has a subcommittee to help work out the problem, and every township will have its subcommittee. When the system is fully organized there will be more than 15,000 members of the various committees.

Recognition of the highway's value as a transportation resource was evidenced at the conference by the appearance before the committee and its chairmen of cabinet officers, members of the Railroad Administration, the Food Administration, the War Industries Board, the National Highways Council, the Electric Railways War Board, the Army and the United States Senate. President Wilson received the conferees at the White House on the conclusion of the sessions.

Rural Expresses Urged

Various governmental agencies proposed close coöperation between their respective organizations and the Highways Transport Committee. Herbert C. Hoover, Federal food administrator, approved the development of the rural express as a means of saving perishable foodstuffs now produced, for stimulating production of more food, for lowering costs of living, and for conserving farming man power for the soil. He observed that 50% of the perishables produced in America are wasted, largely through ineffective means of getting them to market. Fast, intimate service by rural expresses, he foresees, will be a great source of saving. By the use of motor expresses, Mr. Hoover pointed out, the farmer need not maintain so many draft animals on the farm, animals that eat the crops of millions of fertile acres that otherwise could be devoted to raising food for people. The failure of the public market in America, Mr. Hoover said, was caused by inadequate transportation of an intimate sort, and he believes that a developed rural express will give public markets a basis for economic success and tend toward lower price levels.

Franklin K. Lane, secretary of the interior, tied the highways development into his plan for putting millions of returned soldiers and their families on small farms carved by the Government from great areas of public domain now either unused or in need of reclamation.

"I can see the making of a new America," said Secretary Lane, "a nation of farming communities and small industrial centers. These centers must be developed and tied together and made easy of access by good roads, over which the most efficient of transport will move goods to market."

Highway, Waterway and Railway

William C. Redfield, secretary of commerce, told the regional chairmen that he regarded highway, waterway and railway as a trinity of economic usefulness, incapable of full function unless all factors of it were developed efficiently. He pointed out that the perfection of the internal combustion engine has given both highways and waterways a new tool—the motored vehicle on the roads, the motored barge on the rivers and canals. He remarked that though the Hudson River were bordered with three times the rail lines it has now, and its waters ploughed by all the ships it could carry, still the farmer living inland five miles from it would fail to profit unless access to docks and depots by rural expresses were afforded.

Secretary Redfield said he regarded legislation to restrict the size of motor trucks in order to save the roads as a menace to development of highways transport, as intolerable as it would have been to have stopped locomotive development forty years ago because engines and cars were getting too heavy for the light rails of those days. Our transportation routes must be fitted to the new tools, he declared.

Relief for the railways by another of the Highways Transport Committee's projects—the store-door delivery system—was welcomed by Edward Chambers, formerly vice-president of the Santa Fé railroad, now director of traffic in the Railroad Administration. He urged the chairmen to promote the trucking of less-than-carload shipments from the manufacturing centers to communities 30 or 40 miles out, and the coöperation of the highway regional chairmen with the railways' regional traffic directors, to facilitate the clearing of the terminals in the larger cities.

Mark L. Requa, director of the oil division of the Fuel Administration, asked the committee's coöperation in a campaign to promote more efficient operation of all gasoline-propelled vehicles and the conservation of fuel through the stopping of wasteful practices and nonessential running.

The Army was represented before the conference by Lieut.-Col. W. D. Uhler, Q.M.C., in charge of army truck convoy service. Lieutenant-Colonel

Uhler bespoke the coöperation of the chairmen in providing for the clearing of roads during the coming winter, when, as it has moved for nine months now, the Army will be moving long trains of motor trucks from inland factories down to the seaboard, under their own power and cargoed with munitions.

Joseph D. Baker of the War Industries Board's staff asked the chairmen to help make clear to motorists and garage managers the necessity for saving both materials and man power, and suggested ways in which such savings can be effected.

Reports made by the regional chairmen show increases of tonnage as high as 400% over last year.

The regional chairmen, all but one of whom were at the entire conference, are J. Randolph Coolidge, Jr., Boston; George H. Pride, New York; C. A. Musselman, Philadelphia; Thomas Winn, Atlanta; Harry L. Gordon, Cincinnati; John J. Stockton, Chicago; J. F. Witt, Dallas, Tex.; Julius H. Meier, Portland, Ore.; L. A. Nares, Fresno, Cal., and Earle Brown, Minneapolis.

American Ship Construction

(Concluded from page 598)

vessels of over 1,500 dead-weight tons."

The fleet lists on Sept. 1, 1918, were as indicated in Table II.

There are now 203 shipyards under the United States Shipping Board; 77 for steel ships, 117 for wood, two for composite and seven for concrete ships. Of these 155 are completed. The yards have 1020 ways, which the board says is more than double the total shipways in the rest of the world. In these yards, during the year ending Aug. 30, 1918, more than 2,000,000 deadweight tons of new ships were delivered, as shown in the second part of Table II.

The program of ship construction as announced is as follows:

	Dead-weight Tons
2249 contract ships, totaling	13,212,712
42 concrete ships, totaling	301,500
402 requisitioned ships, totaling	2,790,792
2693 ships	16,305,004

"The Shipping Board has also contracted for the construction of 170 wood barges, 279 tugs, 100 trawlers, and 25 harbor oil barges, totaling 50,000 deadweight tons."

Government Railroad Completed to Alaska Coal Fields

Completion of the 190 miles of Alaska railroad reaching from tidewater to the Matanuska coal fields has been effected. At the close of the active working season last year there was a gap of 16 miles on the main line between Anchorage and Seward, the southern terminal of the railroad. This gap was along Turnagain Arm, and involved some of the most difficult construction work on the whole line of the railroad.

Safety Measures Profitable in Construction

Engineers and Contractors Form Organization at Safety Congress to Further Work

Injuries to workmen, now more prevalent in construction in proportion to the numbers employed than in any other industry, can be reduced materially by preventive methods differing not greatly from those successfully employed in other industries. Progressive construction companies have demonstrated the fact that safety engineering is practicable. Their records show that accident prevention reduces labor turnover and loss of time, increases the earnings of the workmen and saves money for the employer. Education is necessary, no less for the employer than for the workmen themselves. These are the outstanding lessons of the deliberations of the construction section of the National Safety Council, during the seventh annual safety congress held in St. Louis Sept. 16-20.

Officers were elected and a permanent construction section of the National Safety Council was organized Sept. 18. Tentative efforts have been made from time to time for several years toward this end, but it was not until about four months ago that these efforts assumed practical form. Then the National Safety Council engaged Sidney J. Williams as manager of the accident prevention division of the council. Time was short in which to develop a construction accident prevention program for the congress, but, aided by a few enthusiasts in the field, he succeeded in arranging a schedule of six formal papers and several impromptu talks, and in obtaining the attendance at the meetings of the section of some sixty men prominent in the construction industry. The construction section temporarily organized for the congress was made a permanent section, with L. D. Von Woedke, of the Fred T. Ley & Co., Springfield, Mass., as chairman; W. J. Lynch, of the Thompson-Starrett Co., Chicago, as vice-chairman, and E. W. Bush, of the Aetna Life Insurance Co., as secretary. Working with Mr. Williams as an official of the National Safety Council these officers will not only plan a program for next year's congress, but will also promote various activities during the year which will aid construction firms to organize and execute accident prevention measures.

Possibilities in accident prevention were set forth in the first paper of the meeting by Mr. Von Woedke. Insurance rates as affected by accident prevention were discussed in a paper by H. L. Geisler. As secretary of the Builders' Limited Mutual Liability Insurance Co., of Wisconsin, Mr. Geisler quoted the saving in accident costs to the contractor policy holders of the company, by very simple means. As policy holders these contractors became vitally concerned in reducing injuries to their workmen, and this is the first great object to be attained in all accident prevention propaganda. Support of the contractors being assured, education of their workmen proceeded by means of bulletins and frequent addresses on safety methods, delivered to groups of workmen. In this last activity the interest of heads of labor unions was engaged so that they would order their members to attend the meetings. The results of these simple methods have been to reduce materially both frequency and cost of accidents.

Experience of the General Builders' Association of Detroit, Mich., working with the insurance interests to reduce accident costs, was outlined in a paper by F. S. Robinson, secretary of the association. This organization of 11 builders, only two years old, has reduced accidents and insurance rates very greatly by educational work. Every job handled by a member is directed according to the recommendations for safety of the insurance experts. Bulletin boards carrying safety placards are installed on every job; the workmen are assembled at intervals to listen to safety talks, and field aid classes are conducted for superintendents and foremen by physicians of the insurance company.

Engineers Ask Railroad Wage Board for Hearing

Onerous conditions imposed upon the railroad technical engineers by reason of wages alleged to be too low to meet living expenses have been brought to the attention of the officers of the American Association of Engineers so many times, not only by individual members but by many who are not members, that the association has petitioned for a special hearing on the subject before the Board of Railroad Wages and Working Conditions. One petition, signed by the engineering corps of the Michigan and Logansport division of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry., states the following wage conditions: (1) Increases under order No. 27 are not sufficient to cover the normal increase in cost of living; (2) salaries paid to engineers are not consistent with salaries paid in other lines of engineering work, nor with salaries paid men over whom the engineer has supervision. In some cases these men are receiving double and treble the compensation of the engineer.

Referring to reports of the statistician of the United States as to the increased cost of food, the figures are 3% for the month of July, 15% for the past year, and 69% for the past five years. Investigation of the local markets in Logansport places the increased cost of the necessities at 160%. [Figuers compiled by the United States Food Commission and released Sept. 23 give the increase in the total national food bill during the year which ended June 30, 1918, as 3.2%, but it is stated that the percentage increase in rent, clothing, transportation and other items is several times greater.]

Comparison of wages is made with contractors' forces as follows: Foreman, $225, as against $135 to railroad's engineer, with 13 years' experience, in charge of construction; contractor's chief clerk and team foremen get $150; steam shovel engineer, $200; crane men, $150; firemen, $125; and dump foremen, 55c. per hour. Against these figures are four assistant engineers with salaries and years of experience as follows: $123.25, seven years; $105.75, three years; $98.75, three years; $95.90, seventeen years.

Varied Program for Municipal Improvements Convention

Discussion of and reports on a wide variety of subjects, included under the general heads of paving, sewage, water-supply and refuse disposal, form the basis of the program of the twenty-fourth convention of the American Society of Municipal Improvements, to be held in Buffalo Oct. 2-4. If the convention of 1917 had not been omitted, this would have been the twenty-fifth convention of the society. The preceding convention was held in Newark, N. J., in 1916.

After the registration of delegates the Buffalo meeting will open on the morning of Oct. 2 with committee and subcommittee meeting to discuss street paving subjects. These will be followed by the evening session, which will listen to the president's address, the report of the executive committee, the report of the finance committee, and the report of the special committee on standard tests for bituminous materials. The morning session of Oct. 3 will be devoted to a discussion of sewage problems, including the Miles acid process for the recovery of grease from sewage, the pressing of sewage sludge, and the private sewerage question. The session will also include the report of the committee on sewage and sanitation.

The afternoon session of the same day will be devoted to the report of the committee on street paving, as well as various papers on paving subjects, including the maintenance of old asphalt pavements, and the report of the committee on sidewalks and street design. The evening session will be devoted to business matters of the society, in addition to the reports of the committee on standard specifications, street lighting, municipal legislation and street occupation under franchises.

The "jubilee session" to be held on the morning of Oct. 4 will be devoted to papers on the early history of the association, its recent history, and statistics and the documentary history of the society, as well as reports by the committees on parks and parkways, city planning, traffic and transportation and fire prevention. The afternoon will be given over to an automobile trip through the city of Buffalo and its surroundings, including visits to the city water-works and industrial plants.

Notes from the Field

It was my good fortune during the first week of this month to fall in with the mining engineers at their convention in Denver and Colorado Springs. They are an intensely human crowd—"regular fellows," in the vernacular of the day. They are close to the realities of life in mining camps, unspoiled by the pretense and conventions of the city. There was a frankness and heartiness that we do not find in the cañons of Broadway and State Street.

And yet, when the men from the open threw themselves, between sessions, into the moment's duty of having a good time, the city fellows joined in. They were just as human, but they had been concealing it. There was not the same abandon, but the hard-pavement boys had a good time, nevertheless.

Expressive of the character of the crowd was the fact that all joined in singing "Onward, Christian Soldiers," after unexpurgated outbursts of "Mary Ate Some Oysters," and "Hail, Hail, the Gang's All Here." That was at the dinner in Denver. At Cripple Creek, after a basket luncheon, the Doxology followed the same tuneful ditties. As one New Yorker expressed it, "Can you beat it?"

And the ladies present, the wives of these same rollicking, substantial mining engineers, realizing that the boy spirit for the time was uppermost, smiled indulgently, and if they did not join in the "Mary" and "Gang" songs, their voices were loud and sincere in the hymns.

Intelligent Publicity

One other feature of the convention of the American Institute of Mining Engineers I should record. The publicity was intelligently handled.

By publicity I mean not blatant notices of the meeting, but newspaper items that told the story of the convention and emphasized in nontechnical language the thought of important papers, and, in consequence, gave to the local papers and those in the intermountain mining country a correct idea of what occurred.

The institute has here set an example worth following. Various engineering societies have had good publicity in their home and headquarters cities. I do not remember any intelligently handled away from home. Under the usual procedure, the reporters are passed from one man to another, finally reaching a clerk or assistant who has too many details in his hands to be able to give the reporters intelligent assistance. Consequently, the latter content themselves with brief notices or make their own attempts to tell something about the technical proceedings—the latter efforts invariably ending in garbled reports that make the engineers smile derisively, and misinform the public.

The institute has followed the sensible course of making some one man responsible for seeing that the newspaper men get the assistance they need. In fact, the responsible man at this meeting took the further—and wise—step of preparing a brief résumé of each session's proceedings and placing it at the disposal of the reporters.

This procedure is of benefit to the institute, of service to its many nonattending members who thereby are kept informed at once of the distant convention doings, and of help to the profession generally in informing the public about the work of the engineer.

Paraphrasing the newspaper line, "Other societies please copy."

E. J. M.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Chicago.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

CITY MANAGERS' ASSOCIATION; Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

The Associated Engineering Societies of Seattle held a meeting Sept. 17 which was devoted to the subject of fuels of the Pacific Coast. The papers presented were "Coal," by Amos Slater, "Mill Waste," by H. W. Beecher, and "Combustion," by C. V. E. Dove.

The Detroit Engineering Society was addressed by Prof. Henry S. Jacoby of the civil engineering department, Cornell University, on "Recent Progress in Bridge Construction," at a meeting held Sept. 20. Professor Jacoby's address dealt with the principal features of the world's greatest bridges, and made special reference to progress during the past seven years.

The Vermont Society of Engineers will hold its fall meeting at Montpelier, Oct. 2-3. On the first day of the meeting Prof. G. H. Perkins, state geologist, will present a paper on "The Geology of Central Vermont and Smugglers' Notch." The second day of the meeting will be devoted to an automobile trip to the mill and mine of the Magnesia Talc Co., near Waterbury, and thence over Vermont's first strip of Federal aid highway to Waterbury, followed by an inspection of the new highway which the state is building.

The Minnesota Joint Engineering Board elected the following officers at a meeting held in St. Paul, Sept. 21: President, W. F. Hoyt; vice-president, R. J. S. Carter; secretary-treasurer, G. H. Herrold.

The Western Society of Engineers held a meeting Sept. 23 in Chicago under the auspices of the hydraulic, sanitary and municipal section, at which William G. Edens, president of the Illinois Highway Improvement Association, spoke on "Good Roads in Illinois." Mr. Edens explained the need for improved highways and the proposed $60,000,000 bond issue to be voted on Nov. 5. The Illinois centennial photoplay, "Through Illinois Over Unchanged Roads in a World of Change," was shown.

Personal Notes

PAUL G. REDDINGTON, city manager of Albuquerque, N. M., since the city-manager plan went into effect last January, has resigned to resume his work as district forester in the Government Forestry Service.

W. H. WOODBURY, valuation engineer of the Duluth & Iron Range R.R., has been made valuation engineer also of the Duluth, Missabe & Northern Railroad.

EVERETT EDGAR KING has been appointed professor of railway civil engineering at the College of Engineering of the University of Illinois. Professor King was graduated from Rose Polytechnic Institute in 1901 with the degree of bachelor of science, receiving the degree of civil engineer in 1908 and the degree of master of science in 1909 from the same institution. In 1910 he received the degree of master of civil engineering from Cornell University. He was engaged in railway work in the United States and Mexico for seven years and was professor of civil engineering at the Agricultural and Mechanical College of Oklahoma from 1907 to 1910. From 1911 until his recent appointment he was professor of railway engineering at Iowa State College.

ANTON ANDERSON, principal assistant engineer of the Chicago, Indianapolis & Louisville Ry., has been made engineer for the corporation.

A. M. PARKER, division superintendent of the Pennsylvania R.R. at Camden, N. J., and formerly principal assistant engineer, has been transferred to the Philadelphia terminal.

J. H. REDDING, division engineer of the Pennsylvania R.R. at Camden, N. J., has been transferred to Altoona, Penn., and is succeeded by W. E. Brown, division engineer at Elmira, N. Y.

W. J. BERGEN, first assistant to the chief engineer of the New York, Chicago & St. Louis R.R., has been made corporation engineer. Mr. Bergen was born in 1872 and was graduated from Rensselaer Polytechnic Institute in 1897. He entered the employ of the Burlington & Missouri River R.R. in 1899, and became division engineer the next year. A year later he went to the New York, Chicago & St. Louis as assistant engineer. In 1907 he was made chief supervisor of track and later the same year was promoted to the post he now leaves.

MAJ. A. MARSTON, Engineers, U. S. A., formerly dean of the School of Engineering, Iowa State College, is now Lieutenant-Colonel Marston.

A. R. HEBENSTREIT has been appointed city manager of Albuquerque, N. M., succeeding Paul G. Reddington, who has resigned, as mentioned elsewhere in these columns.

C. E. ARNOLD, city engineer of Woodland, Cal., has resigned to become engineer in charge of drainage and irrigation work for the Los Alamitas Sugar Co., the property of which consists of 20,000 acres between Long Beach and Los Angeles.

JAMES W. BEEBE, engineer for the San Joaquin Light & Power Co., with headquarters at Fresno, Cal., has been commissioned as captain in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

CHARLES H. RUST, who recently resigned as city engineer of Vancouver, B. C., as mentioned in *Engineering News-Record* of Aug. 22, p. 380, has become associated with the Toronto Railway and allied Mackenzie interests.

W. S. READ, assistant engineer with the Kansas Public Utilities Commission, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

FRANK LAF. ANDERS, city engineer of Fargo, N. D., has been commissioned as captain in the construction division of the Quartermaster's Department.

THOMAS C. ATWOOD, who for the past year has acted as supervising engineer in charge for the Navy Department of the construction of the Squantum destroyer plant, has been appointed district plant engineer for the third district of the United States Shipping Board, Emergency Fleet Corporation, with headquarters in Baltimore.

RUDOLPH WELCKE, supervising engineer for the Navy Department in charge of construction in the Baltimore district, has been appointed supervising plant engineer for the United States Shipping Board, Emergency Fleet Corporation, and will have charge of construction of dry docks and marine railways along the Atlantic coast.

W. G. MASSENBURG, division engineer of the Gulf, Colorado & Santa Fé Ry. at Beaumont, Tex., has been appointed district engineer of that road, the St. Louis-San Francisco & Texas, and other lines, with headquarters at Galveston.

GEORGE NAUMAN, assistant engineer, Pennsylvania R.R., with headquarters at Oil City, Penn., has been appointed assistant to the chief engineer, with headquarters at Pittsburgh.

C. E. NEWELL, of the valuation department of the Southern Ry., with headquarters at Washington, D. C., has resigned to enter the construction department of the Tennessee Coal, Iron & Railroad Co. at Ensley, Ala.

MAJ. J. P. JACKSON, Engineers, U. S. A., previously dean of the School of Engineering, Pennsylvania State College, has been promoted to the rank of lieutenant-colonel.

GEORGE KENDERDINE and George Patton, transitmen, Pennsylvania R.R., have been appointed assistant engineers, with headquarters at Pittsburgh.

T. EDWARD OLSEN, resident engineer, New Jersey State Highway Commission, with headquarters at Trenton, has been commissioned a first lieutenant in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

COL. T. HUGH BOORMAN, of the British and Canadian Recruiting Mission, who had been engaged in military highway and construction work, has severed his connection with the recruiting mission to establish offices in New York City as a consulting engineer.

H. S. MARSHALL, chief land appraiser of the Chicago, Burlington & Quincy R.R., has been appointed valuation engineer, succeeding W. W. K. Sparrow, whose appointment as chief engineer of the Chicago, Milwaukee & St. Paul corporation has been noted in these columns.

E. J. CLEAVE, division superintendent of the Pennsylvania R.R. at Trenton, N. J., has been appointed terminal manager of the Allegheny region, U. S. Railroad Administration, with headquarters at Philadelphia. He will have jurisdiction over the Philadelphia terminals of the Pennsylvania, Philadelphia & Reading and Baltimore & Ohio Railroads and over the Philadelphia Belt Line in that city. Mr. Cleave has been in the service of the Pennsylvania since 1881. From 1886 to 1889 he was assistant supervisor. For the following eight years he was supervisor. In 1897 he was appointed

division engineer at Williamsport, Penn.; in 1900 he was made principal assistant engineer at Altoona; in 1902 he was promoted to division superintendent at Cresson, Penn., and in 1917 was transferred to Trenton.

L. M. PERKINS, engineer maintenance-of-way of the Northern Pacific Ry., lines west, at Tacoma, Wash., has been made engineer for the corporation, with office at St. Paul. Mr. Perkins' entire service, since his graduation from Dartmouth College in 1903, has been with the Northern Pacific. In 1906 he became assistant engineer of construction and the following year division engineer. In 1910 he was made engineer maintenance-of-way of the eastern lines, and in 1911 transferred to the western lines.

EDWARD J. CLAIR, engineer in the Bureau of Sewers of the Borough of Queens, New York City, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps.

JOHN HEWES, JR., has been appointed division engineer of the Baltimore & Ohio R.R., western lines, at Flora, Ill., succeeding R. E. Chamberlain, who is transferred to a similar post at Chillicothe, Ohio.

H. D. NEWELL, Hermiston, Ore., engineer on the Umatilla irrigation project for the past twelve years, has been transferred to other Government work in the vicinity of Denver. H. M. Shilling, who has been engaged in the work of the Reclamation Service in Montana, succeeds Mr. Newell.

E. R. BREAKER, chief engineer of the San Antonio, Uvalde & Gulf R.R., has been appointed assistant mechanical superintendent.

W. T. MEAD, acting group engineer of the western group of the Presidents' Conference Committee, has been appointed assistant valuation engineer of the Illinois Central R.R., succeeding D. W. Thrower, whose promotion to valuation engineer was noted last week in these columns.

A. F. BATES, acting town engineer of Montclair, N. J., since the resignation of Maj. Christopher Harrison, has been appointed town engineer.

C. A. JENNINGS, manager of the Chicago office of the Wallace & Tiernan Co., and previously superintendent of the Bubbly Creek filtration plant of the Union Stockyards, Chicago, has been commissioned as captain in the Quartermaster Corps and assigned to duty in the construction division of the maintenance and repair branch.

H. N. RODENBAUGH, and not S. S. Roberts as indicated in the organization chart for the United States Railroad Administration in *Engineering News-Record* of Sept. 12, p. 503, is the engineering assistant to the Southern regional director. His title is staff officer—engineering. He was formerly principal assistant engineer in the valuation department of the Southern Ry. Mr. Roberts is a member of the Southern regional organization, reporting to Mr. Rodenbaugh.

OBITUARY

WILLIAM KENT, Montclair, N. J., former dean of the L. C. Smith College of Applied Science, Syracuse University, and associate editor of *Engineering News* for several years previous to 1903, died at Gananoque, Ont., Sept. 18, in his 68th year. After graduation from Central High School, Philadelphia, in 1868, Mr. Kent entered Stevens Institute in 1875, shortly after which

WILLIAM KENT

he assisted Prof. R. A. Churstons on the Government board appointed to test iron and steel and other metals. From that time until 1890 he held many important positions as mechanical engineer and superintendent in various large iron and steel works and boiler manufactories, including the Torsion Balance Scale Co.'s factory, where he developed the torsion balance. From 1895 to 1903 he was associate editor of *Engineering News*, and then for five years was dean of the L. C. Smith College of Applied Science of Syracuse University. Since that time he had practiced as a general consulting engineer. He contributed numerous valuable papers and discussions to the engineering societies in which he held memberships, and to technical journals, and wrote many technical books, among which is Kent's "Mechanical Engineers' Pocket Book," which reached its ninth edition in 1915. He had taken out more than twenty patents on weighing machines, boilers, smokeless furnaces, etc. He was an active member of many engineering societies from 1876, as follows in their order: The American Institute of Mining Engineers (member of the board of managers for two years); American Association for the Advancement of Science (vice-president for one year); Engineers' Society of Western Pennsylvania (treasurer for two years); American Society of Mechanical Engineers (manager three years, vice-president one year); American Society of Heating and Ventilating Engineers (member board of governors, vice-president and president); Society for Promotion of Engineering Education and the Engineers' Club of New York.

MARTIN SCHENCK, formerly state engineer and surveyor of New York, died in Albany Sept. 17, in his 69th year. Mr. Schenck was born at Palatine Bridge, N. Y. He was graduated from the department of engineering in Union College in the class of 1869, and soon after entered the service of the Missouri, Kansas & Texas R.R. in the construction department. After his connection with the M., K. & T. he entered the service of the Union Pacific, and was placed in charge of bridge construction at various points. Returning to the East in 1872 he became employed in contracting and railroad work. From 1874 to 1880 he was engaged in private practice, specializing in hydraulic and power plant engineering. Mr. Schenck was appointed assistant engineer for the improvement of the upper Hudson River under the jurisdiction of the Canal Department in 1883, and remained continuously in the service of that department until 1892, when he was elected state engineer and surveyor, two years later becoming consulting engineer to the State Board of Health. He was again nominated by the Democrats for state engineer and surveyor in 1898, but was defeated.

LIEUT. ARTHUR TREMBLAY of the firm of Cobe, Tremblay & Pearson, civil engineers, Edmonton, Alta., was accidentally killed in London recently while training for the air service. He enlisted in 1915 and saw service in France, where he received a wound which incapacitated him for further land service, after which he enlisted in the air service.

LIEUT. ROBERT B. WOODBURY, Pennsylvania Engineers, was killed in action on the western front Aug. 14. Lieutenant Woodbury had been mentioned in recent dispatches from the front for conspicuous gallantry in action.

WILLIAM WOODBURN, who for a number of years was chairman of the exhibit committee of the New England Water-Works Association, died of pneumonia in Boston, Sept. 9. Mr. Woodburn was New England representative of the Warren Foundry and Machine Company.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Steady, Consistent Driving Need of Liberty Loan

Success Will be Won by Determination of the Committees—New Draft Will Take Away Subscribers

That the ultimate success of the Fourth Liberty Loan will depend upon steady, consistent driving on the part of everyone interested is indicated in a statement by Chairman Green of the Advisory Trades Committee of New York City. Continuing, he points out that success will be attained more by sheer determination on the part of the various committees than through any other circumstance.

The new selective draft will call to the colors thousands of men, especially those between 32 and 36, who are in the prime of their earning capacity, and who, by giving themselves, will not be expected and in a great many cases will not be able to do their part in the necessary subscriptions to make the loan a success. These are probably the reasons that prompted Chairman Green to state that there will be less of the spectacular than heretofore, and the ultimate success will depend on hard driving by all. Mr. Green's committee is planning to work hard to interest every business man in New York City in the loan and to obtain his assistance in reaching the interest of every one of his employees. "In this way," says Mr. Green, "we believe we will leave nothing neglected which might lead to obtaining the influence, however large or slight, of anyone and every one toward making the new loan a tremendous success."

Lumber Industry Gets Priority

The lumber industry is included in the priority list by Labor Priority Bulletin No. 1. It is addressed by Judge E. W. Parker of the priority division of the War Industries Board to the United States Employment Service and all industrial advisers covering the industry. Charles Edgar, director of lumber, War Industries Board, explains that this statement calls the attention of industrial advisers and the district exemption boards to the essential nature of the lumber industry.

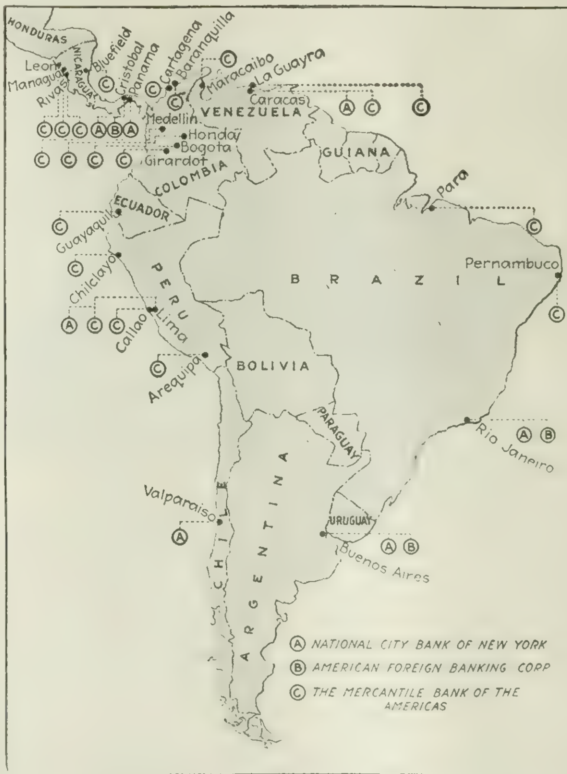
It will be in the hands of district exemption boards, but it will be necessary for each lumber manufacturing plant to present its case before the proper district exemption board (1) by showing the amount of direct Government orders on hand; (2) by showing the amount of indirect Government orders on hand, and (3) by showing the amount of lumber, supplied to others than the Government, which is of primary importance.

Greatest Trade Expansion in History

Increase of $1,000,000,000 in 1918 Shown By Records of Latin-American Commerce

The total trade of the United States with the twenty Latin-American countries for the fiscal year of 1917-18, just closed, shows the unprecedented increase of $1,000,000,000 over that of 1913-14, the last fiscal year before the outbreak of the war. The United States exports to and imports from Latin America reached a total of $1,750,000,000 in the past year, in contrast with $750,000,000 four years ago. The official records prove that nothing equal to this trade expansion has heretofore been known in the history of the world, according to a statement issued by the Pan-American Union at Washington.

In a review emphasizing the present importance of Pan-American commerce, but cautioning against overconfidence, Director General Barrett of the Pan-American Union points out the following figures confirming the statement: United States exports to Latin America grew from approximately $280,000,000 in 1913-14 to $720,000,000 in 1917-18, or 257%, and the imports increased from $470,000,000 to $1,030,000,000 or 214%; the grand total of exports and imports advanced from $750,000,000 to $1,750,000,000, or 235 per cent.



LOCATION OF UNITED STATES BRANCH BANKS

Trade with Chile in the same period jumped from $43,000,000 to $205,000,000, or 375%; Argentina, from $90,000,000 to $305,000,000, or 240%; Cuba, from $200,000,000 to $500,000,000, or 150%; Mexico, from $132,000,000 to

$248,000,000, or 90%; Brazil, from $130,000,000 to $190,000,000, or 46 per cent.

These figures, states the report, emphasize the importance and possibilities of Pan-American commerce, but they must not encourage false hopes as to United States trade of the future. This exceptional growth is due largely, first, to the supplanting by the United States of the trade of the central allies; second, to the caring by the United States for the trade of Great Britain, France, Belgium, Italy, and Holland and other neutrals, for which they, under war conditions, could not provide; third, the heavy war demands of the United States for the raw products of Latin America, and the war demands of the latter for manufactured products of the United States, formerly obtained from Europe.

The closer relations thus forming between the republics of the Americas mark the beginning of the use of a great merchant marine, according to recent statements by Secretary of the Navy Daniels. The recognition of the commercial and other ties and the activities springing up in consequence thereof act as great encouragement to those who have long wished to see closer commercial and friendly ties between these republics, says Mr. Daniels.

The progress that has been made by this merchant marine is illustrated by the construction records, those of August amounting to almost 300,000 gross tons and the total for the year ended Aug. 31, 1918, to almost 2,000,000 gross tons. The problem of the use of this fleet when released from war needs does not bear solely upon the economic use of an available good, but, as recently pointed out by Chairman Hurley of the Shipping Board, as a balancing function during the period of conversion of war-making plants to those of peace industries. Chairman McCormick of the War Trade Board in a recent statement said the merchant marine "means the possibility of free export of American commodities which can be spared under our war program to overseas destinations to help pay for our great war imports for war materials, and to redress the adverse balance of trade running so strongly against us in many foreign countries. Payment for war imports by commodity exports rather than by our limited stock of gold is a war measure of prime importance, and it should not be forgotten that exports of articles to us of nonessential or nonwar character which help us to pay for essential imports may, from a war standpoint, be regarded as essential." Secretary Redfield of the Department of Commerce said: "Great opportunities lie open to us. In South America and elsewhere men seek the credit and the enterprise of which we are now the greatest reservoir. The future of America calls to the present not to neglect it, and opportunity beckons

(Concluded on page 606)

Former Westinghouse Official Now Brigadier General

Guy E. Tripp, formerly chairman of the board of directors, Westinghouse Electric & Manufacturing Company, with headquarters in New York, later colonel United States army and

GENERAL GUY E. TRIPP

head of the production division, has been made brigadier general, United States army, having charge of the production of ordnance material in various sections of the country. The district chiefs will report direct to General Tripp, who is succeeded as head of the production division by Colonel C. C. Jamieson.

Motor Truck Club of America Changes Its Name

The Motor Truck Association of America has found that there has been a good deal of misunderstanding as to its objects and its method of attaining them, due to the word "club" being incorporated in its title, so at a meeting held Aug. 27 it was decided to substitute the word "association" for "club." The change took effect Sept. 19.

Scotland Will Need American Road Machinery After War

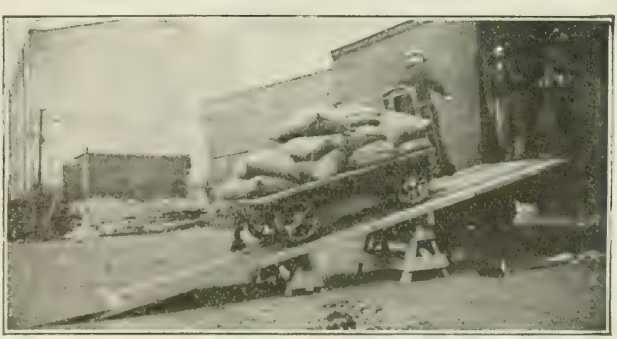
After the war there will probably be a strong demand for road-making machines and tools in Scotland, due to the necessity for an intensive construction campaign in that country, according to Consul Rufus Fleming in recent commerce reports. Mr. Fleming states that "since 1914 roads and streets have been neglected; county and city authorities have economized by letting the highways fall into disrepair, and diverting funds usually granted for their upkeep to other purposes." He further states that as a result of this policy the main roads and by-ways are in such condition that large expenditure for reconstruction of surfaces and for repairing and building bridges, culverts, etc., will be necessary, and adds that the extended use of motor trucks, etc., has caused such deterioration of narrow country roads that a large portion of them will have to be rebuilt.

Aid Extended to Electric Co. by War Industries Board

The War Industries Board has decided to extend aid to the Lorain County Electric Co., Ohio, because of the important War Department and Emergency Fleet Corporation war work which is drawing power from that company. The loan will amount to about $400,000, and the Government will share with the company the war wastage.

Labor-Saving Electric Truck

A labor-saving industrial truck driven by electricity is shown in the accompanying illustration. It is used in industrial plants for the hauling of pig iron, castings or finished machinery parts, and it is said to have released for use in more important work twelve men in one plant who formerly handled hand trucks. The steering mechanism controls both the front and the rear trucks, so that it is possible to manipulate the vehicle through crowded machine shops and storage space. It is manufactured by the Crescent Truck Co., Elizabeth, N. J.



ELECTRIC TRUCK ASCENDING 20% GRADE

South American Trade

(Concluded from page 605)

from many a land with insistent finger. Much that we need is waiting for us."

The Webb bill is entitled "An Act to Promote Foreign Trade, and for Other Purposes" and indicates that Congress is alive to the situation. Even before the passage of this law, non-competing industries had already united their forces for export trade, the Allied Construction Machinery Corporation being an illustration. Since then other combinations have been formed, the most recent of which is the Allied Industrial Corporation, composed of 34 manufacturers whose domestic sales are reported to aggregate $100,000,000 annually. The association reports that agents will be sent to Central and South America, Cuba, Porto Rico, the Dominican Republic, the Philippines and the Straits Settlements, not only for the sale of United States products, but for the encouragement of reciprocal trade activities here, and they state they are paying particular attention to Central and South America. The activities of the South American countries along the same line are illustrated by a number of fairs held in various countries to encourage foreign trade.

The Japanese have shown interest in the trade possibilities in South America, and recent reports state that the Japanese Mail Steamship Co. will shortly inaugurate a regular schedule of sailings touching at Rio de Janeiro, Santos and Buenos Aires. Recent reports also state that the Japanese have opened branch banks there and in other ways are promoting trade with their country.

American Bankers Seize Opportunity

That American bankers realize the opportunity is indicated by the map of South America, on which 23 branch banks are shown on the continent and seven in the immediately adjacent Central American countries. These are representative of three large banking corporations in the United States and are laying the foundation of a system which will furnish the basis for the further expansion and financing of the trade at the close of the war. In addition to the regular banking business, the war is making it possible for commercial paper to be transmitted directly to the United States without going through the hands of London houses, thus eliminating expense, and it is said that additional accommodations and the enlarging of existing exchange arrangements for American business houses are under consideration. It is also stated that the conditions under which banks can be established successfully are today much more favorable for making a beginning than they are likely to be after the war. The Bureau of Foreign and Domestic Commerce has been at work on the South American trade problem for a number of years.

That Brazil is active in foreign trade is indicated by a recently created commercial section of the Brazilian Ministry of Foreign Affairs. It has met with the unanimous approval of the press and commercial associations of the country and is rapidly completing its plans for extensive propaganda work for Brazilian products in foreign markets. Trade opportunities in Brazil include the introduction of pipes and machinery used in sewerage systems, mining machinery, brick-making and rolling mill machinery, and motor trucks. Brick-making machinery is also required in Argentine and Uruguay. The commerce report giving the information also gives the size of the brick, the probable price at which it will be sold, and other information. The commerce reports also give complete information concerning the market for construction materials and machinery in Colombia. The saving derived from the use of motor-driven vehicles, such as trucks, lorries, vans, etc., are becoming so thoroughly realized in Trinidad that the demand is already heavy, and will increase when shipping conditions become better after the war. Lack of railway facilities and the bulky nature of a large portion of the material hauled has created this demand.

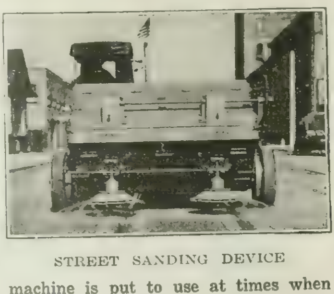
The Bureau of Foreign and Domestic Commerce states that its consular agents hold themselves ready to render all assistance possible to American firms desiring to establish trade relations of any kind, and urges that advantage of the opportunities be taken immediately.

Industrial Machinery Admitted Duty Free to Mexico

A decree excepting all mining and industrial machinery from import duty has recently been published by the Mexican government, according to data received from the American consul general at Mexico City. The decree took effect Sept. 1. Such machinery was formerly dutiable at 0.02 peso per kilo, or 45c. per 100 pounds.

Sanding Device on Street Sweeper Reduces Idleness

By the use of a sanding device attached to a street-sweeping machine, converting it into a street sander, the



STREET SANDING DEVICE

machine is put to use at times when it would otherwise stand idle. The improvement was developed by Peter J. Owen, superintendent of the street cleaning department, San Francisco.

The sweeper as supplied by the factory sprays, sweeps and collects simultaneously, but is not in such use in the foggy and stormy seasons as it is in summer, so that Mr. Owen's improvement, converting the equipment into a street sander, enlarges its use. The attachment consists of a pair of twin spreaders geared to be run at two speeds. This can be attached to the machine in place on the trap door at the front or the back. The change from sweeping machine to sanding machine and vice versa takes less than an hour. The sweeper is an Elgin motor street-sweeping machine.

War Work Shutting Off Road Construction in Northwest

Government disapproval of extensive expenditures for road work has induced a number of counties in the Northwest to issue orders suspending all highway improvement, except where it is imperatively needed to keep the roads passable. Douglas County, Oregon, has suspended all highway work, and of the $85,000 left in the treasury for road work has voted to invest $50,000 in the Fourth Liberty Loan bonds. Work on the Scenic Highway in Snohomish and Chelan Counties has been stopped. This contract totalled $50,000. Road and street work in Yakima County amounting to more than $300,000 will be discontinued.

Business Notes

The Continental Pipe & Mfg. Co., Portland, Seattle and Tacoma, has received further orders from the Government for 230,000 feet of machine-banded wood-stave pipe, varying in size from 6 to 8 in. in diameter. The order will require more than 1,000,000 pounds of wire and 500,000 feet of lumber. The three large plants of the company have previously furnished pipe, on Government orders, amounting to more than 625 carloads.

The Jeffrey Mfg. Co., makers of coal-mining machinery, electric locomotives, etc., announce that they have reopened their Cleveland branch office at 437 Leader-News Bldg. The office will be in charge of P. C. Dierdorff and C. B. Reed.

The United States Spruce Corporation, Vancouver, Wash., has been organized for the purpose of handling the spruce airplane stock production in the Northwest. It is headed by Col. Brice P. Disque, commander of the spruce division. The corporation has a capital stock of $10,000,000 and the incorporators are John Morley, Prescott W. Cookingham and John P. Murphy Colonial Disque heads the board of directors. The company is empowered to engage in a general logging business and operate mills and railroads.

Engineering News-Record

October 3, 1918

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, OCTOBER 3, 1918 — Number 14

The Colleges Respond

PLAYING their part in the people's war, some 500 American colleges, with perhaps 150,000 students, were simultaneously turned into army training camps on Oct. 1. Engineers will be more fortunate, in a strictly educational sense, than most of the other students, because aside from the military drill, required of all alike, they will devote themselves chiefly to engineering studies during the three, six or nine months or longer period before they enter upon full military training or active service. Intensive training in various industrial specialties, such as has been given of late at many engineering schools, will be continued. The reaction on students and instructors, both in technical and other courses, will be watched with great interest. This great experiment may have a profound permanent effect on college education. The main thing today is that the colleges have responded to the call of freedom.

The People's Money For the People's War

TRUER and more significant words were never spoken than those of President Wilson on Sept. 27 when he declared that this war "has become a people's war." Whatever it may have been at the start it is now a war "of the people, by the people, for the people." We have entered upon a campaign for our Fourth Liberty Loan. The people's money is needed for the people's war. For previous loans we have subscribed more than $12,000,000,000 of our savings. We are now asked for $6,000,000,000 more. Again we will oversubscribe. Let no one think that money alone will win the war. Blood is the sacrifice required. But money will lessen the blood which must inevitably be shed. It will hasten "the final triumph of justice and fair dealing" awaited by a world that will accept nothing less.

Allocating Railway Value to States

ONE problem not encountered by the Interstate Commerce Commission in its first final valuation, because the Texas Midland R.R. is all in one state, is that of distribution of property between states. The commission indicates in the Texas Midland report, however, that it will follow the simple course of crediting fixed property to the state where it is found, and listing equipment in one item as unassignable. Much more troublesome the commission finds the suggestion that the value of important structures ought to be distributed to states other than those in which the structures themselves are situated. To illustrate, it concedes that the Pennsylvania's New York terminal benefits the lines west of Pitsburgh. "When, however, any basis for such distribution is sought," says the commission, "the impossible nature of the problem of distribution appears, and above all the express language of the act seems to forbid. This station is in the State of New York and should be so reported." Which means that if occasion demands an equitable determination of value by states some other agency than the Interstate Commerce Commission will have to guess how to make it.

Influenza Must Be Stamped Out

APPROPRIATION by Congress of $1,000,000 to enable the U. S. Public Health Service to help combat influenza indicates how serious the present epidemic may become if it is not speedily put down. Engineers and contractors responsible for groups of men, large or small, should inform themselves immediately as to both precautionary and combative measures—which they can readily do by appealing to their local or state health authorities or to the U. S. Public Health Service. In some localities engineers may need to inquire whether their local health authorities are alive to the situation. At this crucial moment our armies and our war industries must not be crippled through any lack of ordinary, or if need be extraordinary, health precautions. A duty rests on each individual; as to himself, his immediate associates and his community.

Committee on Yards and Terminals Again on the Job

NO COMMITTEE of the American Railway Engineering Association has shown a keener perception of the needs of the present war emergency than the yards and terminals committee. Last March it issued a report and catechism aimed to point the way to improving the operation of existing yards by minor physical changes and by improvement in operating methods, in the absence of time or opportunity for extensive construction and reconstruction of yards. Since then the true import of the possibilities of unified operation has come to be felt. Unified operation naturally begins at the large city terminals. So the yards and terminals committee has produced a special report on terminal unification, and a second catechism. The catechism and other parts of the report are printed on p. 615. The committee deserves warm commendation for being again—or still—on the job.

Also the Minor Railroad Officers

DIRECTOR GENERAL McADOO well says, in his report to the President on the first seven months of Government operation of the railroads, that "the salaries paid to the higher railway officers should be commensurate with those of private enterprise and industry"; and he has lived up to the theory by retaining to direct this $20,000,000,000 worth of property a pay roll only $4,000,000 less, despite the ousting of some 400 presidents, than prevailed under private control—a pay roll that includes salaries far higher than his own or those of any other Government official except the President himself. But he could well turn his attention to the lower officers. It is a common saying that the fighting quality of an army depends on its sergeants. What would be thought of a scheme of army pay in which sergeants were paid less than the privates they commanded? In the army of railway workers, however, it is not at all uncommon for foremen and superintendents and educated technical workers to receive lower pay than some of the workmen under them. Whether the railways are operated after the war by the Government or are returned to the companies, the efficiency of their operation will depend very largely on the character of the few thousand minor officers. To pay these men inadequate salaries will in the long run inevitably mean that the places will be filled with incompetent men, and the public will be the chief sufferer.

Wanted—A Connected National Highway System

A CONNECTED workable plan of highways for the United States does not exist. This will be apparent to anyone who will examine a map showing the various Federal-aid projects approved in the past few years. The condition is not the fault of the engineers who have supervision of the Government work, but of the law which puts the chief function of selection upon the political division of the country to which the aid is to be given. This has resulted in an indicated system of such proportions that it is estimated that it would take upward of 150 years at the present rate of building to bring it up to a unit. The states have highway departments. Why not a United States highway department? The states have highway systems. Why not a Federal highway system? At the least, Congress might well provide for a careful engineering study of the national aspects of the highway problem as an aid to making ready for the great reconstruction period to come when the war closes.

Is This Disguised Enemy Propaganda?

THERE are many ways to impede the successful prosecution of the war. Fortunately, most of them are now punishable by law, but one remains which may be practiced with impunity. That is the sneering reference to the "bomb-proof" jobs at Washington. Started by certain Congressmen jealous at their growing loss of importance at the capital, this habit has spread in conversation and press until it assumes the importance of enemy propaganda, so serious has been its effect on the morale of the thousands of loyal and hard-working Americans giving freely of their time and money—for few at Washington in war work can live within their income there—at what is in effect the Great Headquarters of the American cause. Many of these men are engineers, for whom this journal feels competent to speak. The importance of their work at Washington should require no argument; the serious necessity for most of those there is obvious to any one at all conversant with the innumerable details of war. Finally, if those who are there were granted their dearest wish, which is to join that army for which they are all working, their places would have to be filled with others whom the same slanders would attack. After the war these men will not share the glory that will attach to every one who has seen service in France. Can they not now be accorded the respect which should be the due of every man who serves his country according to his country's needs?

The Task Confronting the Contractors

UP TO THE present time no considerable proportion of influential contractors has ever been interested in the formation of a national organization to look after their especial needs. This in spite of the wonderful demonstrations of the possibilities of such an organization afforded by a number of strikingly successful local associations of general contractors. Though the contractor is the sole employer of construction labor, he has permitted labor to become nationally organized without even considering the necessity for nationally organizing himself to treat intelligently with labor. Though the contractor is the sole buyer of construction materials and construction equipment, the manufacturers of every sort and kind of material and equipment have long been nationally organized and have led the progress and shaped the developments in the construction field, while the contractors have sat idly by.

It took the upheaval of war conditions to force home to contractors the truth that nobody can be expected to look out for their national interests except themselves. Contractors in Omaha and Atlanta, Albany and San Diego, began to find themselves in exactly similar troubles, which were beyond remedy through local influences on which they had been wont to rely, and to which existing national organizations or those connected with building and construction were indifferent, not being directly affected. It became increasingly evident that the contractors needed a national organization of their own, and that the work would be cut out for such an organization from the start.

There is no need to review the difficulties confronting contractors, nor to point out again their solution. The difficulties are only too well known, and the way out is to be found by hard work along the lines laid down by the Committee on Organization of the new National Association of General Contractors, reported on page 619.

It remains to be seen, however, whether the contracting fraternity of this country will make this association the universally supported, progressive force that it ought to be in the construction field. Will the greed of large firms who feel themselves so strong as to be independent of the rest of the world prevent their

supporting the movement? Will the localized interests of the average general contractor continue to blind him to the national aspects of his own business, and prevent his joining the movement in sufficient numbers to insure immediate success?

We think not. Scarcely a contractor but has had borne in upon him during the past few months that forces beyond his control are having a disastrous effect on his business. What more natural than that contractors should welcome an organized effort to deal with these forces nationally and to interpret them through a national organization to the individual? The enthusiasm and determination of the contractors brought together at Atlantic City and in the meetings of the executive committee on organization there formed are a further guarantee of success to the new organization. Fully awake both to the dangers and the possibilities of the situation, and determined to make the most for the industry and for their own business of the situation, these men will leave no stone unturned to inspire the contractors in their territory to action. The determination and enthusiasm manifested at the meeting in New York is of the sort that does not stop short of the accomplishment of its object. The movement will succeed, to the everlasting benefit of the construction business in this country.

Land Reclamation and Reconstruction

THIRTY years ago, on Oct. 2, 1888, the Congressional act which made possible the irrigation survey organized by Major John W. Powell was signed by President Cleveland. That survey, as carried out by Major Powell and his successor at the head of the Geological Survey, Charles D. Walcott, prepared the way for the creation of the U. S. Reclamation Service under President Roosevelt. The service has since built many dams, some record breaking, great networks of canals, and thousands of major and minor structures, all of which together have made possible the irrigation of vast areas of otherwise arid lands, provided homes for thousands and contributed largely to the food supply of the world.

The Powell irrigation survey, the later and still continuing hydrographic surveys, the extensive and intensive investigations of the Reclamation Service associated with various irrigation projects have given Congress and the country at large some conception of the water resources of the country and the vast regions awaiting conversion from aridity to fertility.

Great as have been these accomplishments, the land reclaimed is only a small part of what is available for reclamation—by further irrigation, by drainage and by clearing cut-over land. What these areas are and what the reclamation of only a portion of them would mean in the way of providing work and homes for returning soldiers was set forth by Arthur P. Davis, chief engineer and director of the U. S. Reclamation Service, in our issue of Aug. 22, 1918, p. 361. These possibilities have repeatedly been laid before the public in the spoken and written words of Secretary Lane.

Responding in part to Secretary Lane's pleas for ample funds with which to conduct further reclamation surveys, Congress has made available $100,000 for drainage and cut-over land investigations. An equal sum is also available for further irrigation studies. While more was needed, these sums have made it possible to start investigations under the able district leadership of F. E. Weymouth, F. W. Hanna and H. T. Cory, with the counsel of Prof. Elwood Mead and the direction of Mr. Davis, as announced in our issue of Sept. 5, p. 469. Accessions to the staff are given on p. 645 of this issue.

Knowledge of these studies will give heart to many in our armies. Engineers in the service may look forward to useful employment on these investigations and on the construction of irrigation and drainage works and the clearing of stump lands by modern methods which it is hoped will follow speedily the preliminary investigations.

The act of Oct. 2, 1888, made possible the beginning of the realization of the great visions of land reclamation which Major Powell saw so clearly and constantly notwithstanding a public indifference that would have meant blinding discouragement to other men. The Newlands Act and its consequences carried the realization forward under the engineering direction of Newell and Davis and with the aid of scores of able engineers. Another great reclamation survey has been initiated, but it needs further congressional support and should be heartily backed by engineers and the public. The Cleveland administration initiated investigations for land reclamation on a large scale. The Roosevelt administration started the work and gave it a mighty push forward. Yet little more than a good start has been made. The need for progress is greater now than ever before. The Wilson administration should hasten with a comprehensive reconstruction program, in which land reclamation will play the large part already proposed by Secretary Lane.

Necessity Teaches Proper Use of Irrigation Water

RESTRICTED allotments of irrigation water have taught the water users on the Orland Project of the United States Reclamation Service in California that small amounts of water well used are just as effective as deluging quantities which eventually may bring on exasperating drainage problems. The restriction the past summer was due to shortage of water, but the farmers may congratulate themselves on having been assured of a supply that was sufficient if used carefully. Engineering foresight in providing a diversion canal over a divide from an adjoining watershed saved the situation. The energy spent by the service in educating the irrigator in normal times to level his lands, to keep the ditches clean and to apply the water properly, produced its beneficial results. In sharp contrast to this was the burnt-up condition of many farms in the semi-irrigated Canadian Northwest districts. Several years of plentiful supply have made the farmers indifferent to the necessity of maintaining their ditches and land in proper condition for irrigation, so that what little water was available this year could not be used to the best advantage. With wheat at present prices it is apparent that an engineer's study of rainfall and runoff are a vital factor in the successful operation of an irrigation district.

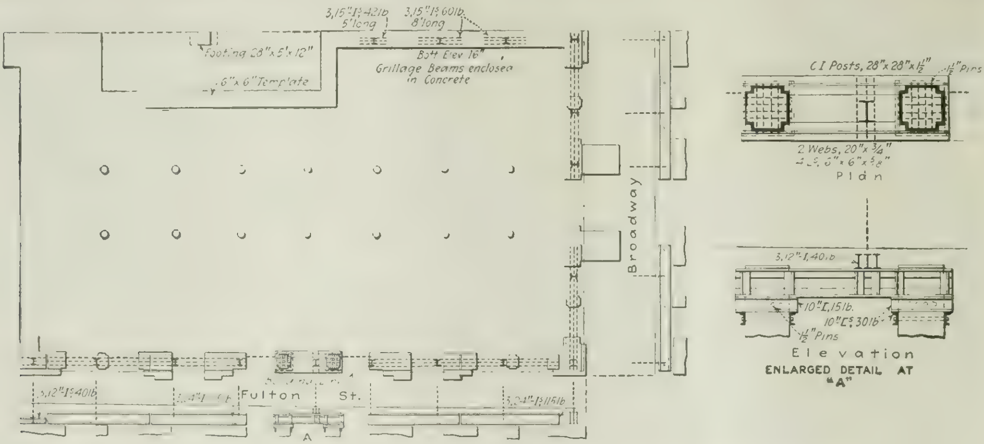
Altering Old Office Building Requires Heavy Underpinning

Brick Arch Floor 60 by 100 Feet in Area Raised Three Feet in Two Sections—Thick First-Story Brick Bearing Wall Replaced by Steel Framing

EXTENSIVE alterations in the office building at the southeast corner of Broadway and Fulton St., New York City, formerly occupied by the New York *Evening Post*, involved some very difficult underpinning and shoring operations, which had to be carried on while practically all of the tenants remained in the building and in spite of the fact that an adjacent busy subway station prevented the use of obviously simpler methods. The structure was formerly a ten-story office building with basement and sub-basement, both extending out to the curb on both streets. It had brick bearing walls with interior cast-iron columns carrying brick arch floors on iron floor-beams. Alteration involved the raising of the second floor 3 ft. so as to permit of street-level entrance to the first story, the removal of the thick brick street walls in the two lower stories and the substitution of glass on both streets for these walls, and the cutting off of 2 ft. of the 2 ft. 8-in. brick bearing wall on the south party line on the store floor, so as to provide additional rental store floor area.

In addition to these major operations, several minor changes were bothersome. These consisted of raising the store floor about 1½ ft. merely by placing framing of that height on the old floor; removal of the brick walls of the two topmost stories and the substitution therefor of small piers; removing the two former hydraulic elevators and extending the new electrical elevators to a penthouse above the roof; strengthening the roof to carry a possible future story, and providing necessary steel at the ninth story level in order that brick walls between the third and ninth stories could at some future time be removed without interfering with the tenants of the first, second, ninth and tenth floors. These changes were all made at the same time as the major operations, but will not be described here in detail.

Raising the second floor 3 ft., in order to provide sufficient story clearance in the first floor, involved the elevation in two sections of a floor 60 x 100 ft. The old floor consisted of 12-in. wrought-iron I-beams spaced about 4½ ft. on centers, and the floor proper, of 4-in. brick segmental arches with a rise of about 10 in. carrying a cinder fill and wood sleepers and floors. The floor-beams were supported by all the walls on the outside and by two rows of longitudinal girders resting on a row of cast-iron columns near the middle of the building. These columns had curious joints at the floor level. Instead of the base of one column resting on the other, a boxlike casting, shown in one of the drawings, was introduced between the cap and the base, and the end of the girder passed through and was supported on these boxes or pintles. To raise the floor-beams and girders 3 ft. meant that the boxes would be unbraced in all directions, which would introduce a dangerous condition. To overcome this the pintles were concreted to make solid connections.



GRILLAGE PLAN IN NEW YORK OFFICE BUILDING WHICH HAD TO BE UNDERPINNED

Steel-angle frames were first bolted to the columns about 12 in. above and below the pintle. Heavy corner angles connected the frames, and the box corners were wedged tightly against the angles. The entire box was then thoroughly braced and was filled with concrete. Slots were then cut in the side walls to the proper height, and ample shores and jacks were placed underneath, on the first-story beams. The second-story girders were then cut off with acetylene torches close to the steel-column box braces and, the columns being interbraced thoroughly with wood struts, the floor was raised by jacking to its proper level. Brackets were then attached to the column box braces to support the girders at their new level, and all the shoring was removed.

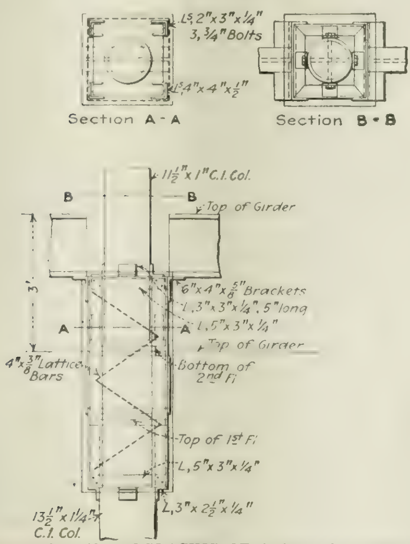
There were no tie-rods between the floor-beams but this difficulty was overcome by cabling together with

BROADWAY FRONT OF OLD EVENING POST BUILDING SHORED UP WITH STRADDLING STRUTS

steel-wire cables about twelve of the floor arches. In order to avoid leaving all the walls unbraced for a height of about 30 ft., only one-half of the floor was raised at a time. The remaining half was raised after the first operation was completed. This part of the work was considered so dangerous by the building authorities that they required about three weeks in the jacking operation on the first half of the floor. This turned out so well, however, that the second half was raised in eight hours.

The floor was raised, instead of being taken out and replaced, because this permitted the owner to use the floor for the same loading as that for which it had been authorized before. If a new floor had been put in the building code would have required a heavier and more expensive floor system.

The removal of the front brick bearing walls on the first and second stories offered a serious problem, because conditions prevented the usual shoring methods. The basement and sub-basement, including vaults, were occupied on Fulton St. by a printing firm which would



BRACING AND REPLACING OF CAST-IRON PINTLE AT TOP OF COLUMNS

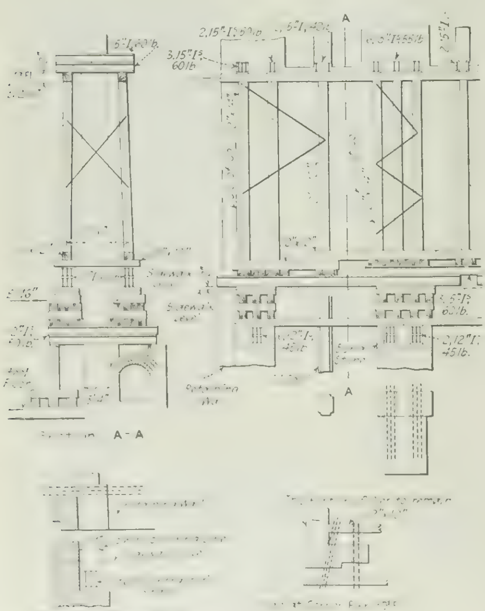
FULTON STREET FRONT, SHOWING EXTENSION SUPPORTING BEAM AT CORNER

not permit any work being done near the presses. The Broadway sidewalk vault space to the curb was partly occupied by the same tenant and partly by the Fulton St.-Broadway subway station. It was thus impossible to carry the shores vertically on either street down to bearing on the ground. Instead, therefore, the brick wall (about 25 tons per linear foot) was carried on two sets of shores, straddling the wall to be removed and resting on needles protruding on either side of the brick base piers, which they pierced. New steel framing was then put in to rest on grillages bearing on the brick piers.

The drawings show the details of this shoring framing. Holes were first cut in the old piers just below the proposed new grillage level under the sidewalk and above the top grillage which would have to support the brickwork above the second story. Through these holes horizontal steel I-beam needles were placed. Longitudinal needles parallel to the walls of the building were then carried on blocking built up on the ends of the lower cantilever needles. On the top of the longitudinal beams vertical shores were placed and wedged in between the top and bottom cantilever needles running through the wall. In this manner a rigid rectangular frame was formed in a plane at right angles to the wall, extending inside and outside of the building. This permitted all of the brickwork to be taken out quickly and the new grillage and steel columns to be set in place without any difficulty.

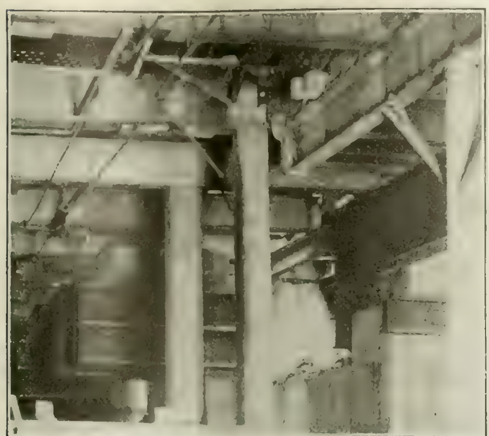
The work on the Broadway front was completed first. In order to avoid interference of any kind with the subway stairway on the Fulton St. corner the vertical shore at that point was placed at an angle so that the bottom of the shore was wedged against the lower end of the new steel column and the upper end against a projection of the steel girder lintel at the ceiling of the second-floor level. This projection was made for temporary use to aid in the shoring and carried the end of a set of longitudinal needles, as shown in one of the views. These needles supported small cross-beam needles upon which two of the intermediate brick piers rested. After all the permanent steel was in place at this corner the temporary 24-in. I-beam which projected 5 ft. into Fulton St. was cut off with a blowpipe.

CAST-IRON PINTLES COVERED WITH CONCRETE AND BRICK ARCH FLOOR RAISED



DETAILS OF SHORING TO SUPPORT BUILDING DURING ALTERATIONS

Other difficulties were met in taking care of two 32-in. square hollow cast-iron columns in the basement, shown in one of the drawings. These columns had to be reinforced to carry the additional load resulting from the elimination of two of the old brick piers. Two heavy-web channels were placed on opposite sides of the sub-basement columns, and clamped tight to the box column by through bolts passing clear through the boxes. The ends of these channels extended out about 4 in. beyond the column on each side and supported on top of these channels and attached to the other two sides of the columns by similar bolts were two more channels. These acted as brackets for the support of two heavy girders which ran across the two sub-basement columns. These girders were utilized to support the shoring of the street columns. Before the final weight of the street columns was placed on the girders the sub-basement columns were filled solidly with concrete up to within a few inches of the pins supporting the channel, and from



AT RIGHT ARE CHANNELS CLAMPED TO OLD COLUMN TO SUPPORT SHORING; AT LEFT MAIN SHORING GIRDERS THROUGH BRICK COLUMN

this point to the sidewalk level with a rich mixture of grout. Any movement of the supports was prevented by bracing the construction to the adjacent piers and connecting the steelwork thoroughly to the first-story floorbeams. A view of one of these columns while under reconstruction is shown in one of the photographs reproduced herewith.

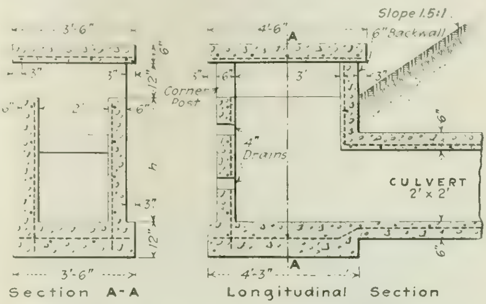
In cutting off 2 ft. of the 2 ft. 8-in. south brick bearing wall at the store level the loads on this 10-story wall were transferred to new steel columns practically without any shoring and without interfering with the adjoining building or the tenants of the basement or upper floors. This stretch of wall, about fifty feet long, was carried by three new steel columns. Vertical and horizontal slots were cut into the brick wall, of just sufficient size to make room for the new grillage and the column. After these were set in place the walls were temporarily wedged up against the steel work. At alternate spaces between the columns horizontal slots were then cut at the ceiling of the store floor of sufficient size to permit the I-beam girders to be shifted into place for bearing on the tops of the new columns. The brick wall was then wedged on the new girder, after which 2 ft. of the 2 ft. 8-in. brick wall below the girder to the store floor level was cut out. This method resulted in considerable saving in time and cost for construction, and avoided possible claim of damage to adjoining property, which might have resulted if the total removal of the wall with the underpinning had been adopted instead.

The estimates received by the owner, based upon the plan of using the methods of shoring which contemplated interference with the adjoining building and carrying all shores to the basement, amounted to about twice the estimate on the scheme used, not counting the saving to the owner due to the elimination of interference with the tenants. The owner of the building is the Broadway-John St. Corporation; Deutsch & Polis, architects and engineers, 50 Church St., New York, designed and carried out the reconstruction and Drew Bros., New York, were the shoring contractors.

Road Culvert Checks Destructive Storm-Water Flow

New Design Prevents Erosion of Ditches and Farm Lands, Guards Against Washouts and Fills Gullies by Silting

PREVENTION of erosion of roadside ditches by storm-water, protection of roads and reclamation of waste land by the filling of wide and deep ditches, are the purposes of a concrete drop-inlet culvert now being used in Iowa. In some places heavy rains wash



ROAD CULVERT DESIGN WHICH PREVENTS EROSION

gullies in the land and enlarge the road ditches until they encroach upon the road and the adjacent farm land. At small bridges and culverts especially, the rush of water may cut away the slopes and narrow the road to a dangerous extent.

To check the velocity of the storm water, the standard culvert of the State Highway Department is made with a vertical intake shaft at its upper end. In times of storm, this causes a pool to form in which sediment will

DROP INLET PREVENTS RUSH OF WATER FROM THIS CULVERT AND CONSEQUENT EROSION

be deposited and the ditch gradually filled. The culvert is extended usually so that its inlet is near the fence or the right-of-way line. Farmers have sometimes paid the additional cost of extending it inside the fence line to prevent further cutting of the land and to cause the filling of gullies and washes which prevent cultivation of the land.

Construction of the drop-inlet culvert is shown in the drawing. Small drains at different elevations in the sides or end wall allow the water to drain off and thus prevent the formation of a stagnant pool, while the lower part of the ditch is silting up. In many cases the ditch has been filled to the top of the inlet shaft in one year. The fill for the road should be well tamped around the barrel of the culvert, and its top should be at least 3 ft. higher than the inlet, thus keeping the subgrade well above high-water mark.

The shaft is made the same width as the culvert, but in order to provide ample capacity, its length is made 12 in. greater than the width. Thus, on a culvert

CULVERT EXTENDED TO FENCE LINE TO FILL DEEP DITCH AND STRAIGHTEN ROAD

2 x 2 ft. the shaft will be 2 x 3 ft. As a rule, the shaft is built with its spillway 4 ft. below the grade of the road, and its face 6 ft. from the shoulder of the road, giving the fill a 1 on 1½ slope. A concrete slab covers the top, being supported by the outer corners and back wall which are carried 12 in. above the spillway for this purpose. Thus there are three inlet openings, the combined area of which is about 50% greater than that of the barrel of the culvert.

Access to the culvert for cleaning is provided by making the cover removable, but in no case has such work been found necessary. The cover is held in position by four 2-in. dowels at the corners of the shaft. As the concrete slab is poured in place, the dowels and the tops of the posts and back wall are covered with tarred felt to prevent bonding.

The beneficial results of this type of culvert are shown in the views which portray the inlet and discharge ends of a culvert 2 x 2 ft., 75 ft. long. This is in a high fill and replaces an old wood truss bridge. A vertical drop of 10 ft. 9 in. is given by the inlet shaft and the slope of the culvert gives a fall of 3½ ft. In less than a year the ditch on the upper side of the road had filled to the spillway, and it is stated that the

GULLY AT CULVERT INLET FILLED IN ONE YEAR

inlet could be raised to increase the drop to 20 ft. with benefit to the road and the adjacent land. In one view the wide ditch and caving land can be seen. In future the culvert will discharge only a steady, quiet stream, instead of one that is rushing and destructive. In another view, erosion has widened the ditch until the road is out of line and is still being attacked on its upper side, while piling driven for its protection has been undermined. With the drop-inlet culvert, this will be overcome by silting.

Culverts of the same general type, sometimes with pipe inlets, have been used before, in Iowa and elsewhere. This concrete drop inlet for culverts is the design of E. B. Hiatt, county engineer, Winterset, Iowa, who has already built a number of such structures with successful results.

Plans for Land Reclamation in Oregon

Plans for land reclamation to provide employment for munition workers, shipbuilders, returning soldiers in the reconstruction period, are urged by John H. Lewis, state engineer, Salem, Ore. A total of 1,183,000 acres in land is embraced in Oregon drainage and irrigation projects. Of this acreage 583,000 are in irrigation projects for which plans have been prepared by the state or Federal government, and 200,000 acres are in irrigation districts organized or in process of organization under the state irrigation district law. Mr. Lewis believes that the actual reclamation work should be done by private capital.

Urges Study of Unit Operation of Railroad Terminals in Large Cities

Yards and Terminals Committee, Railway Engineering Association, Presents Catechism, Recommends Investigation by Representative Committees of Possibilities of Coördinating Existing Facilities

PURSUING further its policy of attacking the emergency needs of the railroads, the yards and terminals committee of the American Railway Engineering Association in a special report now urges study of the possibilities of unit operation of railroad terminals in large cities. A statement of fundamental principles of unification of terminals and a recommendation for the appointment of representative committees to study the problems of each city is followed by a catechism which the committee believes "will suggest changes that will be fruitful of good results in any unification where local conditions are favorable." Appended to the report is an abstract of the address on unified operation of terminals made by John F. Wallace last April to the convention of the Chamber of Commerce of the United States (see *Engineering News-Record* of Apr. 18, p. 779), and papers on phases of the subject by H. J. Pfeifer, chief engineer of the St. Louis-East St. Louis terminal district, and E. H. Lee, vice-president of the Chicago & Western Indiana R.R. Company.

Fundamental Principles

Under the unification of terminals, states the report, are the following fundamental principles, which must be understood and applied:

1. A terminal is a clearing point and not a storage point for cars.

2. Each and every facility within the unified terminal limits must be considered absolutely a part of the whole plant. The word "facility," as used, includes "man power."

3. The use of each individual part must be coördinated with a view to its effect upon the best use of the plant as a whole.

4. Each individual operating organization must be coordinated and directed under one head.

The full application of these principles should give the most economical operation of the plant—by accomplishing the most expeditious and efficient movement of cars; by avoiding duplications, as in switching, clerical and other work, and of facilities; and by employing man power as well as physical facilities and mechanical power to capacity, where and when necessary.

As prerequisites to terminal unification, the following information should be obtained and analyzed:

1. A situation or key map on a small scale showing or indicating: (a) The entering lines; (b) the terminal facilities of each line; (c) the interchange connections and junction points of the lines in the district to be unified; (d) the location and capacity of yards; engine terminals, including coaling and water stations, cinder pits, sand houses and engine parking tracks; freight houses, transfer platforms and team tracks; (e) the location and track capacity of large industries and private warehouses.

2. Larger scale maps, indicating the facilities of each road, in sufficient detail, for critical study.

3. Topographical maps of the territory, where necessary.

4. Record of traffic handled by each line, divided: (a) As to local or through, as referred to the district; (b) as to prevailing and possible routing; and (c) as to preponderance of direction of tonnage due to commodities and seasons.

5. Outline of present method of operation, considering: (a) General movement; (b) transfer or interchange movement, and (c) use of individual facilities, yards, engine facilities, freight houses, etc.

It is the thought that the investigation of and recommendation for any terminal unification should be made by a representative committee composed of representatives of all departments—transportation, engineering, mechanical and traffic officials, including, where complex situations are involved, at least two members from other locations than the terminal under study.

Catechism on Unit Operation of Terminals

In the operation of the unified terminal facilities, the load should be distributed evenly among all units so as to secure their constant normal use at the most intense efficient rate, coupled with avoidance of any excess peak load on any unit, treating both the individual carrier's terminal and the unified terminal always as a part of the railroads as a whole.

Certain captions under which improved conditions may be obtained by unification have been selected and, while constantly bearing in mind the fundamental principles first enumerated, questions are asked under each caption which will suggest changes that will be fruitful of good results in any unification where local conditions are favorable.

Interchange

1. Are you now handling maximum number of cars by the most economical or direct route, either existing or reasonably attainable?

2. Can the number of interchange movements be reduced advantageously by combining movements from various origins to various destinations?

3. Can you extend the practice of reciprocal interchange now working so advantageously at many points?

4. Are you interchanging directly between yards instead of on assigned interchange tracks? Could not delay and rehandling be reduced by so doing?

5. Are you, as far as practicable, making interchange with regular crews familiar with the routes and the work to be done?

6. Can volume of direct interchange be increased by minor track changes or changes in practice?

7. Are interchange facilities at any point inadequate for periods of heavy traffic under new conditions, and, if so, is it practicable at reasonable cost to make necessary increase of capacity, or is it better by rerouting interchange to relieve the situation?

8. Have you any separate route of interchange that could be discontinued to advantage by consolidation with another route?

9. Can you have cars grouped, either in cuts or solid trains, before they reach the terminal, so as to reduce terminal switching?

10. Can interchange in any terminal be reduced to advantage by rerouting through outside junctions?

Consolidation of Industry and Team-Track Switching

11. Have all industrial plants sufficient track capacity and other facilities so that cars may be promptly placed, loaded or unloaded to the full capacity of the plant during each working shift without unduly frequent switching or interference with plant operation?

12. Can you arrange for "one line" switching of individual or grouped industries or team tracks?

Consolidation of Yards

13. Can greater efficiency in yard operation be obtained through the consolidation of the yards of one or more railroads:

(a) By dividing large terminals into zones and assigning as great a number of receiving yards to as small a number of classifying yards as possible, thereby assembling the maximum number of cars into the minimum number of classifications?

(b) By pooling similar yards of neighboring railroads so as to conserve yard room, avoiding both the duplication of switching and interchange between yards?

(c) By consolidating existing facilities, adapting such combined facilities to a new program of operations which disregards prior uses, with or without minor physical changes; or by pooling the same in the sense that one line's facilities are used to serve the overflow of traffic confronting a neighboring line's facilities?

(d) By combining the use of two or more yards to adapt them to the segregation of freight with respect to commodities or destinations?

Consolidation of Engine-Terminal Facilities

14. Can you re-assign or coördinate the use of engine-terminal facilities so as to avoid or reduce delay and congestion, reduce expense and engine miles, or improve supervision?

15. To what extent can neighboring engine-terminal facilities be adapted to the economical housing and handling of engines grouped according to the nature or location of their service or their size without regard to road ownership?

Consolidation of Car Inspection

16. Has "single inspection" been instituted wherever cars are interchanged?

17. Can greater efficiency be obtained by consolidating the car inspection forces at adjacent yards, junctions or stations?

18. Are car inspections and repairs so made as to insure safety and prevent further damage to equipment and lading?

19. Is such inspection made so as fully to detect violations of loading rules, and are these rules effectively enforced in every case of such violation?

20. Has the force of inspectors been *educated* to the making of effective inspection, and is the inspection followed unremittingly by the making of adequate repairs?

Consolidation of Car-Repair Work

21. Can you obtain greater efficiency through extending consolidation of car-repair forces and facilities: (a) By combining in one repair yard the work of one or more roads? (b) By combining the forces and facilities in a given zone?

22. Do you require car inspectors at outlying points to repair cars as far as possible and to make light repairs to cars in industrial districts where cars are "made empty" or placed empty for loading?

23. Are you keeping maximum number of cars in service by giving preferred attention to those needing light repairs?

Consolidation of Car Records

24. Can the number of records and incidentally the amount of clerical work be reduced:

(a) By the consolidation of car-record departments?

(b) By the consolidation of car-record forces in yards reasonably near, one to the other, whether these yards are combined or not?

(c) By the elimination of certain intermediate car records on each road through a more comprehensive and manifold use of train and yard reports so as to supply the greatest amount of information from each report?

Consolidation of Freight-House Facilities

25. Can the freight houses of two or more lines be so combined that certain houses may be used for inbound and others for outbound business?

26. Can the use of a freight house be discontinued, transferring its business to another or to a combination of other freight houses?

27. Can certain freight houses be assigned to designated commodities (perishable or non-perishable)?

Transfer of Freight Between Freight Houses

28. Are you preventing transfer of freight between freight houses:

(a) By loading more intelligently at originating points?

(b) By utilizing more fully in both directions drays, tractors, trucks, tunnels, or other means of conveyance, so as to reduce the use of trap cars and save rehandling?

Consolidation of L.C.L. Business at Terminals

29. Are you coördinating: (a) the routing of L.C.L. freight, (b) the use of freight houses at either end of the route, (c) the use of transfer stations, to avoid (1) congestion, (2) unnecessary local transfer of freight between houses, (3) light loading of cars?

30. Have you adopted "sailing days" for L.C.L. freight: (a) To secure better and heavier loading of cars, (b) to avoid breaking bulk in transit, (c) to reduce loss and damage in transit, (d) to avoid "overs and shorts" by such stowing in the car as to make individual shipments readily accessible in "peddler" cars at intermediate stations?

31. What may be done in the way of extending railroad service to include "store-door delivery" of freight?

Consolidation of Team Tracks

32. Can team tracks in reasonably adjacent territory be consolidated and thus bring about, (a) reduction in classification, (b) more intensive use of valuable terminal property, (c) more prompt release of cars, (d) greater convenience to the public, (e) avoidance of a needless duplication of operation or maintenance, (f) the use of yards near passenger stations for baggage, mail and express when desirable?

Bureau of Collection of Freight Charges

33. Where collection of freight charges is necessary at other than stations, have you given consideration to (a) collection for all railroads by zones as a matter of economy and public convenience, (b) collection for all railroads from all sources by a designated bureau?

Consolidation of Wharves, Docks and Elevators

34. Can you obtain greater efficiency in the use of waterfront facilities of one or more railroads by consolidation of (a) coal piers, (b) grain elevators, (c) merchandise piers, (d) other piers so as to (1) reduce number of units operated, (2) take full advantage of most modern facilities to reduce double handling of freight, (3) release facilities for other uses, (4) reduce switching or floatage, (5) secure more prompt release of cars?

35. Will beneficial results follow the placing of all waterfront facilities, or those in certain zones, under single control?

Consolidation of Passenger-Station Facilities

36. Can you obtain greater efficiency in operation through extending consolidation of the passenger facilities of one or more railroads:

(a) By combining forces of two or more lines using the same station?

(b) By using one or more stations for handling the business of two or more lines, thus enabling certain stations to be closed?

(c) By coördinating the use of stations so as to handle in the same station the traffic from or to certain regions?

(d) By continuing the use of adjacent stations, but consolidating their forces?

(e) By abandoning passenger service on certain sections of a line, the traffic affected to be accommodated on other lines?

Consolidation of Passenger-Station Switching

37. Can you obtain greater efficiency in operation through extending the consolidation of passenger switching:

(a) By combining the switching of two or more roads, using the same station, where each now performs its own switching?

(b) By combining the switching operations of adjacent stations?

(c) By extending any existing joint service to include all switching operation of passenger equipment within the terminal?

(d) By reassigning coach yards so as to reduce haul of equipment to a minimum and to obtain maximum efficiency?

38. Can an existing freight or other yard and terminal be converted into a purely passenger facility, effecting economy, reducing congestion in both freight and passenger traffic, and decreasing haul of empty passenger equipment?

39. Can you use wye tracks or loops for turning trains?

Consolidation of Ticket Offices

40. Are city ticket offices, other than at stations, so consolidated that all tickets for each road are sold by each ticket clerk?

41. Are ticket forces now consolidated at stations used jointly?

42. Can ticket forces of adjacent stations be consolidated to advantage?

43. Have you analyzed the necessity of continuing city ticket offices outside of stations?

44. Have you analyzed the ticket sales in the office to develop the relative number of tickets sold to a certain few heavy traffic destinations, with a view of improving the service by confining the sale of such tickets to one or more windows?

45. Have you considered at depot ticket offices the limited consolidation of sale of railroad tickets to heavy traffic destinations, with the general sale of Pullman tickets, to improve service to the public: (a) By avoiding the sale of excess railroad fare, for privilege of riding in Pullman cars, to passengers who may later be unable to secure Pullman space? (b) By avoiding delay to passengers at ticket windows? (c) By retaining simplicity and accuracy in the internal work of the ticket office, through limiting access to the diagrams to isolated and the fewest possible regularly assigned clerks —whose duties are to mark reservations and both to handle and check cancellations—and providing telephone or other communication between them and window clerks?

Consolidation of Telegraph Offices

46. Can you obtain greater efficiency in the use of telegraph facilities of two or more lines: (a) By further consolidation of adjacent offices? (b) By using offices of one line in handling trains on an adjacent line? (c) By through routing of messages? (d) By consolidating or coördinating relay offices? (e) By a more general use of the telephone, telautograph, automatic telephone, or other means of transmission; attracting attention by visible or audible signals?

Conversion Into Multiple-Track System

47. Can you convert two or more single-track lines into a multiple-track system, establishing currents of traffic, to expedite train movement; to increase safety, capacity and train tonnage; and to promote economy?

Segregation of Freight and Passenger Traffic

48. Have you considered the possibility of consolidating the passenger traffic of several lines, now carried over three or more main tracks, upon two main tracks:

(a) For the purpose of providing a better entrance to a passenger station?

(b) For the purpose of setting free badly needed tracks for use in freight service?

(c) For the purpose of securing freedom from inter-

ruption by passenger train movements of freight, transfer or switching movements?

Roadway and Structures

49. Have you, with the intensified use of terminals, made proper arrangements for the maintenance and improvement of all yard and main tracks and structures to such standards as will render them reliably serviceable under the new conditions?

50. Are there limitations of curvature, clearances or other conditions that may interfere with plans of unification in any case?

51. Are the terminal buildings located and so maintained that the maximum efficiency of the terminal operation may be attained?

52. Are trains delayed on account of inconvenient or remote locations of billing offices?

53. Are terminal buildings reasonably accessible to the homes of employees? How should this condition be improved?

54. Are proper conveniences in the way of rest rooms provided for female employees; and are the buildings properly lighted, ventilated and heated?

"Catechism of Yard Design and Operation"

55. Are you familiar with the pamphlet entitled "War Emergency Yard Improvements" of the American Railway Engineering Association, issued February, 1918, and are all of the recommendations therein contained being observed in your terminals?

56. Would not familiarity with the "Catechism of Yard Design and Operation" contained in that pamphlet result in increased efficiency?

57. Should not a copy of that pamphlet be placed in the hands of each official and employee concerned in yard operation?

Economies of Consolidation

To illustrate the advantages of consolidation of facilities, H. J. Pfeifer, in his monograph on the subject, points out that if two roads are so close together that the trains of one can enter the yards of the other with little extra expense, the assigning of the yards of one for inbound and the other for outbound movements will reduce the number of classifications 50%, and as a consequence the number of cars assembled in each classification in a given time will on the average be doubled. If six, nine or more lines consolidate in groups of three each, the ratios of classification and number of cars in each classification become 1:9 and 9:1 respectively, and with groups of four, 1:16 and 16:1. If a given car movement is handled through five yards, there will be 16 times as many cars in each transfer between yards in a given time as if the same volume of traffic were handled through 20 yards.

The economies in time and expense resulting from such a consolidation of yards, eliminating one or more intermediate classifications, says Mr. Pfeifer, are many and varied, resulting in a saving of car days, car damage, extra switching expense, locomotive hours and many other sources of delay and expense. The money value of these savings depends, of course, on the size of the terminal and the reduction in complexity of service it is possible to bring about through yard consolidations. That it will involve savings in time and expense aggregating a value of millions annually in some of the larger terminals is not an unreasonable expectation.

Principles for Moving Cars Through Terminals

As the movement of a car through a terminal, or over a road, is governed by its destination, regardless of its origin, the following general principles governing the expeditious and economical movement of freight cars through a large terminal, are suggested:

1. The train being the unit in which car movement is conducted between two points, cars moving to common points should be got together at as early a stage in their movement as possible, and kept together as long as possible. Therefore, if two or more lines come into a terminal from the same general direction their trains should enter a common yard, so that cars moving to common points in the terminal can be put together.

2. As cars can be kept more closely together in a small group of yards, the number of classifying yards should be maintained at the minimum, consistent with the movement of cars by reasonably direct routes.

3. As a given number of cars will accumulate in trains of proper size to be moved more rapidly with a small number of classifications, the minimum number consistent with securing the required separations should be used.

4. As intermediate switching involves loss of time and extra expense, car movement should be consolidated as much as possible to reduce it to a minimum.

Intermediate Transfer Railroads

E. H. Lee, discussing the operation of intermediate terminal transfer railroads, particularly those which operate trains with their own power and crews, set forth principles and reasons therefor which, condensed, are as follows:

1. The operation of transfer railroads should usually be restricted as much as possible to the transfer of cars as distinguished from the classification of cars. The through line should so far as practicable deliver its cars to the transfer line classified and straightened out into cuts for the various through lines to which deliveries are to be made by the transfer line for through line account. The main tracks of most transfer railroads are ample for a larger volume of traffic than is handled over them, but in times of congestion they are frequently blocked at junction points, yard entrances and connections by trains which are unable to get into yards by reason of their crowded condition. These yards, in turn, are congested by an oversupply of cars awaiting classification, which occupy room which should either be reserved for the receipt of main-line transfer trains or which should be kept for the classifications which are necessary and which cannot be made to advantage elsewhere.

The place to control congestion is at or near the various points where business originates. By proper measures the through line may in a degree control congestion in its own important terminal yards, by holding back business, something impossible to the belt line, without the help of the through lines.

Business moving even in heavy volume is not congestion, and where they exist, belt lines if kept reasonably open and uncongested are the best means of keep-

ing cars moving in terminals, thus avoiding congestion and blockades.

KEEP FOREIGN POWER OFF BELT LINE

2. Where transfer or belt roads are of considerable length and equipped with motive power to handle transfer trains, it is the better practice to keep foreign engines off the belt line, performing the transfer service with belt crews. Better supervision can be secured where train crews are kept at home. It is difficult, if not impossible, to enforce discipline over crews while operating on a foreign road (particularly against loafing on the job), even though in theory they become the employees of that road while so engaged. Moreover, discipline and standards of performance differ on different railroads, being better on some and worse on others. Where foreign trains and engines operate over a transfer road it ordinarily happens that the general movement is regulated by the slowest and most indifferently operated train. There is also a difference in the standard of power maintenance as between railroads. A stalled train caused by the engine breaking down, not steaming or being overloaded, delays all following trains, and if the crew is foreign, the railroad officers who should apply discipline have no direct stake in the failure, and find excuses ready to hand.

3. Trains should be so made up that one engine will handle as many cars as far as possible. This principle is used in the operation of through lines very generally. Under the new Federal operation trains of war material have been consolidated and run solid over several different railroads without breaking up, with a saving of time and expense. The application of the principle on transfer railroads is even more important than on the through lines, because it is one of the best ways of reducing dead time.

DELIVERIES

4. Where track facilities permit, the through-line engine should make deliveries to the belt-line yard and should haul back its own deliveries from the belt-line yard. This eliminates light running. It also fixes responsibility, something of great importance during times of congestion, because it permits the prompt application of the remedy. This presupposes that the belt line has sufficient tracks for both its receipts and deliveries, which will doubtless be true in most cases, where its yards are kept properly clear. As the receiving road controls its own receipts, this arrangement would give control of both receipts and deliveries to the belt line, because unless the through line keeps its receiving tracks clear by taking its business, the belt line can shut it off, and this is as it should be.

5. Transfer trains should be loaded to capacity so far as practicable, because a light train costs about as much and occupies the track facilities to about the same extent as a full train, while handling less cars.

Three things which it is believed would have especial effect in controlling congestion are the construction of storage yards outside the terminals; the advance classification of transfer cars to the greatest practicable extent; and an extension of the authority of the men in charge of terminal operations, whatever their rank or title, in order that they may better control the flow of traffic to and through the terminals.

Lay Down Lines of Organization for Contractors' Association

Objects of New National Body Are Broad in Scope—Contractors' Committee to Build on Local Association Idea

AGREEING that conditions growing out of the war have made a national organization which would serve the general contractor an imperative necessity, the temporary committee which met in New York Sept. 23-24, as noted on page 604 of this journal last week, proceeded to lay down the broad principles on which such an organization must be built, and to call a convention of contractors and contractors' associations to make the national association a reality.

After a discussion which lasted, with a few hours' intermission for sleep, from Monday morning until Tuesday night, and in which consideration was given to written opinions expressed by almost every one of those unable to attend, the committee reached a number of conclusions as to the possible lines of action for such an association, set forth in the minutes of the meeting as follows:

"There is immediate and great need for a national organization of contractors. There should be included in such an organization all general contractors, whether engaged in building, heavy construction, highway, railway or other branches of engineering construction work. There must be excluded from such an organization all men who supply construction materials or equipment and all subcontractors, defining as subcontractor one who contracts with general contractors to perform the work required on the part of one or two trades.

MEMBERSHIP BY ASSOCIATIONS

"Membership in such an organization must be by national, state, local or sectional associations of general contractors, where such exist or can be formed, and the formation of such associations where they do not exist must be one of the chief concerns of the national association, since many reforms can only be obtained through local concerted action on the part of all the contractors concerned, and such action can be obtained only through local associations. Until, however, such associations can be formed, contractors should be admitted as individuals to the national association in territory where there is no available local association.

"Such an association could be of great assistance to the Government in the present emergency in providing additional construction organizations, if needed, and especially in taking upon itself the burden of proof regarding construction and building work which might go forward without hampering war work, and which would contribute to the strength and efficiency of the nation.

"Such an organization could exert great influence to secure better contract practice and to relieve the contractor of unnecessary risks both at present and in normal times. Such an organization could exert great influence to eliminate undesirable practices in the letting and conduct of work on the part of owners and engineers.

"Much could be done toward eliminating from public

work both undesirable politics and antiquated contract methods

"The labor problem could be dealt with and developed in a comprehensive manner on a national scale, so as to avoid an open and disastrous war with organized labor, and at the same time eliminate trade union practices that are bad for both men and employers, and so as to increase the efficiency and standing of construction workers.

"There is an opportunity for such an organization greatly to improve business methods between owners, contractors, material men and equipment makers. Such an organization would be a powerful instrument for improving the standing of contractors in the business world and eliminating the undesirable and inexperienced from the field.

"Such an organization could coördinate the efforts of local associations of contractors so that it would be possible to realize local reforms which cannot now be made because outside contractors are free to come in and prevent the taking of concerted action on a question by refusing to coöperate.

"The general level of efficiency on construction work could be steadily raised through such an organization by eliminating methods of doing work in which the efficient performance of the work is lost sight of in making profits on investments, securities and other business features connected with the project."

To carry these ideas into effect through a permanent national organization, to be known as the National Association of General Contractors, a constitution was drawn up which will be submitted to the convention called to meet in Chicago Nov. 20-21. The proposed constitution is based on the idea of accomplishing reforms through the activity of a strong central organization, backed by ample funds, in coöperation with active local associations of general contractors. The proposed constitution is given below:

Section I—Name

The name of this association shall be the National Association of General Contractors, hereinafter referred to as the association.

Section II—Purposes

The objects of the association are to promote better relations between private owners and public bodies and their architects and engineers on the one hand, and contractors on the other; to maintain high standards in the conduct of construction work; to combat unfair practices; to encourage efficiency among contractors, to support contractors and contractors' associations in efforts to rectify construction conditions of an unsatisfactory character; to encourage those methods of contracting for work which relieve the contractor of improper risks, and to encourage sound business methods tending to raise the standing of contractors generally in the business world.

Section II-A—War Service

1. The association shall endeavor to focus on the construction problems raised by the war the resources of contractors, and to coöperate with the Government to distribute work required in the best manner.

2. The association will also endeavor to collect facts regarding non-war construction work which will show whether materials and labor can be obtained without affecting the war program.

Section III—Membership

1. Members of the association shall be national, state or local organizations of general contractors, or individual firms engaged in general contracting where there does not exist an available association eligible to membership. Members of associations must be general contractors in order that said associations may be eligible to membership in this association.

2. The term "general contractor" is understood to mean a contractor or contracting firm engaged in construction work which undertakes and carries out, at least partly with its own forces, construction operations of any description in their entirety.

Section IV—Administration

1. All affairs and activities of the association shall be conducted by an executive board of 15 elective members and of the three elective officers of the association, who shall be a president, a vice president and a treasurer.

2. The executive board shall hold two regular meetings each year, at times and places to be determined by it. At these meetings all regular business of the association shall be considered.

3. Special meetings may be called by any two of the elective officers of the association.

4. The president of the association, or, in his absence, the vice president, shall preside at sessions of the executive board.

5. The president and executive board shall employ a paid secretary, who shall have a close acquaintance with the contracting business. The secretary shall conduct the general offices of the association, which shall be located in Washington during the remainder of the war. He shall be empowered to employ the necessary office staff and to conduct the business and further the objects of the association. His compensation and the expenses to be incurred in maintaining the offices shall be determined by the executive board.

Section V—Elections

1. Officers of the association and members of the executive board shall be elected at the annual convention, to be held the third Tuesday in January.

2. Each member association shall be represented at the annual convention by one duly authorized voting delegate for every ten members in good standing; but no such association shall have less than two voting delegates in the convention.

3. Any 10 individual contracting firms, members of the association, but not of any member association, may designate one of their number as their delegate to represent them with one vote in the annual convention, under rules to be prescribed by the executive board.

4. The president, vice president and treasurer of the association shall be elected annually.

5. One-third of the members of the executive board shall be elected at the first annual convention for a term of three years, one-third for a term of two years,

and one-third for a term of one year. At each succeeding annual convention new members shall be elected for a three-year term to replace those whose terms expire. Vacancies shall be filled until the next annual convention by the executive board.

6. Any member of the association or of one of its member associations is eligible to office or to membership on the executive board; but no person who is a paid officer of a member association shall hold office in the association or be a member of the executive board.

SECTION VI—DUES

The dues of the association shall be for each individual member firm $50 annually and for member associations, $10 annually for each member of such member association at the beginning of the year in which the dues are paid, with a minimum for each association of $100 per year.

SECTION VII—AMENDMENT

This constitution may be amended at any annual convention by a two-thirds vote of the duly constituted delegates registered at the convention.

Government's Mississippi Barge Fleet Now Building

Steel Tow-Boats 300 Feet Long and 48 Feet Beam Designed To Carry 3000 Tons at High Water and 850 Tons at Low Water

NINETEEN steel barges and four steamers to tow them comprise the upper Mississippi River barge fleet, contract for which has been let at $3,360,000. Plans for the barges and boats have now been prepared by W. S. Mitchell, assistant engineer, in charge of the United States Engineer Office in St. Louis. In the July-August *Journal* of the Engineers' Club of St. Louis, Baxter L. Brown, consulting engineer, gives the following details.

The barges had to be so designed that they could carry economically large tonnages of low-class bulk freight like ore, coal, steel and lumber, or oil. The limiting navigable draft during the low-water season in the upper Mississippi River is 4 ft. for a wide tow. The limits of length and width were imposed by bridge spans and locks. There are 14 bridges between St. Louis and St. Paul; all but one of the bridges have clear spans of at least 150 ft., through which three 48-ft. barges may be passed abreast. There are two locks, at Keokuk and at Moline, and there soon will be three, as an additional lock is being constructed on the Upper Rapids at Smith's Island, a few miles above Moline. The clear length limit at the present Moline lock is 300 feet.

The problem, therefore, was to design craft which should handle upstream tonnage against rapid currents, and could be operated profitably on a depth of 4 ft. in time of low water in a country whose rail transportation is on a lower ton-mile basis than that of any other country in the world. These barges will be 300 ft. long, 48-ft. beam and 10 ft. deep, with 8- to 9-ft. full load draft. They will be double enders, with modified spoon bows. Such a barge will carry 3000 tons on 9-ft., and 850 tons on 4-ft. draft at time of low water. A tow with three such barges, which is the best approved arrangement for a river towboat, would thus carry 9000 tons at high water and 2500 tons at low water.

The barges will be built with open cargo hoppers, 36 ft. wide by 256 ft. long and 6 ft. deep, with the bottom 5 ft. above the bottom of the barge. The hopper will thus leave a 6 ft. deck on each side of the cargo space, which will be surrounded by a raised coaming. As the barges will be equipped with pipes and pumps they may carry oil in the double bottoms. The situation of the great oil fields of southern Illinois and Louisiana relative to the Mississippi River makes this a desirable feature.

The fleets to be constructed under these plans will have a wider range of operating possibilities than any other river craft ever designed at home or abroad, and will operate profitably on even the minimum draft allowed. The barges will be pushed, as on the rivers of the Mississippi Valley, or may be towed tandem, as in Europe. They may be loaded with oil or with heavy bulk freights, or any other commodities that may be carried without protection from the weather.

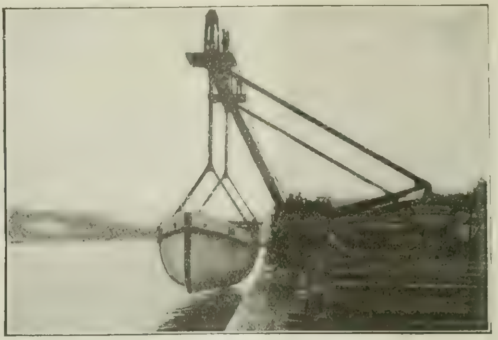
The upper Mississippi is a reach of river 675 miles long. The available depth of channel during the high-water months is 7 to 9 ft. The channel is relatively stable, as the river carries but little shifting sand. The stream runs through an agricultural region of great richness, but the traffic possibilities of immediate importance arise from the fact that at its upper end is a district entirely without coal, yet possessing the richest iron mines in the world, and two industrial cities having together considerably more than 500,000 inhabitants; while at its lower end is an inexhaustible field of excellent steam coal and the fourth manufacturing city in the United States.

French Concrete Tugs Launched by Swinging From Cranes

Quantity Production of Small Seagoing Boats Now Under Way in Yard at Paris on Bank of the Seine

SMALL reinforced-concrete tugboats of a total deadweight carrying capacity of about 80 tons are being built in quantity production in the yard of the Pelnard-Considère-Caquot Co. in Paris, for the French Government. The tugs will be used in harbor and river work to piece out the usual wooden and steel tug production, which has been very much reduced on account of the war. While designed largely for still water service, they are assumed to be seaworthy for the open ocean. No small part of the speed of production is due to the simple method of launching shown in the photographs reproduced herewith.

The yard is on the quay wall of the Seine River, and the boats are built some 20 or 30 ft. from the edge of the wall. Back of the boat is a track or a pathway on which rolls the double-member balanced crane shown in the view. This crane consists in effect of two shear legs spaced some 30 ft. apart and thoroughly crossbraced in the plane of the front masts. They are balanced by a counterweight, made up of a reinforced-concrete box which is filled with stone to provide the proper weight. Dependent from the top



EIGHTY-TON CONCRETE TUGBOATS LAUNCHED BY CRANE FROM BANK OF THE SEINE

of each mast is a hanger working in a jackscrew at the top and provided with a spread grip at the bottom which can be carried around the hull of the ship. When the ship is to be launched the crane is moved up to it on the longitudinal roadway and the boat is fixed in the jaws of the hangers, and the crane is then moved transversely on rollers until the boat overhangs the river, as shown in one of the views. The jackscrews are then lowered until the boat is in the water. The jaws are released after the boat is afloat.

The tugboats are provided with Diesel engines of 300 hp. They are 82 ft. long and 16 ft. wide and draw 6 ft. of water. The views shown herewith were given in *Le Génie Civil.*

Consolidation of Texas Railroads Under Federal Operation

By a Former General Manager

FOR THE purposes of Federal operation the Texas railways have been divided into three Federal managers' districts: (1) The Southern Pacific-Gulf coast lines group, including: (a) Galveston, Harrisburg & San Antonio, (b) Texas & New Orleans, (c) Morgan's Louisiana & Texas, (d) New Orleans, Texas & Mexico, (e) St. Louis, Brownsville & Mexico, and (f) San Antonio & Aransas Pass; (2) Texas & Pacific-International & Great Northern group, including (a) Texas & Pacific, (b) Louisiana Railway & Navigation Co. (west of Mississippi River), (c) St. Louis Southwestern Ry. of Texas, (d) International & Great Northern (except line from Spring to Fort Worth, Texas, and Madisonville branch), (e) Missouri, Kansas & Texas Railway of Texas (Trinity branch), and (f) Beaumont & Great Northern; (3) Gulf, Colorado & Santa Fe-Frisco-Katy groups, including (a) Gulf, Colorado & Santa Fe, (b) Fort Worth & Rio Grande, (c) St. Louis, San Francisco & Texas, (d) Texas Midland (e) International & Great Northern (Spring to Fort Worth, and Madison branches), (f) Missouri, Kansas & Texas Ry. of Texas, (g) Wichita Falls & North Western, (h) Fort Worth & Denver City, and (i) Houston & Texas Central. The amalgamation of the Texas lines is perhaps the most extreme case in the country of operating a number of distinct lines under one management, many of which have no relation one with the other, and in some instances former through lines have been separated or dismembered and placed under separate managements.

The Texas laws require all trunk lines having mileage within and outside of that state to maintain separate and complete organizations covering the lines in Texas, and headquarters must be maintained in that state. This requirement in the past has caused the Texas through lines much expense and inconvenience. Federal operation has met this requirement by locating its officers in the state of Texas. The question arises, Will the combination of lines in the state of Texas under Federal management produce greater efficiency and economy in operation?

It has always been the opinion of experienced railway men that one reason for the lack of greater efficiency in the operation of railways is the limited supervision obtaining on certain roads. If this is true, then the situation has not been improved by the present grouping of Texas lines, the extension of territory under one management and the separation and dismemberment of lines, placing them under new organizations unfamiliar with their operation.

It might have produced greater efficiency if the main trunk lines had not been disturbed, but made the nucleus of a Federal operating district to which the smaller lines could have been added, also intact, as feeders or branches. In this manner the integrity of the trunk lines would have been maintained and the operating staffs familiar with them would obviously secure greater efficiency in their operation than is obtainable under a system of separation, dismemberment and a new and untried organization.

Looking forward to the eventual return of the railways to their owners after the war, intact and in substantially the same condition as before they were taken over by the Government, prudence would seem to suggest that some regard be given to the original identity of the respective lines, thereby reducing confusion and business disturbance, with perhaps less expense to the Government.

It is absolutely necessary that anything and everything be done toward the main object—the winning of the war—and this can best be done by promoting efficiency and economy in all activities. Is this result being accomplished in the manner in which the Texas railways have been grouped under Federal operation, and have the foundations been laid to accomplish the great considerations of increased efficiency and economy—the two most essential elements in war activities?

Guatemala Earthquakes Destroyed All Masonry Buildings

Wood and Concrete Frames Stood Shocks Well—Wrecked Sanitary Services To Be Rebuilt Under the Direction of Red Cross Engineers

By Edward Stuart
Sanitary Engineer, American Red Cross Guatemala Relief Commission, 106 Strathcona Hall, Cambridge, Mass.

Masonry buildings, of the almost universal type used in South America, were practically without exception destroyed in the severe earthquakes that shook Guatemala City last December and January. Framed structures, whether of steel, wood or concrete, suffered little damage except in the shaking off of the applied surfacing. Engineers of the American Red Cross, sent to the city soon after the disaster, were able to inspect the destroyed structures and also to report on the reconstruction not only of the buildings but of the sanitary services, which were seriously damaged.

CONCRETE WATER TANK INTACT. MASONRY HOSPITAL DESTROYED BY EARTHQUAKE

Guatemala City, the capital of the Republic of Guatemala, was violently shaken by three great earthquakes on Dec. 25, 1917, and Jan. 3 and 24, 1918, Between these dates there were many minor shakes, on some days occurring hourly, and for months afterward vibrations of varying violence passed through the city. There were shocks even as late as June 1. The three large earthquakes destroyed 95% of the buildings, throwing the walls into the streets and destroying the houses, with a considerable loss of life and an enormous loss of homes and property. About three hundred lives were lost at the first great shock, and the continual vibrations destroyed more and more of the buildings, rendering the entire population of 120,000 homeless, and producing a disaster of large proportions. The water-supply systems were broken, the normal food supply was interrupted, the railroad was damaged, preventing the inhabitants of the city from leaving for other points, and serious sanitary conditions arose as a result. The greater portion of the people built little shacks and leantos, of lumber rescued from the wreckage, in all the squares, parks and around the edge of the city; and, demoralized by the continual quakes, they waited resignedly for the earth to open or for an enormous volcanic eruption.

As soon as practicable the American Red Cross ordered a shipload of foodstuffs, amounting in value to $110,000, sent from Panama to San José, the Pacific port of Guatemala; and the United States War Department sent 4000 army tents for the shelter of the refugees. A commission was sent from Washington to administer relief and give medical and sanitary aid.

The city lies on a large plateau 5000 ft. above sea level on what may be considered the continental divide, part of the run-off flowing to the Pacific, the remainder to the Atlantic Ocean. More than 150 years ago the former capital of the country, Antigua, on a neighboring plateau, was destroyed by an earthquake, and a different site was selected for the new capital, Guatemala City. It was thought at that time that the new site would be protected against earthquakes by the great ravines which surround the city. The great ridge of mountains running through North and South America, from Alaska to Patagonia, is especially active volcanically in Central America, and earthquakes are frequent, the largest recent shocks being one at Quezaltenango, Guatemala, in 1902, one at Cartago, Costa Rica, in 1910, and one in San Salvador in 1917. In this section they are very often followed by volcanic eruptions, as in the cases of the first and third mentioned above, and it is greatly feared that the volcano, Pequaia, 15 miles from Guatemala City, will erupt some time this year.

The recent Guatemala earthquakes were very variable in character, consisting of vertical, longitudinal, transverse or S-shaped, and long surface waves, some violent and others slow and gentle, with long-continued after-

shocks. It is therefore not surprising that, with such a variety of movements, great destruction resulted in the city. The Government seismograph was destroyed at the first great shock, so that there are no local records of the earthquakes. However, complete records of the earthquakes were obtained in North America and are recorded at the Harvard, Cornell and Ottawa stations; and some of the waves traveled across the Atlantic, as Barcelona, Spain, recorded some of them. The shocks apparently were not recorded across the Pacific Ocean. Although the damage in the city was great, and the disaster considered of large proportions, we cannot exactly class this as a great earthquake, geologically, as otherwise the shocks would have been felt around the world; moreover, the cities on the other plateaus of Guatemala were not damaged, although the shocks were felt. The writer was present during the third large shock, which occurred on Jan. 24, and, with other engineers who were in the city at the time, is of the opinion that the maximum displacement of the ground produced by the vibrations was about 12 in. The general direction of the waves was east and west. They produced an interesting effect upon the stone benches in the parks, those placed with the long axis in a north-south direction being overturned, while the east-west benches remained standing.

RAILROAD CARS OVERTURNED BY EARTHQUAKE —STEEL FRAMES IN REAR INTACT

Practically all construction was of masonry, which, as has been observed in previous disasters of similar character, is least suited to withstand the shocks. The masonry walls were rocked back and forth, the heavy cornices falling, and then with great crashes fell into the streets or collapsed into the interiors of the buildings. The heavy tile roofs, so common in the tropics, were all shaken down. More numerous than brick or stone were the buildings of adobe (large sun-dried bricks of clayey mud, with straw as a binder). Buildings of this character were in nearly all cases leveled to the ground, forming large masses of débris all over the city. The adobe, partly pulverized, was the source of enormous clouds of dust which caused much eye infection. Walls of stone and brick withstood the shocks badly, the damage increasing in proportion to the poorness of the mortar, which usually is very bad, the high cost of cement in the country discouraging the use of cement mortar. However, masonry walls with heavy buttresses and walls battered on both sides, even with poor mortar, were but very slightly damaged.

Buildings of wood construction alone remained standing practically intact, except where they were injured by falling walls or chimneys. There were, however, very few buildings of this kind, and consequently no fires resulted from the earthquakes. In fact, fires are so infrequent at any time in Guatemala that absolutely no provision has been made for protection against the spread of fire in the city.

Another form of construction is "bahareque," rough wooden framing bound together with bands of cane, and plastered inside and out with mud. Such houses remained undamaged, except that the greater part of the mud plaster was shaken off, and where the roof was covered with tile the roof framing usually collapsed.

There were no modern structures of reinforced concrete with the exception of one building, a residence of two stories, just completed, and now the home of the British legation. This has small reinforced-concrete columns, with walls 4 in. thick reinforced with expanded metal; the floors, stairs, balconies and balustrades were of similar construction, and a large amount of filigree cement work, reinforced, is around the cornice. This building remained intact, not one crack appearing; it gives us additional evidence of the value of reinforced-concrete construction in earthquake regions. Another example is furnished by the water tank at the General Hospital, which was set upon long 8 x 12-in. reinforced-concrete columns, which were not even cracked, although the surrounding structures, all of heavy masonry and brickwork, were entirely destroyed. An accompanying photograph strikingly shows the contrast.

The railroads suffered principally from the many landslides occurring on the plateau. They covered the track with earth and rocks for stretches as great as a half a mile in length. The large steel trestle bridge over the deep ravine on the edge of the city, the anchor bolts at the footing having been sheared, was shifted a maximum of 6 in., as described in *Engineering News-Record* of May 23, p. 999. Other than a slight twisting of the track and a bending of a few steel members, no damage resulted, and the bridge was promptly put into service again.

BRICK AQUEDUCT DESTROYED BY QUAKE, WITH TEMPORARY WOODEN FLUME CARRYING WATER

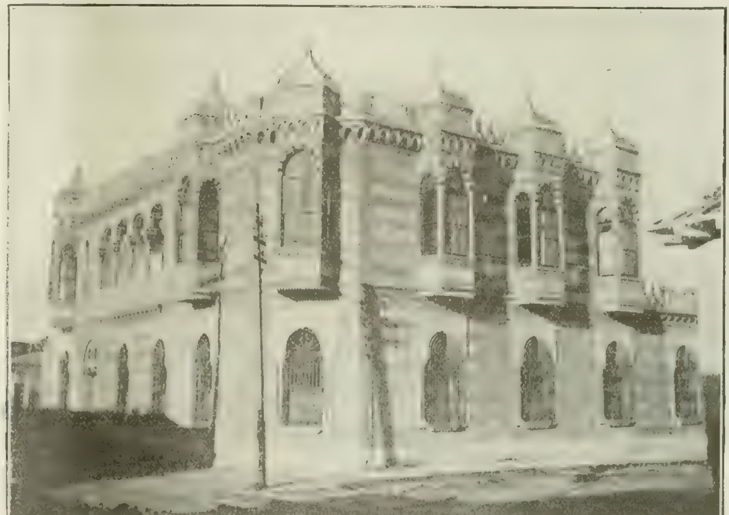
The primitive and inadequate sewers of the city are of rough masonry, very shallow and small, so that heavy

traffic on the streets often breaks through the pavement into the drains. Although twisted and broken to some extent by the earthquakes, the sewers continued to carry off what sewage still flowed from the city. They are liable to become badly clogged in the rainy season, when a large portion of the débris of the city will be washed into them. In the reconstruction of the city an entirely new sewer system is of great importance.

Because of the menace to the health of the people the Red Cross Commission gave considerable attention to the problem of the water-supply. Four systems supplied water to the city, two of them bringing the water

The Oldest Church in Guatemala, Built by the Spaniards Four Hundred Years Ago

The Cathedral, One Hundred Years Old



The One Reinforced-Concrete Building In Guatemala

Church of the Recollection, Whose Walls Were Twelve Feet Thick

Wooden Frame, Lath and Plaster Houses Which Withstood the Shocks

over large masonry aqueducts built 150 years ago, another conveying the water in a 14-in. cast-iron bell and spigot pipe, and the fourth in a 10-in. steel spiral riveted pipe. The masonry aqueducts were badly broken in many places, the 14-in. pipe was broken at many points both at the joints and in the sections between the joints, while the 10-in. spiral riveted pipe was opened in but a few places along the seams. The distribution systems through the city were disconnected, and the people consequently suffered a great want of water. The writer has even seen native women dipping out sewage to use for household purposes.

In brief, it was recommended by the Red Cross that about five miles of piping be immediately purchased in the United States and laid upon the surface of the principal streets, to supply 100 fountains to be located at the most important points. In order that it might be quickly and easily laid, and to resist vibrations of shocks best, flanged and bolted pipe was recommended. The Guatemalan Government accepted these recommendations for a temporary and emergency supply and purchased the pipe in New York. For its part, the Red Cross purchased and installed two chlorination plants on two of the reservoirs, in order to treat the grossly polluted water before its entry into the temporary system.

In the reconstruction of Guatemala City it will first be necessary to remove approximately 1,000,000 cu.yd. of débris. Structures proof against earthquakes will for the most part be erected, and concrete and wooden buildings have begun to make their appearance all over the city. The most popular form seems to be wooden framing with metal lath inside and out, covered with cement mortar, and corrugated iron sheets are taking the place of tile roofing. Although there is a great deal of lumber in the country large quantities are being imported from our Southern states and from the Pacific coast, on account of its better milling and seasoning. The lumbering possibilities in Guatemala are well worth the attention of American capital, as well as the great demand and need for American building materials.

[Supplementing his article in *Engineering News-Record* of May 23, p. 999, W. T. Penney, contractor, of Guatemala City, has sent the five photographs of buildings reproduced on p. 625. They show how well the one reinforced-concrete building (middle picture) withstood the shocks. Of its construction Mr. Penney, says:

"It should be taken into consideration, furthermore, that the concrete work and appliances on this one building were by no means up to date. The concrete was mixed by hand. The sand was volcanic and full of pumice, but was neither washed nor even screened. Most of the time the water was muddy. The rock was broken by a hand machine. Erection of the building was carried on in a desultory manner, the concrete work being delayed many times for a week at a time. In many cases the reinforcing was laid within half an inch of the surface. Also, the Moorish design of the structure called for many delicate members, as the photograph shows."—Editor.]

Seattle Plans Large Extension to Port Facilities

Main Improvement Is Terminal Pier 365 Feet Wide and Half Mile Long, With Complementary Cargo Sheds and Machinery

ADDITIONS to the pier and warehouse facilities of the port of Seattle, Wash., are planned for immediate construction that will fit the port for any increase in business incident to or following the war. The improvements are in the Smith's Cove terminal, which already has in Pier A one of the largest freight piers in the world. It is 310 ft. wide and one-half mile long, and has almost 4000 ft. of berthing space. It may be regarded as two long wharves, back to back, with four depressed railway tracks between.

About one-third of the area of the pier, or 130,000 sq.ft., is covered by one-story sheds, nearly 100 ft. wide, which have a cubical content of 3,500,000 cu.ft. The remainder of the structure, comprising 260,000 sq.ft., is an open wharf, the east side being used for export lumber and steel, while the west side is utilized for the storing and bulking of vegetable and fish oils. This pier will be widened and extended to West Garfield St., adding approximately 100,000 sq.ft. to the open wharf. The extension will permit of the straightening out of the railroad facilities at the pier, so that the capacity of the terminal will be materially increased. Slips on either side of the proposed extension to the pier will be dredged to the full depth of 35 ft. at low tide. The berthing space will be increased from 4000 lin.ft. to 6500, giving a total berthing space for 13 large ocean carriers. The cost of the extension of the pier will be approximately $400,000.

In addition there will be built a new pier B. This will be 365 ft. wide and 2700 ft. long, or a trifle more than one-half mile long. A slip 380 ft. wide separates the existing and the proposed terminal. A new slip will also be dredged to the west of pier B; in all, the dredging excavation will amount to more than 2,000,000 cu.yd., 1,000,000 of which will be used in filling two of the city waterfront streets. When finished they will give a direct paved thoroughfare from the business district to Smith's Cove, on an easy grade. Two 2-story cargo sheds, 120 ft. wide by 1000 ft. long, will be constructed at the street end of the new pier. Four depressed tracks will occupy the central section of this gigantic pier; the two outside tracks, on the open wharf, will be so situated that the locomotive cranes can operate over them. Two surface ship-side tracks will occupy the outer side of the structure. Crossovers will be provided every 500 ft., to increase speed and efficiency in switching. In all, there will be $4\frac{1}{2}$ miles of railroad trackage on the new pier and a total of six miles of trackage, including the pier A extension and connecting tracks with the large Interbay Railroad Yard, which is directly behind the new terminals.

A great deal of heavy freight handling equipment is contemplated in connection with the new pier. Two 10-ton traveling cranes, each operating on 120 ft. steel spans 22 ft. above the open wharf, will travel 1600 ft. up and down the open area of the new structure, each crane serving one side of the pier. The elevated cranes are used so that valuable open wharf cargo space will

not be taken up by cranes. By the method to be adopted all the cranes will be operated above the cargo on the dock, and the traveling cranes will be able to unload direct from cars on the depressed tracks to ship and vice versa. This equipment will consist of high-speed cranes, with a view to handling heavy cargo faster than ever before. The cost of pier B will be about $2,000,000.

When pier B is completed and the extension made to existing pier A, a berthing space of 11,000 lin.ft. will be provided, permitting 25 large ocean-going vessels to load and discharge at the same time. Two 35-ton locomotive cranes will also add to the loading capacity, as will a battery of electric tractors and tractor trailers. Each train with a capacity of 8 to 10 tons will increase the means of handling in the cargo sheds. Eight portable second floor loading platforms will also be installed, to allow loading and unloading in connection with the second floor of the cargo sheds. A 100-ton shear legs will also occupy a prominent place on the pier, to expedite the handling of heavy equipment. This capacity to handle cargo on a tremendous scale is a special feature in the new design, and will help facilitate the movement of the large China and Japan trade and the trade with Russia that is expected to assume vast proportions after the war.

Precast Concrete Lumber Proves Successful in Mine

Fire Resistivity Sought in Replacing Steel-and-Wood or All-Timber Construction—Costs About Twice Those of Timber

DURING the past four years considerable precast concrete "lumber" has been used by the Oliver Iron Mining Co. in the relining of its shafts on the Vermilion and Mesaba range in northern Minnesota. A concrete plant was started in 1914 at Hibbing, and 450 complete shaft sets have been manufactured and shipped to all parts of the range. Much experience has been gained since the methods of making and using concrete lumber were described in *Engineering Record* of Oct. 31, 1914, p. 478.

Where a new shaft is to be lined with precast lumber it is excavated and constructed in much the same way as the ordinary timbered shaft. The surface of the ground is leveled and two trenches 4 to 6 ft. deep, depending upon frost depth, are dug for reinforced-concrete bearers 18 x 24 in., which support the shaft lining. These trenches are 20 ft. apart and 34 ft. long.

Cross-bearers of structural steel consisting of two 15-in. 33-lb. channels are placed under each wall plate. Under each divider the cross-bearer is one 15-in. 42-lb. I-beam. Channels are used under the wall plate so that hanging bolts may be placed in between. Immediately on top of the bearers is placed the first shaft set, consisting of two wall plates 20 ft. long, two 8-ft. end pieces, and two dividers 6 ft. 3 in. long. All of these are 12 in. square in cross-section, except that the dividers are 10 x 12 in. Forms are then built up for placing the concrete for the collar, which is from 6 ft. to 8 ft. in height, extends directly above the shaft set and prevents water and débris from falling into the shaft. Pockets are left in the collar for nuts for hanging bolts. As the earth is excavated it is placed around the collar.

The shaft sets are horizontal and are spaced 5 ft. apart. Each set is supported by twelve 1½-in. hanging bolts, two in each end piece and four in each wall plate. Each set weighs approximately 10 tons, including the concrete lining slabs or lath. Posts or stuttles separating the sets are made up as follows: Four corner stuttles, 4 ft. long and 10 in. square, and four center stuttles under dividers, 4 ft. long and 8 x 10 in. Be-

LOOKING DOWN ONE BAY OF CONCRETE PRODUCTS PLANT WHERE CONCRETE LUMBER AND PIPE ARE CAST

tween sets there are eight 3 x 10-in. slabs and thirty-eight 3 x 10-in. slabs, all 4 ft. 2¾-in. long. These slabs are fitted in on the exterior side of the sets, being held in position by a 3 x 1⅜-in. groove in the wall plates and end pieces and by the earth which is packed in behind the lath.

The 20-ft. wall plates are first lowered into position and the end pieces fitted over them. The stuttles are then put in place, after which the hanging bolts are placed in the proper holes. When the whole set is in position and lined up, the bolts are tightened and the lath shoved into position. Most of the shafts lined with precast lumber on the Mesaba Range are about 200 to 300 ft. deep.

The usual type of shaft used by this company has three compartments; a ladderway 6 x 6 ft. 4 in. and two skipways 5 x 6 ft. in the clear, with dividers in between, making the over-all dimensions 8 x 20 ft. At Spruce No. 4 there are five compartments. This shaft is now being sunk from a 240-ft. level to the 400-ft. level by the same method as described for other precast shafts. From the old 240-ft. level upward the shaft was relined in 1916 by the use of precast members. In this method jacks were used to hold up the concrete members until the end members and slabs were put in place along with the stuttles or posts. With the stuttles exactly 4 ft. long the end pieces and wall plates were fitted in at the corners so as to form a perfect joint. The dividers are notched at the ends into a dovetailed shape so as to fit into the wall plates. Ladders at the Spruce shaft are all of steel, as are the landing platforms. Between the compartments 6-in. wire mesh is used for protection.

First Cost Higher, But Sets Last Longer

Cost data tabulated during 1914 and 1917 show that concrete sets can be manufactured at a cost practically double that of timber. The cost of installation is a little higher, due to increased weight. The ordinary timber shaft must, however, be replaced within six or eight years, while a concrete shaft has an indefinite life, besides being fire-resistive.

All of the precast lumber on the Mesaba Range is manufactured at the plant at Hibbing, which has been in operation since 1914. Besides concrete lumber for mine shafts, concrete blocks and concrete pipe have been made in large quantities. The manufacture of reinforced-concrete sewer-pipe is somewhat new at this plant, but at the present there is being made 24-, 30-, 36-, 48- and 60-in. pipe in lengths of from 33 in. to 45 in. Under ordinary circumstances, eight men are employed at the plant, able to turn out daily 100 reinforced 3 x 12-in. concrete slabs 4 ft. 2¾ in. long.

Auto Oil Distributor Reported Economical

An auto oil distributor, to work in conjunction with three horse-drawn distributors, was placed in service in 1917 by the Department of Public Works, St. Paul, Minn., and is reported to have been more economical than the horse-drawn type. The auto oiler distributed 189,642 gal. of oil at a total cost of $1309.64, or $6.91 per 1000 gallons. The three horse-drawn oilers spread 252,105 gal. of oil at a total cost of $2138.56, or at the rate of $8.48 per 1000 gallons, showing a balance in favor of the auto distributor of $1.57 per 1000 gallons.

When Railroad Lands Are Used for Carrier Purposes

Interstate Commerce Commission Allows as Such, and Commends Purchase of, Lands Needed for Future Terminal Expansion

PROPER foresight demands that railroads acquire land for future development of terminals—so states the Interstate Commerce Commission in its final report on the valuation of the Texas Midland R.R. This, the commission states, does not imply unlimited license to buy land on the chance that it may sometime be needed. The test the commission applies as to whether the land is used for transportation purposes is whether the carrier can point out with reasonable clearness the probable future use to be made of it.

Other phases of the general problem of use or nonuse for carrier purposes are discussed in the report, the wording of which is in part as follows:

"The first step in the land appraisal is to determine what lands are used for transportation purposes and what are not, and this frequently involves questions of much difficulty. The act requires that lands, 'owned or used for the purpose of a common carrier,' shall be classified as carrier. . . . Can lands which have not been devoted to common-carrier use be classified as carrier land?

"One of the most serious difficulties with the present railroad situation is lack of proper terminal facilities. Railroad managers have not foreseen and properly provided for that great development of business which has not only rendered existing terminals inadequate, but which frequently renders it necessary to entirely discard such facilities and provide new ones in different locations. Owing to the great increase in the price of city lands it is usually extremely expensive to procure the land rights needed for this development.

Foresight Encouraged

"Any rule which would discourage railroads from exercising proper foresight in the purchase of land which will be needed for terminal facilities in the use and development of their properties would be most unfortunate, for it would not only tend to prevent the providing of the requisite facilities when necessary, but would much increase the expense of those terminals when provided. At the same time, to give to a carrier the unlimited right to purchase and hold at the expense of the public lands in the vicinity of growing towns, upon the belief that possibly at some time and in some way such lands will be needed for railroad purposes, opens the door to much extravagance and holds out an inducement to unfortunate investment. . . . While a liberal rule should be adopted, there must be some limit to the right of a carrier to hold or own land for transportation purposes at the expense of the public.

"The rule adopted has been that lands not devoted to the public service in fact may be classified as common-carrier, but this shall be done only in those instances where the public use is either actual or imminent. By 'imminent' is meant that the possible use must at least be capable of definition. It is not necessary that the lands be put to this use in any definite time after their purchase, but the carrier must be able to point out with

reasonable clearness the probable future use which is to be made of them. If the carrier asserts that the lands were purchased in good faith, believing that they would be required for carrier purposes, the presumption will be in favor of the carrier, but nevertheless the carrier must be prepared to state the reason upon which the belief is founded, and if the reason is found untenable the land is classified as noncarrier.

"It sometimes happen that the amount of land which is devoted by the carrier to a particular use appears to be excessive. For example, several acres may be used for station grounds when much less would suffice. The carrier's judgment is usually accepted.

"Carriers frequently permit the erection upon portions of the right-of-way of structures which are of a quasi-transportation character. Instances are milk sheds, grain elevators, coal chutes, etc. While these structures are owned by private parties, they perform a function of the carrier itself, in that they provide a means for the receiving, storing and handling of freight. A rental is sometimes paid for the use of this land, but this is seldom so, and often when money is paid the amount is nominal. In such cases the commission has classified the land as carrier. Where the dominant use of the structure is private, as in the case of a flour mill or a wholesale grocery store, the rule is otherwise.

"Carriers sometimes provide dwellings for employees. Where the situation is such that the employee in particular cannot be properly housed without the providing of living accomodations, these are treated as a part of the operative property and so classified, but where the employee could readily obtain accommodations without the assistance of the carrier, dwelling houses and structures of this sort are classified as noncarrier."

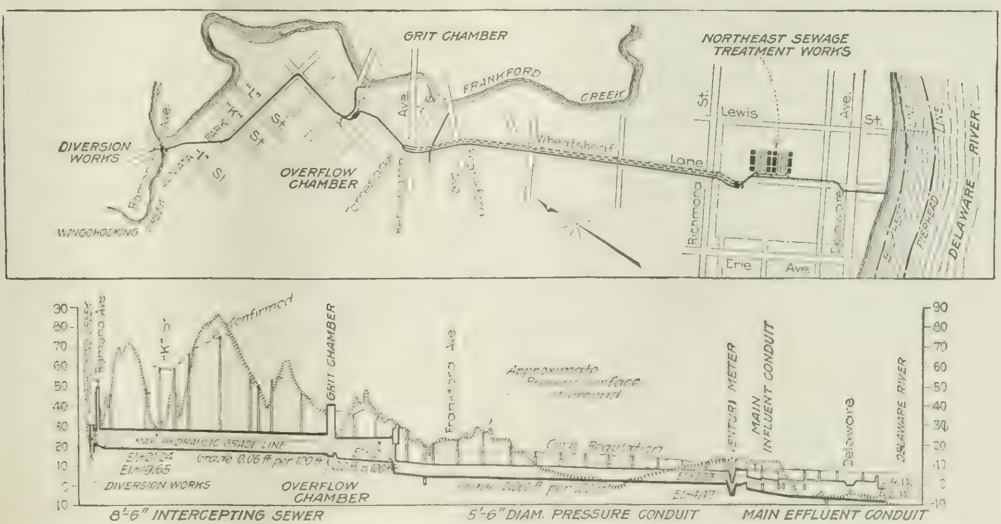
First Unit of Improved Means of Sewage Disposal for Philadelphia Well Started

Design Features Include Intercepting Sewer Partly Under Pressure, Ventilated Grit Chamber With Sand-Removing and Washing Plant, and Depressed Venturi Meter

By W. L. Stevenson
Assistant Engineer, Sewage Disposal Division, Philadelphia

PHILADELPHIA has made a good start on its comprehensive plan for the improved disposal of its sewage. Already construction is well advanced on the Frankford Creek high-level intercepting sewer and on the grit chamber of the Northeast sewage-treatment works, one of the three sewage-disposal units comprising the plan. The work now in hand was authorized by councils in 1915 and 1916, and $3,700,000 was appropriated to meet the construction cost of this unit and of the land for all three sewage-works.

Besides the interceptor and the grit chamber the work here described includes creek diversion works, a storm-overflow chamber and various accessories. The grit chamber will be equipped with sand-removing and washing apparatus. Portions of the intercepting sewer are under pressure. All the sewage passing to these works



GRAVITY INTERCEPTOR DIVERTS SEWAGE FROM FRANKFORD CREEK TO TREATMENT WORKS ON DELAWARE

will be measured by venturi meters. The completed sewage-works will include Imhoff tanks.

This part of the entire project was carried out first because it will not only afford protection to the city's water supply but will also restore to a clean condition Frankford Creek, now grossly polluted by sewage, which flows through park property in its upper reaches and in a built-up part of the city at its lower end. Two-thirds of the city's water-supply is obtained from the tidal Delaware River at Torresdale. Frankford Creek empties into the river 4¼ miles below the intake to the water filters. This creek is the natural drainage channel for the sewage of about 100,000 persons and for the industrial waste from the factories in Frankford.

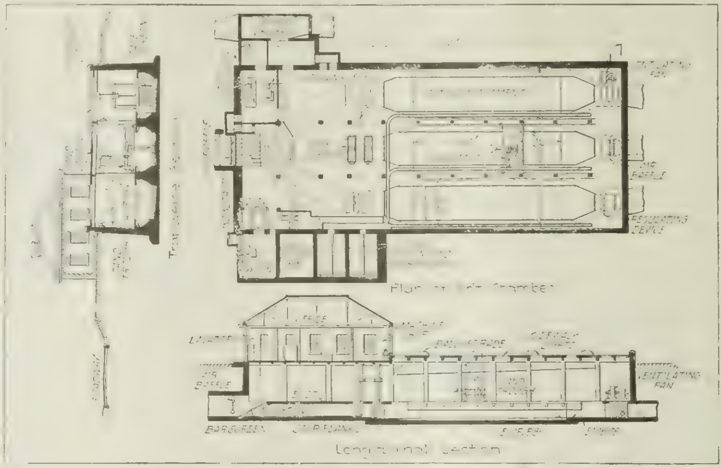
The largest single source of pollution is the 19½-ft. combined sewer which serves Germantown and contiguous parts of the city. This sewer is laid approximately in the valley drained by Wingohocking Creek, and, as the sewer is not completed to its final outlet, the lower part of the creek is practically an open sewer. At Ramona Ave. and I St. Wingohocking Creek is joined by the smaller and comparatively unpolluted Tacony Creek, to form Frankford Creek. The bed of Wingohocking Creek and also the invert of the future sewer outlet at the same point are about 25 ft. above the water in the Delaware River. Hence it is possible to convey sewage from the drainage areas of these two creeks by gravity in an intercepting sewer to the treatment works on the bank of the Delaware River, two miles farther down stream from the water intake than the mouth of Frankford Creek. Sewage entering Frankford Creek at too low an elevation to be received by this high-level sewer will be intercepted by low-level sewers, and must be pumped to the treatment works.

Across Wingohocking Creek, near its mouth, will be built a concrete dam, the top of which will be at such an elevation that it will divert all flows, up to double the average dry-weather flow, into a rectangular channel, in which a regulating gate will be built consisting of a rectangle constructed of structural steel and plates supported on a horizontal shaft in such an unbalanced condition that it will rest normally on stops in a nearly horizontal position. But when flows in the creek rise to an elevation above the shaft, hydrostatic pressure is exerted upon the upper part of the gate, causing it to close and to discharge practically all the flow of the creek over the dam into Frankford Creek.

From these regulating works the sewage from the Wingohocking sewer, in the near future, and later all sewage collected by the extension of the intercepting sewer along Tacony Creek, will be carried for 4475 ft. in an 8½ x 8½-ft. semi-elliptical concrete sewer having a vitrified brick invert laid on a gradient of 0.0006. It is designed to carry at two-thirds depth 160,000,000 gal. a day, which is 200% of the estimated dry-weather flow in the tributary combined sewers in 1950.

In determining the alignment of this portion of the intercepting sewer, two routes were possible; one approximately parallel to Frankford Creek where the sewer could have been built in a minimum depth trench; the other by the most direct streets but which necessitated a relatively deep trench and three tunnels respectively 500, 1278 and 707 ft. long. The latter route was chosen in order to decrease the distance the sewage must be carried and to deliver it as speedily as possible to the treatment works.

The sewer is not reinforced with steel, except that in the open-cut sections longitudinal temperature bars are used. Every effort has been made to obtain smooth interior surfaces on the concrete. The invert was built of smooth-faced brick with straight and sharp edges. It is anticipated that a coefficient of roughness as low as 0.013 will be obtained.



VENTILATED THREE-COMPARTMENT GRIT CHAMBER IS EQUIPPED WITH SAND DREDGE AND TROUGHS LEADING TO SAND SETTLING AND WASHING TANKS

Overflow Chamber and Storm-Water Overflow

In the comprehensive plan it is intended that the intercepting sewers shall receive 141% of the average dry-weather flow of the combined sewers. But in the case of the upper part of the Frankford Creek intercepting sewer it was determined to receive 200%, as the land adjacent to Tacony Creek and the upper part of Frankford Creek has been placed on the city plan as a park. Not deeming it advisable to send these additional storm flows to the treatment works, it became necessary to provide an overflow weir at the lower end of the above-described part of the sewer.

This consists of a rectangular reinforced-concrete chamber which has a length of 62 ft. The roof span is supported by seven columns about 7 ft. apart along the line of the east side of the intercepting sewer. Between these columns a brick dam will be built to be

progressively raised as the depth of sewage increases in the future, so as to maintain its crest at the elevation of 141% of the daily average dry-weather flow.

The overflowed water will be conveyed by a rectangular 6 x 7½-ft. concrete conduit to a screen chamber where, if it is found necessary, a coarse, inclined bar screen can be placed.

It is about 600 ft. from this point to Frankford Creek, and there is a difference in elevation between the creek and the invert of the sewer of about 15 ft. This made possible the construction of a circular sewer only 6 ft. in diameter, laid on a grade of 2.335 ft. per 100 ft. to carry the maximum quantity of water at a very high velocity. In order to prevent discharge of the water in a manner to tear out the banks of the creek, the last 150 ft. of the sewer was made 8 ft. in diameter, built on a curve with a 70-ft. radius and with an invert grade of 0.4 ft. per 100 ft. This will reduce the velocity of maximum flows low enough to prevent erosion of the banks of the creek.

Screen and Grit Chamber

According to the comprehensive plan, the Frankford Creek high-level intercepting sewer and the Somerset high-level intercepting sewer join in the vicinity of Lycoming and O Sts., from which point their combined flows will be carried to the Northeast works. As the project involved about 7000 ft. of inverted siphon, it was deemed advisable to construct, at the point of the junction of the two intercepting sewers, the necessary works for screening and removal of grit from the sewage. For this purpose the city purchased an entire block of ground and the grit chamber is approximately in the middle of it.

Since the surrounding territory is expected to develop into a residential section, it was thought best to design the grit chamber so as to eliminate danger of nuisance and to permit the square of ground acquired for sewage disposal purposes to be made available as a park or playground. The entire structure will therefore be underground, covered by a roof and artificially ventilated, the only part showing above ground being an ornamental parapet wall and an office superstructure of pleasing architecture.

From the overflow chamber a short length of sewer will deliver the sewage to the west or inlet end of the grit chamber, where an inclined fixed bar screen, having 9-in. clear openings, will be placed in the channel in order to restrain from entry large objects which should not but may find access to the intercepting sewer.

Hydraulically-Operated Cage Screens

Immediately east of the screen the sewer will divide into three channels, each 8 ft. wide and provided at their entrances with stop planks, by means of which any one or more may be closed. In each of these channels there will be placed a pair of hydraulically-operated cage screens having two rows of ¾-in. round bars spaced 2½ in. c. to c. and staggered. The hydraulic cylinders will be controlled in such a manner that it will be impossible for both screens to be raised out of the sewage simultaneously.

Two presses will be provided, and the dewatered screenings will be disposed of in an incinerator, within the structure, which will also serve to supply the hot-water heating system for the building.

Immediately beyond the screens each channel is widened by diverging walls to a bottom width of 13½ ft. and a width at the top of 18½ ft. The sides of each grit chamber compartment are made sloping in order that the wetted cross-section of flow shall be such that, with varying depths, the velocity will be maintained at or near 1 ft. per second.

The full section of each grit chamber compartment is 60 ft. long; the inlet and the outlet sections are each 15 ft. long in order to obtain a gradual change in velocity and so utilize the entire 60 ft. of the grit chamber. In each outlet channel will be placed manually-operated regulating devices to increase or decrease the cross-sectional area and so assist in maintaining the proper depth of water in the grit chamber.

The roof of the grit chamber will be supported upon reinforced-concrete columns, carrying a series of girders and beams between which will be reinforced-concrete slabs. Over the grit chamber compartments proper every other slab will contain sidewalk lights with glass prisms. These will be placed in every slab in the west end of the roof over the screens, where most of the work will be done.

Sand Removal and Washing

It was not the intention to throw one of the grit chamber compartments out of service in order to remove the accumulated detritus, as this would have necessitated having four or even five separate compartments. It was necessary therefore to provide a method for the continuous removal of the sand as it accumulates, especially during storm flows. To accomplish this the division walls between the grit chamber compartments have at their tops cantilever walks carrying rails, upon which will travel a platform capable of being moved longitudinally over every part of each grit chamber compartment. Upon the platform a motor-driven centrifugal pump will be mounted, the suction of which is a flexible hose terminating at its lower end in a metal foot-piece. By means of a boom and suitable cables it will be possible to move the foot-piece transversely into any position and to hold it at any height above the invert of the grit chamber. The pump will discharge through a vertical riser into metal troughs carried on the sides of the columns supporting the roof and leading to the two sand-washing bins, each 15 ft. long, 11½ ft. wide and 13 ft. deep. The pumped sewage, carrying about 10% detritus, will enter the sand-washing bin through a port, and the sewage will be collected at the outlet end over a weir extending the width of the tank, from which it will be conveyed by piping under the floor to the inlet channel leading to the grit-chamber compartments.

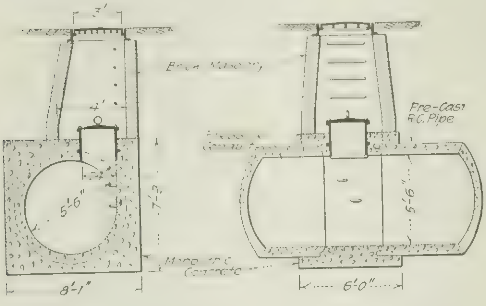
In the bottom of each of the sand-washing bins there will be placed the manifold piping and gravel commonly used in water purification, through which either air or water can be forced to wash the detritus free from organic material, the wash water being also collected from the weir and conveyed to the inlet channel to the grit chamber.

Over the sand washing bins will be placed an elec-

trically-operated traveling crane, the bucket of which can remove the clean sand and convey it to a loading platform, from which it can be hauled to the Northeast sewage-works by motor trucks for replenishing the surface of the sludge-drying beds. To protect the gravel from the dredging bucket, perforated cast-iron plates supported on concrete walls will be used to cover the gravel.

Beside the sand-washing bins, a sand-storage bin is provided which can be used in case of severe weather conditions or of a breakdown in the motor service requiring accumulation of sand at the grit chamber.

As the grit chamber is entirely underground and covered with what is practically a glass roof, adequate ventilation was provided. In the west and south side walls, at about ground surface, ventilating openings will be built which normally will be the only means for admission of fresh air to the grit chamber. In the northeast corner a ventilating fan will be placed of capacity sufficient to change the air in the grit chamber every 12 min. The discharged air will be conveyed by an air duct to the nearby storm-water overflow sewer.



MANHOLES UNDER PRESSURE HAVE INNER BOLTED-DOWN CAST-IRON COVERS

To prevent air from the inlet and outlet sewers entering the grit chamber and destroying the ventilating system, air baffles will be hung in the inlet sewer and in each of the three outlet conduits. They will have spherical floats at the bottom, so that the lower edge of the baffle will just touch the surface of the sewage.

The minimum quantity of sewage expected to be handled in this grit chamber is 25,000,000 gal. a day, but its maximum daily capacity, with largest estimated flows in 1950, will be 170,000,000 gal. By means of the regulating devices in the outlet channels and the use of a proper number of grit-chamber compartments, it will be possible to maintain proper velocities for practically all rates of flow between the limits given.

Intercepting Sewer from the Grit Chamber

The sewage will be conveyed from the grit chamber for a distance of 1100 ft. in a sewer having an arch and an invert of the same shape as the sewer approaching the grit chamber, but it was designed with an invert grade of 0.2 ft. per 100 ft., while the grade of the arch is 0.02. This is accomplished by increasing the vertical side walls of the sewer from 3 ft. at the upper end to 5 ft. at the lower end. This was made necessary by the very great range in sewage flow.

The invert grade will produce self-cleansing velocities for the low flow, and the arch grade is parallel to the estimated maximum flows in 1950.

Between the lower end of this portion of the sewer and the Northeast sewage-treatment works the surface of the ground and the confirmed curb height of the streets is below the hydraulic grade line for discharge at El. +16 at the Northwest sewage-works, and it became necessary to design this portion of the intercepting sewer system as an inverted siphon. Careful study of the varying quantities to be carried indicated the most economical combination of conduits for this purpose to be respectively 5½, 6½ and 7½ ft. in diameter.

With the quantities of sewage anticipated in the near future it is only necessary, at present, to provide the first or 5½-ft. conduit, but as the headworks of the inverted siphon were located at a street intersection where a station on the Frankford Elevated Ry. is to be built, it appeared advisable to construct the headworks of all three pressure conduits across this intersection now as a monolithic reinforced-concrete structure.

The headworks proper consist of an underground chamber containing division walls. Each channel is provided with stop planks, by means of which the flow in the intercepting sewer may be diverted to any one or all of the three pressure conduits. Provisions are made in the headworks to place in the future large sluice gates in front of each tube, so that the flow can be entirely and securely shut off from any one of the tubes.

The sewage will be conveyed through the 5½-ft. and the two future larger pipes for a distance of about 6000 ft. under pressure. To obtain the maximum capacity for these pipes it was necessary to use a type of construction with the smoothest possible interior surface, and to reduce outward leakage to a minimum it was necessary to use a type of construction which would be impervious and provide against leakage through contraction joints.

Precast Reinforced Concrete Pipe

To meet these two conditions it was decided to construct these pressure conduits from precast reinforced-concrete pipes, provided with special grouted joints at their ends, containing copper expansion joints. The pipes were manufactured and stored on the site of the Northeast sewage-works prior to making the contracts for laying them, so that they would be well cured before being placed. The pipes were made of 1 : 1½ : 2½ concrete, reinforced with two layers of wire mesh. For tangents they were made in 8-ft. lengths and for curves in 4-ft. lengths, one end of which was beveled.

In laying the pipe, the concrete foundation was first placed; upon this the pipe was laid true to line and grade. Generally, a minimum cradle of concrete was carried up outside the pipe for a height of 21 in. above the outside bottom of the pipe. When passing under transverse streets subject to heavy traffic and having a small earth cover, or on curves, a maximum cradle was used, which extended up to the outside top of the pipe.

Pressure manholes are made by pouring a monolithic section of concrete between two pipes. In this monolith a flanged cast-iron circular piece is placed, having a bolted-down cover, over which the ordinary brick manhole is built.

This pressure conduit is being built in three contracts, one of which includes a passing under the four main tracks of the New York division of the Pennsylvania R.R. and the 28 adjoining railroad tracks. Another contract includes the grading of the street to provide a minimum cover of 4 ft. over the pipes, as the present road surface was for a considerable distance at about the same elevation as the bottoms of the pipes.

At the lower end of each of the three pressure tubes there will be placed a venturi meter to measure the flow of sewage. If it had been planned in the first use of the pressure conduits to operate them as inverted siphons, the venturi meter could have been placed directly in the line of the conduit, but, as it was deemed advisable to construct the first installation of tanks at the Northeast works at such an elevation as does not require the use of the inverted siphon principle, it became necessary to depress the venturi meter below the invert of the pressure conduit, so that even with very low flows in the bottom of the conduits the venturi meter would be entirely filled. To accomplish this, the lower end of the pressure conduit will be built as a vertical reverse curve made of precast pipe to the lower end of which will be attached the metal part of the venturi meter placed in an underground concrete chamber to contain the various accessories.

From the outlet end of the venturi meter the conduit rises until it reaches an elevation approximately level with the normal grade of the pressure conduit above the venturi meter. At this point there will be built at the present time the foundation for a terminal gatehouse containing the riser tubes which will be built when it is desired to utilize the pressure conduits as inverted siphons. From this point the sewage will flow through a relatively short rectangular concrete sewer to the main influent conduit of the Northeast works, which will consist of 32 rectangular horizontal-flow Imhoff tanks and 80 sludge-drying beds, having a capacity at three hours' retention in the tanks of 60,000,000 gal. a day. The effluent from the works will be conveyed by a rectangular reinforced-concrete conduit to submerged outlets in the bed of the Delaware River.

Supplementary Artesian Supply for Indianapolis

Each Well Equipped With Pump in a Reinforced-Concrete Pit — Special Foot Valve on Each Suction Pipe

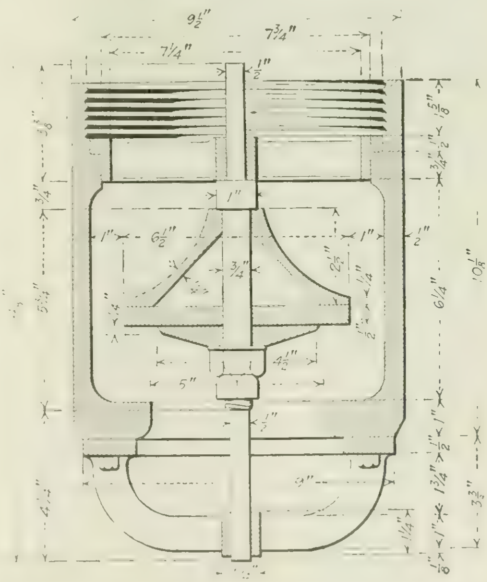
FEATURES of the supplementary artesian well supply being developed by the Indianapolis Water Co. are a special foot valve in each well and a reinforced-concrete pump pit. Fifteen wells will be sunk in addition to the 26 wells now in use at the Riverside station. The old wells are spaced about 360 ft. on centers and yield from 300 to 400 gal. per minute each. The new wells will be spaced 500 ft. apart, and it is expected that each will yield 400 gal. per minute.

The wells now being sunk vary in depth from 325 to 400 ft. They pass through glacial drift for the first 90 ft. and through water-bearing limestone for the remainder of their depth. All the wells are cased with 10-in. pipe to the limestone in order to shut off the water found in the glacial drift. The static head of the artesian supply is 12 ft. below the ground level.

Each well is equipped with its own pump. The 10-in. well casing is capped at the floor level of the pit with a special flange connection. Extending 35 ft. downward in the casing is a suction line of 8-in. wrought-iron screw pipe having a special foot valve at its lower end and reducing to 6 in. at its upper end. Between this upper end and the pump is a 5-in. gate valve.

The pump pits are of reinforced-concrete, with an inside diameter of 6 ft. and an approximate depth of 25 ft below the ground surface. The walls are 12 in. thick. The lower 12 ft. of the pit is subject to ground-water pressure, so a rich mixture of concrete was made for it and a 6-in. bottom provided, the whole monolithic. The 6-in. bottom rests on a slab of plain concrete. Collapsible steel forms were used both on the inside and outside of the walls. The pits are covered with a heavy galvanized-iron conical roof.

Electrically driven centrifugal pumps are used, operating against a total head of 60 ft., of which 25 ft. is suction head and 35 ft. discharge head. The pumps have a guaranteed efficiency of not less than 64%. The suction and discharge lines are each 4 in. in diameter, set vertical. This obviates the necessity of priming the



THERE IS A FOOT VALVE ON EACH WELL SUCTION

pump, as the artesian water level and the foot valve keep them primed at all times.

The improvement is being carried out by the working forces of the Indianapolis Water Co., under the direction of B. J. T. Jeup, chief engineer, and W. C. Mabee, assistant chief engineer.

Taking Soundings Above Niagara Falls from the Shore

Experimenting Develops Effective Use of Triangular Float and Weighted Pole, Controlled by Cables, for Work in Horseshoe Rapids

By Leon R. Brown

Office and Field Engineer, New York State Railways, Rochester, N. Y.

SOUNDINGS of the Niagara River just above the Horseshoe Falls were made by the writer entirely from the shore, the current being altogether too swift for boats, rafts or divers. The special float and weighted sounding pole devised, controlled by cables on windlasses, required a month of experimenting before they would work satisfactorily, but all the soundings were then taken in a few days. The operation took 12 men.

Over a large part of the area of the Niagara River, just above the Horseshoe Falls, between Goat Island and the Canadian shore, the river varies in depth from 10 to 20 ft. and has a velocity of about 30 ft. per second. The bottom is worn very uneven by the action of the water on the limestone and is strewn with many large boulders. The purpose of the soundings was not only to obtain the depth of the water, but also to obtain elevations of the bottom of the river so contours could be shown.

For a person to venture out with a boat or raft, even when secured to the shore with strong cables, was out of the question, for the craft would have been quickly overturned by striking a rock, or drawn entirely under by the swift current. It was impossible, because of the width of the river, to get soundings from a car carried on an overhead cable, and no diver, however heavily weighted, could keep his feet in the river. The conclusion was reached, after some experimenting, that in order not to risk human life some way must be devised to obtain these soundings from the shore.

The plan chosen was to operate a float or raft with cables from the shore. The float contained a sounding pole graduated in feet and weighted at one end, so arranged that it would always remain upright in the water. The pole moved up and down vertically and was operated by a trip rope from the shore. Its position was located by triangulation from the shore, and the elevation of the river bottom was obtained by level readings on the pole.

The float was constructed of three 12 x 12-in. pine timbers 16 ft. long, arranged in the form of a triangle, with the ends mitered and securely bolted. This was much more rigid than a square frame would have been, and did not require lateral bracing. The triangular shape also lent itself especially well to the action of the current and the scheme of navigation that was used to move the float from one point to another.

One of the most difficult problems was to get the float into a position to take soundings. At first, an attempt was made to attach two cables to the float, one secured to a windlass located a considerable distance above the area where the soundings were to be taken, and the other some distance below. These two cables were each attached to a corner of the float, the third corner being allowed to point toward the shore. Fig. 1 shows the plan. The current acting against the upper side of the float was expected to push it out into the river as far as was necessary to take the soundings.

By this arrangement advantage was taken of a great

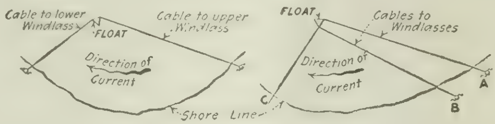


FIG. 1 FIG. 2

UNSUCCESSFUL (FIG. 1) AND SUCCESSFUL (FIG. 2) METHODS OF CONTROLLING FLOAT

bend in the river. It was soon found, however, that the arrangement was not satisfactory. There was so much strain on the cable leading to the upper windlass that four men could not wind it up. At times the float with its long sounding pole was drawn entirely under the water, leaving no evidence on the surface to show where it was. The upper windlass itself was nearly drawn from its moorings and had to be secured by a long timber buried several feet in the earth. The lower cable continually caught under the large boulders in the bottom of the river as the float was moved in toward or out from the shore. But even had this arrangement been satisfactory, it was found that the float could not be forced out into the river far enough to cover the entire area where the soundings were wanted.

These difficulties were overcome by the arrangement

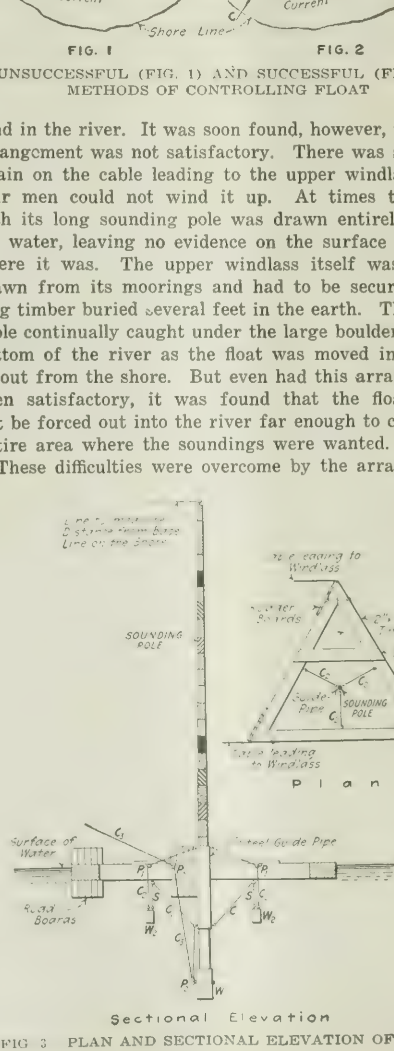


FIG. 3 PLAN AND SECTIONAL ELEVATION OF FLOAT

shown in Fig. 2. The downstream windlass was removed and placed by the side of the upstream windlass, the cables being attached as before to two corners of the float. This at once relieved the excessive strain on the cables. Instead of pulling against each other, they were now pulling together. Short planks nailed vertically on the upstream side of the float formed the rudder, and the control of the float was now almost perfect. The action of the current on the upper side of the float caused it to move away from or toward the shore, depending on the angle the side made with the direction of the current. This was controlled by the two windlasses. At the angle shown in Fig. 2 the float would tend to move out from the shore. The speed at which it would move at right angles to the current was astonishing. By changing the position of the windlasses it would have been possible to move the float entirely across the river. To move it up or down the stream it was only necessary to wind up or play out the cables from both windlasses at once.

A third cable leading to the shore at right angles at the point C was necessary to hold the float stable. At times the strain on this cable was so great that it required several men pulling on a block and tackle to haul the float toward the shore. This cable was found to be very convenient in the taking of a line of soundings at right angles to the shore. By merely paying off the cable, starting with the float near the shore and the rudder set for an offshore movement, one sounding after another could be taken without any movement of the windlasses. The course followed would actually be an arc of a circle, but the radius was so long that it approximated a straight line.

Almost Lost Windlass and Cable

To support the long cables leading from the windlasses to the float and keep them from catching under the large boulders in the bottom of the river, and also to keep the weight of the cables from dragging the float under, empty barrels carefully plugged and made waterproof were fastened to them about 200 ft. apart. These were attached to the cables by clips which passed through rings on special hoops around each end of the barrel. Special care had to be taken to keep the barrels from sliding down the cables. During the experimenting, when one of the windlasses was located near the brink of the falls, the downstream cables parted below the raft and several barrels and a long section of cable went over the falls. But for presence of mind and quick action shown in cutting the cable near the windlass, the windlass with all the cable attached would have been dragged over the falls by the floating barrels.

The sounding pole was 30 ft. long, about 5 in. in diameter, and octagonal in shape. The advantage of this shape was that the paint wore off only at the corners. It was found that a round pole sliding up and down in its pipe soon wore off all the graduations.

The bottom of the pole, for about 10 ft. where it received the most wear, was wrapped in sheet zinc, and around this at the extreme end was cast a lead weight of 200 lb. This was done by pouring melted lead into the space between the pole and a short piece of 8-in. cast-iron pipe, as shown in Fig. 3. An eyebolt that passed through both the pipe and the pole was cast in the lead and provided a place to attach the lift cable.

At first each alternate foot of the pole was painted black and white, but difficulty was experienced in reading it from the shore, as it was not possible to tell from the level instrument on which foot the reading was being made. Later, therefore, each foot was painted a different color, but, unlike the rainbow, the order of colors was arranged so that adjacent colors contrasted instead of blending. As not enough colors were found to paint each foot of the pole a different color, the colors were repeated in the same order. Thus if the levelman read on white he knew that it was either 12 ft. or 22 ft., and a glance at the pole would indicate which, because in the first case there would be 18 ft. of it above the instrument level and in the latter case only 8 ft. In a short time the levelman had associated each color with its number of feet, and so could read it instantly. Readings were estimated to tenths of a foot, and after each reading in the book the color was also marked for a check.

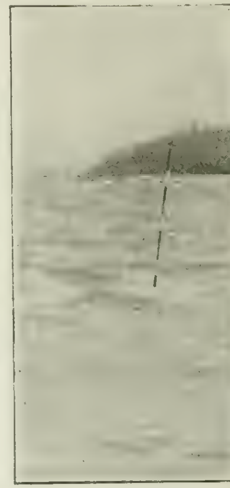
Holding the Pole Vertical

Great difficulty was found in holding the pole vertical at all times. If it were held rigidly at right angles to the plane of the raft it would seldom be in a vertical position, and the violent plunging and rocking of the raft would soon break it off. The problem was solved as shown in Fig. 3, by a system of ⅜-in. wire-rope cables attached to a 5-in. steel guide pipe, through which the sounding pole slid up and down. Three cables or guys, C_1, each about 4 ft. long, went from an eyebolt in the middle of each side of the raft to another eyebolt riveted in the bottom of the vertical steel guide pipe, the cables being of such a length as to bring the top of this pipe about a foot above the top of the raft when the pipe was vertical. The guide pipe itself was 5 ft. long. These supporting guys held the entire weight of the guide pipe and the sounding pole with its 200-lb. weight. The guide pipe was held in a vertical position by three more guys, C_2, attached in a similar manner to the top of the pipe and then passing through pulleys P_1, attached to the middle of each side of the raft. On each of these three guys a weight of about 25 lb., W_2, was hung, the weight being about 3 ft. below the pulley when the guide pipe was vertical. The next step was to provide the supports, S, which were also of wire rope. These went from the weights, W_2, to the same ring in the middle of the side of the timbers where the main guys C_1, were attached, and were of such a length that all three were just barely taut when the plane of the raft was horizontal and the guide pipe was vertical.

With this system of guys and weights it will be seen that if the sounding pole is moved from a vertical position the weight or weights W_2 on the side toward which the pole is moved, stop pulling on the pole, for they are supported by the supporting cable S; on the other hand the weights W_2 on the opposite side are lifted and so tend to pull the pole back to vertical. It might have been possible to obtain this result with springs, but on short notice no satisfactory springs could be found.

The very heavy weight found necessary at the bottom of the sounding pole to cause it to go quickly to the bottom and help hold it upright was difficult to raise from the bottom, it being necessary to do this while

the float was being moved from one position to another. This was accomplished by securing one end of the trip cable, C_3, to the bottom of the steel guide pipe, then passing it through a pulley, P_2, attached to an eyebolt in the weight at the base of the sounding pole. The trip rope then passed through a second pulley, P_3, attached to a brace on top of the float, as shown, whence it went directly to the shore. This reduced by half the force that would have been required to lift the sounding pole if the trip rope had been secured directly to the weight, and also made the force lifting the weight more directly vertical, and at the same time put a strain on the guys, C_1, thus tending to hold the entire arrangement in a more stable condition.



LEFT—NEAR VIEW OF FLOAT AND SOUNDING POLE

CENTER—NOT FAR FROM BRINK OF FALLS—LEVELMAN WORKING ON SPECIAL SCAFFOLD

RIGHT—FLOAT DRAWN NEARLY UNDER BY SWIFT CURRENT—RIVER 20 FEET DEEP

Triangulation for locating the soundings with the aid of two transits on the shore was found unsatisfactory after trial, owing to difficulty in getting the readings simultaneously, and the necessity of plotting up the locations each time to be sure the soundings were being taken at the proper points. This method was abandoned for the range system. A base line was established near the shore with white stakes driven every 20 ft., and directly back of these another row of stakes was set, each stake being directly opposite the corresponding one in the base line. The sounding pole on the raft could then be brought into line with two of these white stakes.

The distance of the raft from the base line was measured by a line running from the top of the sounding pole to the shore. White tags were tied on the line at each 20-ft. point, starting on the pole as zero, and the tags were marked 20 ft., 40 ft., etc. When the line was taut the number of the white tag over the base line indicated the distance of the sounding pole from the shore.

When soundings were being taken four men operated the windlasses, two the trip rope, four the tackle attached to the cable leading at right angles from the shore to the raft, one man read the level and a signalman directed the work. The signalman gave instructions to the men at the windlass by the aid of a red and a white flag—the red flag for one windlass, the white one for the other. A flag held high in the air meant wind up; horizontal, pay out. It was not necessary to use the signals a great deal, for when a regular order for taking soundings was established and all understood which sounding was to be taken next, each person knew just what he must do to get the float in the proper position to take that sounding.

In order to get the level closer to the water and thus eliminate the need for a longer sounding pole, a special tripod was devised which brought the telescope about a foot above the surface on which it was standing. The level was then placed on a stone pier which projected above the water, and a special scaffold was made to hold the levelman.

The operation of the sounding apparatus was now found to be nearly perfect. The first soundings were taken upstream, and as near to the windlasses as was possible.

Starting at the shore a row of soundings was taken out at right angles to the shore. The raft was then let downstream 20 ft. and another row taken back toward the shore. When it was in the best working order a sounding could be taken and the raft moved to another position in about a minute. It required, as previously stated, a month of experimenting to get the float in good working order, but when the float was completed all the soundings were taken in a few days. To take a sounding the signalman would get the raft into position to take the soundings by flag signals to the men at the windlasses and those at the snubbing cable that regulated the distance of the raft from the shore. When the raft was in proper position he would call "Trip," the men on the trip rope would let go and the sounding pole would drop vertically to the bottom of the river. The levelman would take his reading, and when he signaled all right the sounding pole would be pulled up and the raft moved into position for the next sounding. The range numbers and the distance of the soundings

from the base line were given by the signalman to the levelman and recorded with the level readings.

The writer believes that however swift the current or uneven the bottom, however wide the river or turbulent the water, or however dangerous the location, accurate soundings may be taken in water up to 20 or 30 ft. deep cheaply, quickly and safely with an apparatus of this general description.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Remission of Initiation Fee as Special Inducement

Initiation fees required of those joining the Engineers' Society of Western Pennsylvania are being remitted during the war, as a special inducement to get engineers into the organization. The membership committee feels that the most important thing is financing the going organization, which must be done almost entirely by the dues; the initiation fees go into a permanent fund. The activities of the society and its attractiveness to its members depend largely upon keeping up the membership. In addition, members of the four national societies are admitted, without further formality, to the similar grades in the local society.

Southwest Engineer Outlines Proper Society Activities

Three fundamental causes were given as reasons why engineers as a body are not usually invited to discuss public matters, by E. E. Sands, city engineer of Houston, Tex., in addressing the newly established Houston Engineers' Club. They are as follows: Improper education; lack of recognized standards, and devotion to strictly technical matters rather than Governmental activities or economics. Technical schools have been weak, Mr. Sands said, in that they have devoted a large amount of time to such matters as foreign languages and other subjects that are of no practical benefit to the practicing engineer, and have neglected to give the engineer proper training in such matters as practical English, corporation finance, civil government, banking practice, auditing, cost keeping, commercial law, management, and many other branches that are considered essentials by the man who conducts either a public or a private business on a large scale. The lack of a professional standard is recognized by all of us, in Mr. Sands' opinion. He said that any man can establish an office and advertise himself as an architect or an engineer, and if he can get clients who are willing to pay him for his services there is no way (regardless of his qualifications) to prevent him from making an attempt to practice the profession. Before a man can practice medicine, he must pass certain examinations; before he can practice law, he must be admitted to the bar, where his qualifications are judged solely by those already in the legal profession; but the legislatures of most of our states have either neglected or absolutely refused to pass laws that would put engineering and architecture on proper professional planes.

The members of the engineering profession, due to the peculiar training they have received and the character of the work which they follow, are likely to be clannish, and are inclined to prefer association with other engineers and the discussion of technical subjects to taking active interest in public and social affairs—such interest as is necessary to enable a man to view public problems in their broader aspect.

Some of the problems which Mr. Sands felt the club could take up with profit are public sanitation, regulation of street traffic, the motor truck problem, the matter of securing highway and paving funds, the state highway law and its administration, the state conservation law, the state sanitation law, known as the "Anti-stream pollution act," garbage removal and disposal, state and city building codes, plumbing codes, electrical codes, the building and maintenance of city streets, county road and drainage projects, street widening projects, fire protection, grade crossings, traffic laws, street lighting, the rates and franchises of public utility corporations and the platting and subdividing of land in and around cities.

"The whole career of an engineer," said Mr. Sands, "consists of investigating conditions, applying the principles of mechanics in designing structures to meet the conditions found, revising plans to secure the approval of those who have had large experience and are possessed of sound judgment, and last, but not least, to organize crews of workmen to carry out the plans with honesty, efficiency and economy. What better training is there to fit a man for public life? As members of the profession you not only owe it to yourselves but to the public to give its affairs careful consideration and, after mature thought, to let your voice be heard."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Is Surface-Area Grading of Concrete Misleading?

Sir—The paper on "Proportioning Concrete by Surface Areas of Aggregates," which Capt. L. N. Edwards read at the June meeting of the American Society for Testing Materials and of which you present an abstract in *Engineering News-Record* of Aug. 15, suggests conclusions which would seem to need further comment. Captain Edwards has made a thorough study of one phase of the subject of aggregating, that of coating all aggregates with cement. But it is only one phase, and the conclusions must be more or less misleading and cannot by themselves lead to the solution of a very important problem.

The principle which his investigations attempted to prove is that strength of concrete depends directly on the ratio between the quantity of cement and the total area of aggregate—on how well each grain of aggregate is coated with the gluing material, the cement.

Captain Edwards adduces a series of tests showing that where this ratio is constant the strength, both tensile and compressive, is also constant.

If this principle is correct and if there were no other variables that entered into the series of tests, it must also hold if carried to still greater extremes. For instance, from Captain Edwards' table it appears that of sand passing a 4-mesh screen and held on an 8-mesh, there are 14 grains in a gram; from a diagram it appears that such sand has about 1 sq.in. of surface area per gram. To coat these areas as thoroughly as were the tested samples would require only one gram of cement to 13 grams of such sand; it should show the same strength in a 1: 13 mixture as those that were actually tested.

If proportioning concrete were entirely a question of coating surfaces this 1: 13 mortar should test as strong as the rest. One could go further and simply coat coarse aggregates with cement in absurdly lean mixtures and expect the same strength. The real problem in aggregating at once presents itself—that of filling voids. They must be filled. Every desirable property of concrete—strength, toughness, impermeability, resistance to wear—all demand density. Captain Edwards' series of tests did not go beyond proportions where sufficient cement is supplied to fill voids, and within those limits his conclusions are probably correct, but they do not in any manner point the way to the best concrete. They do not tell us what to fill voids with.

The problem has two aspects: Not only must all surfaces be coated with cement, but voids must be filled. It is to reduce surface areas that we use coarse aggregates—the largest that the character of the work permits and as many of them as possible. But even-sized coarse aggregates have 40 to 50% of voids, and these must be filled. Again, to keep down the proportion of areas to be coated they should be filled with the largest grains possible without spreading the larger aggregates, and so on down to the microscopic cement. In short, a mixture of sizes alone will fill voids.

Captain Edwards' conclusions are misleading in so far as they tend to create the impression that a proportion of 50- and 100-mesh material in sand is not beneficial. The grading should continue down to the cement, which is virtually all less than 1/200 in. in diameter, because 40-mesh sand has still voids that are large as compared with the cement particles. These voids may have diameters 10 times greater than that of the cement grains, which means that they have 100 times the area and 1000 times the volume, so that it may require 1000 grains of cement, even after surfaces are coated to fill the voids—which it is so essential to do. Even these voids had best be filled not with neat cement but, to reduce the areas to be coated, with the largest grain of sand that can be used, 80—100-mesh or even 200-mesh aggregates. In short, grading must continue below 40- and 50-mesh to gain the best results.

All research on this subject bears out this assertion. Innumerable tests, in which the fine aggregates were divided into three grades and all possible combinations of these grades were tested, show that the greatest tensile strength is attained when 20% of the fine aggregates are such as pass a 50-mesh screen. The accepted grades are ¼ in.- to 20-mesh, called "coarse," 20- to 50-mesh, called "medium," and the "fine," passing the 50-mesh screen. The results plotted on the Feret triangle show that 70% of coarse, 10% of medium and 20% of fine sand produces maximum tensile strength in mortar mixtures.

Another consideration enters. Most of the tests reported were made with mortar only, not with finished concrete. In mortar, then, we find 70% of the largest permissible grains (those ranging from ¼-in.- to 20-mesh) beneficial with only 10% of medium and 20% of fine. In actual concrete in which coarse aggregates are added to the mixture, we would also find that about 70% of the largest permissible size (now the coarse aggregates) would produce optimum concrete. Fine aggregates—the remaining 30%—would then take a place corresponding to the two grades of "medium" and "fine" in the mortar tests. The proportion of coarse sand necessary to gain maximum results would be greatly reduced, and the proportion of fine grains would be correspondingly increased.

It would seem, therefore, that the final report, July, 1916, of the Joint Committee on Concrete and Reinforced Concrete is not in error in recommending as it does the use of sand or screenings of crushed stone graded from fine to coarse of which not more than 30% by weight should pass a sieve having 50 meshes per linear inch.

In spite of the fact that it takes 10 times as much cement to coat 100-mesh sand as 10-mesh, and that concrete made entirely of dust is impossible because there are too many joints to glue, still nothing should be done to create the impression that a percentage of fine dust is detrimental to the concrete. It is beneficial; theory and practice both confirm this, and the recommendation of the Joint Committee, to limit 50-mesh and finer grains to 30% by weight of the fine aggregates, is conservative.

R. W. SCHERER,
Secretary, Wisconsin Crushed Stone Association.
Milwaukee, Wis.

The above letter was submitted to Captain Edwards, who replied as follows:

Sir—The component materials of an ordinary mortar mix are cement, water and sand aggregate. A concrete mix is produced by the addition of stone aggregate to the mortar mix. The cement and a portion of the water combine chemically to form the cement matrix, which ultimately binds together the inert aggregate particles.

"While the character of the aggregates and the amount of water used influence results to a marked degree, the proper proportioning of the cement is a matter of the utmost consequence, since this is the only active, strength-producing material entering into the mixture." Speaking broadly, the above quotation from the paper in question appears to cover the general situation. That the proper proportioning of the materials of a mortar or of a concrete mix is an intricate problem, containing many variable factors, some of them unknown, is generally conceded, and appears to be in accord with Mr. Scherer's views.

In the fourth paragraph of Mr. Scherer's letter the statement is made, "The real problem in aggregating at once presents itself—that of filling voids. They must be filled. Every desirable property of concrete—strength,

toughness, impermeability, resistance to wear—all demand density." This statement (slightly modified in the following paragraph) indicates clearly that its writer accepts the fundamental principle of the century-old void method of proportioning concrete materials. The formula for this method when reduced to its simplest form is: "Find by actual test how much cement it takes to fill the space in the sand, also how much mortar it takes to fill the space in the stone, and proportion the materials accordingly."

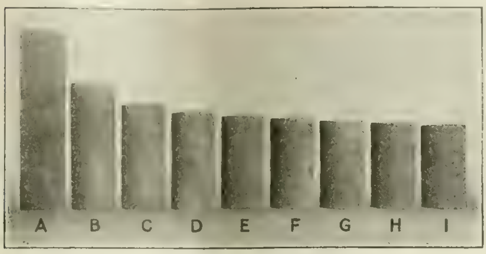


FIG. 1. MORTAR CYLINDERS IN WHICH CEMENT CONTENT WAS DECREASED

Grams cement to sq.in. sand area:

(a) 1:5	(d) 1:20	(g) 1:35
(b) 1:10	(e) 1:25	(h) 1:40
(c) 1:15	(f) 1:30	(i) original sand

The many factors tending to render difficult the absolute determination of the voids in the materials are too well known to be discussed further here. Passing now to the practical value of a knowledge of the percentage of void existing in a given sand, the author's test, "Bulking Effect of Cement Content of Mortars," clearly shows that the original volume of the sand is appreciably increased by the addition of a comparatively small quantity of cement. Figs. 14 and 15 of the original paper are here reproduced as Figs. 1 and 2, and the following is quoted therefrom:

"In this connection it is of interest to note that the void in sand "F" was found to be 31.3 per cent. By the void method of proportioning the quantity of cement paste necessary to fill the void in 1200 g. of sand bulking 41.29 cu.in. would be 12.92 cu.in., requiring 374.3 g. of dry cement. With no allowance for the separating of the sand particles, this corresponds approximately to a cement content, 1 g. cement to 22 sq.in. sand area, by the surface area method."

Figs. 1 and 2 provide no evidence tending to show the practical value of a knowledge of the percentage of voids, since they indicate no marked change in the increment of increase of volume due to the cement content exceeding the voids.

Mr. Scherer asserts that the "series of tests did not go beyond proportions where sufficient cement is supplied to fill voids." In this connection attention is directed to test series No. 2 of the tests wherein two tests contained less than this amount of cement. However, the test results (Fig. 3, *Engineering News-Record* of Aug. 15, p. 318) give no special evidence of this condition.

Why must we fill the voids? Nature, the great mortar and concrete maker of a pre-man period, appears to have totally disregarded this refinement in the construction of the hardest, toughest, strongest and most reliable sandstones (mortars) and conglomerates (concretes). A microscopic examination of the most reliable of these materials will show this statement to be true. Such an examination will also show that nature apparently gave no special care to the obtaining of a "maximum density" grading of the aggregates. However, be that as it will, the examination will further show ample evidence of carelessness in the final placing of the particles, for the largest particles are very frequently found to be wedged and held apart by the smaller ones. Fig. 3 shows (a) a photomicrograph of Caledon (brown) sandstone, and (b) a photomicrograph of the fractured surface of a very weak but thoroughly compacted cement mortar. Note the similarity in the hit-or-miss arrangement of the small particles. A perfect distribution of the sand particles such as Mr. Scherer suggests is quite contrary to nature's "habitual distribution," and, to say the least, is unattainable by any mortar- or cement-making methods now in use.

The microscopic examination of nature's sand mortars shows another, and we believe, a more interesting and possibly a more important detail in their construction, viz: Nature, by depositing the greater portion of its cementing material at the points of contact of the sand particles, has obtained maximum strength by the use of minimum quantity of cementing material. Here we have the most important difference between natural and artificial mortars. The former are "percolator produced," the latter "mixer produced."

From the above considerations we conclude that, in so far as the physical properties of sandstones are concerned, these properties are considerably less dependent upon the void contained than upon the hardness, strength and other physical properties of the inert materials and the strength and volume of the cementing medium holding their component particles together.

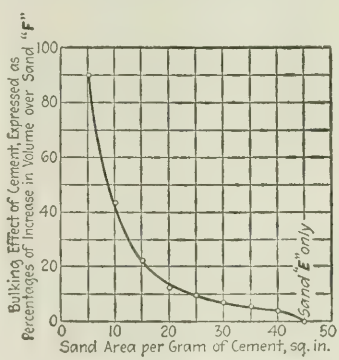


FIG. 2. RELATION OF CEMENT CONTENT TO BULK OF MORTARS

The real object and purpose of the stone aggregate in concrete is, the writer believes, somewhat at variance with that stated by Mr. Scherer. Apart from its effect upon the strength of the final mass in comparison with that of the mortar alone, its inclusion in the mix distends and "bulks up" the mortar to an extent equal to the net volume of the stone content of the mix. Disregarding the effects of excess water, poor workmanship, time of mixing and various other conditions affecting the strength of cement, its strength is depend-

ent upon the physical properties of the stone and upon its volumetric relations to the mortar content of the mix. If the strength of the stone be equal to or greater than the strength of the mortar portion of the concrete, then the reduction in strength as compared with the mortar is approximately as shown in Fig. 4, the data for which were obtained from a series of tests made by the writer. Economy of materials, cement in particular, consistent

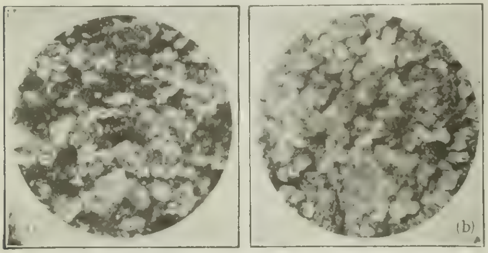


FIG. 3. DISTRIBUTION OF SAND PARTICLES IN SANDSTONES AND IN MORTARS
(a) Caledon Brown Sandstone. (b) Cement Mortar.

with the obtaining of a desired strength is, therefore, the primary purpose and object of the use of the stone aggregate in concrete.

It is not clear how Mr. Scherer gained the impression expressed in the first sentence of the sixth paragraph of his letter. All sands used in the tests contained material passing the Nos. 40, 50 and 80 sieves and retained upon the No. 100 sieve. The tests clearly show that by the surface-area method of proportioning, sands passing a No. 40 and retained upon a No. 100 sieve are adapted to the production of mortars possessing strengths equal to mortars of the same cement-area ratio produced from sands passing a No. 4 and retained upon a No. 100 sieve. The point raised in the latter portion of the paragraph is fully dealt with in the discussion of "Practical Limitations" of the method.

In the seventh paragraph of his letter Mr. Scherer apparently has in mind a sand graded to "Fuller's Curve of Maximum Density." Such a sand, if used in a 1 : 2 : 4 (volume method) concrete would produce a harsh "unworkable" mix, having little cohesion between its component materials. The proper placing of such concrete within the forms would involve an excessive amount of labor, difficulty and expense. Sands approximating this grading are rarely found in natural deposits. They are entirely inadaptable for the production of practical mortars and concretes. As compared with such a sand the author contemplates only the use of well graded coarse sands adapted to the production of a "workable" mortar or concrete mix.

In the eighth paragraph Mr. Scherer gives his specification for inert aggregate to be used in concrete. The percentage of stone particles (over ¼ in. diam.) is about 5% greater than is commonly used in concrete making. Doubtless the concrete mix produced by the use of such aggregate would prove "stony" and somewhat "unworkable." The concrete when thoroughly hardened would be short and friable rather than tough and durable.

The nominal sizes of sieves Nos. 4, 10 and 100 are 0.025, 0.075 and 0.0055, respectively. The surface areas of sand particles passing these sieves bear a somewhat different relation to each other from that stated by Mr. Scherer in the last two paragraphs of his letter.

The recommendation of the Joint Committee contemplates the use of sands passing a No. 4 sieve, and limits the portion passing a No. 50 sieve to 30%. Natural sands fulfilling the committee's requirements will rarely contain a percentage of sandy "dust," passing a No. 100 sieve, exceeding 3% to 5%. Such a sand, well graded from coarse to fine, is adapted to the requirements of a general concrete, the component materials of which are proportioned by the commonly used volume method. It may or may not be satisfactory for use in concretes in which special density, toughness, impermeability, etc., are important factors. The "surface-area" method is adapted to the use of a wider range of sand gradings than is contemplated in the committee recommendation.

Mr Scherer's claim, "It is beneficial; theory and practice both confirm this," having reference to the in-

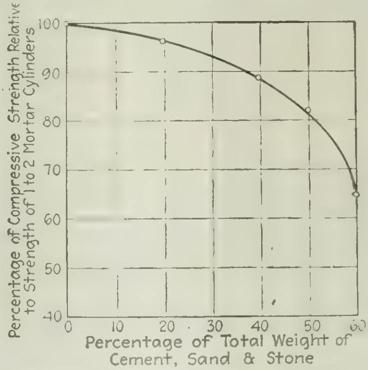


FIG. 4. RELATION BETWEEN STRENGTHS OF CONCRETE OF DIFFERENT STONE AGGREGATE CONTENT

clusion of "dust" in sand aggregate, is, to say the least, far reaching. The writer has failed to find a published record of a complete and systematic investigation of the effects of "dust" in sand aggregates, proving such a claim. Theory, as contained in our best books on concrete design and construction, makes no claim tending to show that it is beneficial. Practice, as recorded in a well known standard specification (American Railway Engineering Association), limits its existence to 6%, not because of its beneficial effect, but for purely practical reasons.

LLEWELLYN N. EDWARDS,
Supervising Engineer of Bridges.
Toronto, Ontario.

Track Elevation at Chicago Is Checked

By agreement between the city, the railways and the Director General of Railroads the progress of track elevation in Chicago will be limited mainly to the completion of two pieces of work whose present condition causes interference with street traffic. These are on the Baltimore & Ohio R.R. between 64th and 69th Sts., and the Rock Island Lines between Vincennes Road and 87th St. The costs are estimated at $200,000 and $185,000, respectively. Work estimated to cost more than $6,000,000 has been deferred until after the war.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Ladies Enter the Lists Against Labor Turnover

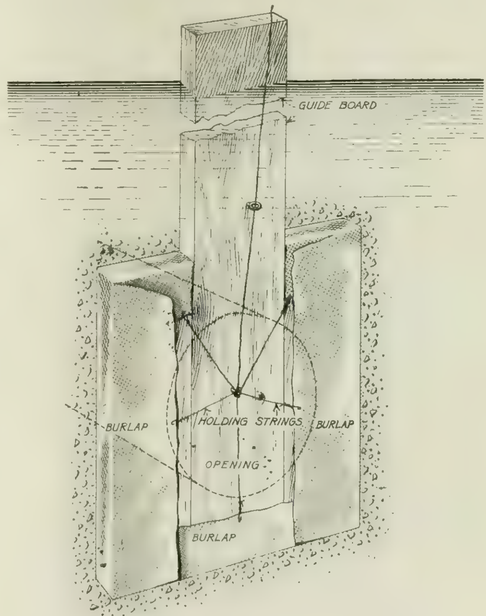
LABOR turnover, that ancient foe of the contractor, is destined, if the editor possesses prophetic vision, to receive a stunning wallop from the wives of the workmen on a large construction job recently visited. Some hundreds of workmen are employed and most of them live in construction camps. The bunk houses at these camps are distinctly model buildings of their sort, but they are not the camp structures which first challenge attention. The latter are the scores of family cottages for managers and machine operators and skilled artisans. Painted outside, decorated inside, architecturally attractive, having running water, electric lights, kitchen ranges, water heaters, bath rooms and sewer connection, these cottages have little resemblance to the ordinary packing-box type of camp houses for married workmen. So pretty were some of these homes which had been occupied longest that they invited an intrusion which the house mistresses met with courtesy. Now, the abounding pride with which these ladies pointed out the curtained windows, called attention to built-in cupboards and cases of drawers, and opened clothes closets and little attic store rooms, bred a thought. That thought was that none of these wives would be likely to greet with encouragement a proposal to tear up, pack up and move away, unless "friend husband" produced a mighty strong argument for the change.

The creation of such a mental attitude in the worker has more than sentimental merit. It has a direct monetary value in decreasing labor turnover. At first sight, perhaps, it seems a long road from lace curtains to labor turnover, but when one comes to pace the distance he discovers that the two are only across the way from each other. A contented wife is a great factor in making a contented workman, and a contented workman does not lightly change his job, and lace curtains and the things they signify have much to do with making contented wives. On visiting these camp cottages the editor wondered how a man had managed to think of and take trouble over all the little housekeeping conveniences and embellishments. The answer is that he didn't. That is, he didn't think of them all by himself. He, too, had a wife and when he had roughed out his camp-house plans she said, "Now that you have made them strong and warm and sanitary, I will make them livable," and she put shelves here and a closet there and a cupboard in another place wherever there was space, and saw that there was a window over the kitchen sink and a place for an ice box, and looked out for all the really important things, including rods for lace curtains and trellises on the porch columns for morning glories, which a woman finds necessary to make a home out of a house. So all this is why this talk started out with the statement that our enemy, labor turnover, seems likely to make way for the ladies after successfully blocking the efforts of menfolk since Solomon built his temple.

C. S. H.

Closing the End of an Inlet Pipe

IT BECAME necessary to make a connection to the 24-in. supply pipe from a reservoir at a point where the pipe was about 12 ft. below the level of the water in



BOARD PLACED OVER THE END OF INLET PIPE

the reservoir, writes James M. Purcell, Richmond, Va., in a recent issue of *Power*. The pipe had no shutoff valve and attempts were made to close its inlet end with bags of sand without avail. A wooden "gate" was then tried but considerable water leaked in between

Other Articles of Interest to Contractors In This Issue:

the wood and the irregular surface of the end of the pipe. Finally the job was made a success by placing a heavy canvas bag over the "gate" held snug by a string, as shown, before pushing it down in front of the pipe. When in position the string was broken and the bag released. The water pressure then forced the canvas into the leak holes and stopped them.

Charts Give Contents of Cylindrical Tanks Without Computation

By E. Earl Glass
Monrovia, Cal.

CHARTS which give, without computation, the number of United States gallons of liquid remaining in any horizontal cylindrical tank when the depth of liquid is known, are shown in the accompanying illustrations.

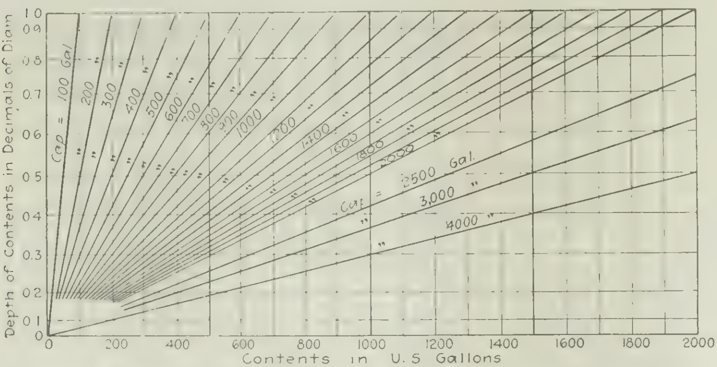


FIG. 1. CONTENTS OF PARTLY-FILLED HORIZONTAL CYLINDRICAL TANKS

One chart gives the total volume of any cylindrical tank when the diameter and length are known. The other shows the actual number of gallons in the tank in functions of the depth of contents in decimals of the diameter, and the total capacity in United States gallons. These charts have been found very convenient for the use of road-oiling inspectors, in determining the quantities of oil received upon the highways.

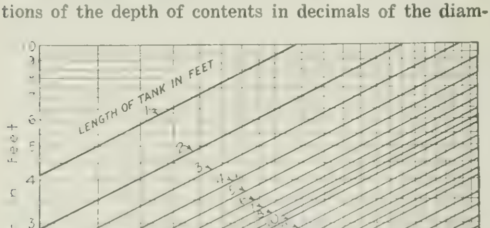
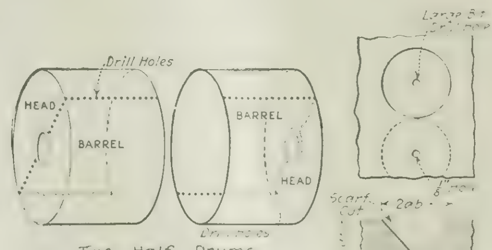


FIG. 2. TOTAL VOLUME OF CYLINDRICAL TANKS

As an example of the use of the charts, if the depth of oil in the tank is 3.4 ft., and the tank is 4.5 ft. in diameter and 9.5 ft. long, Fig. 2 gives its total capacity as 1130 gal. Dividing 3.4 by 4.5, the tank is seen to be 0.76 of the diameter full. For a tank having a capacity of 1130 gal. this decimal, as shown by Fig. 1, gives the contents as 920 gallons.

Mixer Drum Cut Into Quarters to Go Through Tunnel

CUT into four parts, two cast half-drums for a cubic yard concrete mixer are to be carried by cars through a 4 x 6-ft. tunnel four miles long and reassembled by oxyacetylene welding at the job on the opposite side of the mountain. As the drum is manufactured it is cast in the form of two half-drums, each with barrel and head in one piece. The method of cutting the half drums in two at the factory is indicated by the sketch, which, it is to be noted, is diagrammatic and does not depict the actual shape of the drum. Along the lines shown rows of ½-in. holes were drilled through the shell of the drum. Each hole was then enlarged by a drill having a bit width twice the thickness of the shell. This method of drilling gave in large measure the scarf needed in welding the parts together on the job. When the half-drums had been broken apart on the lines of the drilled holes the scarf was finished smooth with hammer and cold chisel. Assembling at the job is merely a task of welding, by the use of oxyacetylene, the halves of the half-drums. To prevent possible error



METHOD OF CUTTING HALF DRUMS IN TWO

in performing this task the drum parts were numbered at the shop in the order in which they are to be welded. Besides cutting the drum, the shop made up other parts of the mixer so that they could be dismantled into fractions which could readily be shipped through the tunnel.

The mixer was manufactured and prepared for shipment as described by the Oshkosh Manufacturing Co., Oshkosh, Wis.

NEWS OF THE WEEK

New York, October 3, 1918

Bridge Policy Outlined By Highways Council

Will Permit Only Urgently Needed Construction—Present Structures Should be Maintained

The United States Highways Council states that it considers only three classes of bridge projects as worthy of approval during the period of the war. These are bridges urgently required as military necessities and so recommended by the representative of the War Department to the council; replacement of unsafe bridges which cannot be made safe through suitable repairs, traffic regulations, or detours; replacement of bridges which have been destroyed and which are a direct or indirect war need.

In carrying out this policy, says the council, every endeavor should be made to keep existing structures in service by all available means, such as: (a) effective supervision; (b) suitable repairs; (c) control of traffic; (d) prohibition of the use of bridges by street car, road rollers, traction engines and other heavy vehicles. The possible relief of a weak bridge by a detour utilizing a safe structure should be investigated. The improvement of such a detour by using materials which can be obtained without serious delay may be preferable as a war-time measure to the reconstruction of a steel bridge.

Attention is also called by the council to the facts that in some sections of the country the urgent Government requirements for cement are now very heavy, and that materials like cement and brick cannot now be turned out in the same quantities as in peace time on account of fuel shortage. Consequently, public officials are not justified in changing their plans for proposed structures from steel to concrete.

If public officials find that it is impossible to maintain existing structures, and cannot substitute temporary bridges for those that are unsafe, they should apply to the United States Highways Council, using forms obtainable from their state highway departments, for approval of their projects. With each application there should be a statement of the size and date of construction of the bridge, the conditions of the piers and abutments, any stream conditions, such as floods or caving banks, which affect the maintenance or reconstruction of the bridge, the local materials available for bridge work and evidence of the impossibility of maintaining the present structure or substituting a temporary structure of materials obtainable without Government assistance. Public officials are reminded that the United States Highways Council looks to them for assistance in reducing to the absolute minimum the use of bridge materials required.

New Exceptions to Construction Rules of Industries Board

Highway and pavement constructions now substantially under way, and farm constructions not exceeding $1000 in cost, may proceed without permit by the War Industries Board, as exceptions to the general regulations governing building construction during the period of the war. The regulations were outlined in *Engineering News-Record* of Sept. 19, p. 557.

Construction projects for the production (but not refining) of mineral oil and natural gas may also proceed without special permit.

Place Highway Transport Employees in Deferred Class

Concerns engaged in the transportation within cities and along the public highways elsewhere of necessary commodities may claim deferred classification for their necessary employees under the provisions of the recent act of Congress referring to "persons engaged in industries, occupations, or employments, including agriculture, found to be necessary to the maintenance of the military establishment, or the effective operation of the military forces, or the maintenance of national interest during the emergency." The above statement was authorized by the War Department from the office of the provost marshal general.

In such cases, as in all others where claim for deferred classification is made on this ground, evidence must be submitted to the district board to show that the particular concern making the claim is included under the definition given above.

Preparing Chicago for Short Haul Embargo

The Illinois State Council of Defense expects to be in a position within the next few weeks to arrange for handling through return load bureaus all less-than-carload shipments by motor truck and trolley lines within a radius of 100 miles of Chicago. The Chicago Association of Commerce has requested its members to coöperate in developing a system of highway and trolley transport as a war time need and patriotic duty, and help to thus relieve the railroads of every ton of freight that can be carried otherwise.

Civil Engineers Wanted in the Navy

Men Between 25 and 35 To Be Commissioned as Junior Lieutenants—Examination Closes November 11

Temporary appointments as assistant civil engineer, Corps of Civil Engineers, United States Navy, with the rank of lieutenant, junior grade, to be made before the new year, will be filled from an eligible list to be established by an examination now open to qualified engineers between the ages of 25 and 35. The candidates must be American citizens who have received an engineering degree from a college or university of recognized good standing, and must have had not less than two years' practical experience since graduation. Those already in the service of the United States are eligible, but must obtain release from their present connection before appointment. Likewise, those subject to the selective draft must obtain releases from their draft boards.

The examination will be nonassembled. The procedure is, first to forward to the examining board, bureau of yards and docks, United States Navy, filled out, the blank shown below. This must be sent as soon as possible. The candidate will then address a letter to the board with the following data, to be sworn to before a notary: (1) Name in full; (2) Present address; (3) Legal residence (voting place); (4) Occupation; (5) Place and date of birth; (6) Height and weight; (7) Photograph (snapshot satisfactory). Mark at bottom of the front the date taken,

Bureau of Yards and Docks,
U. S. Navy Department, Examining Board,
Washington, D. C.

Gentlemen: Being desirous of a temporary appointment to the Corps of Civil Engineers, United States Navy, I am submitting herewith the following 6 names of persons who, from personal knowledge are conversant with my professional ability.

Name	Address
Mr.	....
Mr.	....
Mr.	....
Mr.	....
Mr.	....
Mr.	....

The following preliminary data are submitted:

Country of birth....; when naturalized...
Date of birth.......Married....Single....
Children ....
Health and physical condition............
College from which graduated............
Date of graduation and degree............
Foreign languages, if any, spoken........
read..........
Proficiency in what professional lines.....
Status in draft........................

....
(Name, typewritten or printed)
....
(Address)
....
(Town and State)

height and weight; (8) Evidence of American citizenship (birth certificate or affidavit as to native birth or naturalization); (9) College or university from which graduated, date of graduation, course pursued, length of course, and degree conferred; (10) Testimonials in regard to character and moral fitness; (11) Testimonials from employers covering the candidate's professional experience and ability; (12) Chronological statement in detail of professional experience; (13) Six names of persons who, from personal knowledge, are conversant with the candidate's professional ability. The six names given here should be the same as those on notification blank.

Further examination may be required, in which case the candidate will have to go to Washington at his own expense. The medical examination is taken at the nearest Navy station. Those passing will be put on the eligible list from which at least 17 appointments will be immediately made. The pay and allowances of the rank amount to about $2500 a year. The commissions will continue until the war ends.

Reserve civil engineers and persons on the eligible list for enrollment in the civil engineer corps, United States Naval Reserve Force, need not submit further records, if their records are on file with the bureau; however, it is necessary that they write a letter to the examining board stating that they wish to be considered for this examination. Men who entered the similar examination last December and whose papers have been returned may enter the present examination without prejudice.

Buffalo Committee Reports on Garbage and Refuse

A call for bids for the separate collection of the garbage and refuse of Buffalo, and for still other bids for the disposal of each, has been recommended by a committee consisting of John A. Saurers, superintendent of the Bureau of Sanitation; F. R. Booth, of the Division of Investigation, and J. C. Slippy, chief accountant of the Bureau of Costs. The committee, whose report is addressed to the mayor and council, was appointed to investigate methods and costs of garbage collection in American cities. After a trip to various cities it submitted a report consisting of notes and tables, the recommendations just stated, an expression of preference for municipal collection, doubt as to the best method of garbage disposal, but certainty that utilization of some kind should be practiced and that the present practice of refuse sorting and utilization should be continued by someone.

Dominion Government Buys Bulk of Canadian Northern Stock

Payment of $8,500,000 has been made by the Canadian Government for the 510,000 shares of common stock of the Canadian Northern Ry. held by the Mackenzie-Mann interests. This is in accordance with the parliamentary act covering the acquisition of the road by the Government. There remain in other private hands 90,000 shares, which are to be paid for at $18 per share, the figure fixed last May by the board of arbitration.

Notes from the Field

A ROMANCE OF THE WAR

There are many romances of the war: the conversion of a peace-loving nation to a fighting people; the sending 3000 miles overseas of an army of a million and a half—unprecedented in history and ranking beyond all military expeditionary movements from the Trojan and Xenophonian expeditions down; the building of a merchant marine in a few years that would have required a generation before. Besides these are the creation of new industries—like the Government's explosives plants, private and Government shell plants, the building of the big-gun plant on Neville Island, and conversion of existing plants to hitherto unthought-of uses.

The enumeration might go on indefinitely, but these are nationally known romances. Others there are hidden in out-of-the-way corners, local enterprises, whose romance is known to the few, but whose influence is nevertheless national. One of these is that of the Coors pottery at Golden, Colo.

Little was it thought, when a potter without funds came to Golden for his health and experimented with the local shales and clays as a basis for art pottery, that an industry might result that would play a part in a great war. There was no demand locally for art pottery, and the plant experimented with fireproof baking and cooking ware. Several years ago the thought of making chemical porcelain, to replace the standard German ware then off the market, occurred to the managers.

And then, just when progress was sufficient to justify earnest work to build an industry, the potter left. He was the only ceramist in the plant. But the owner, Coors, was not to be turned back. Investigation of the chemical industry by Charles F. Quaintance, president of the Chamber of Commerce of Golden, had shown the commercial possibilities of the ware. Mr. Coors' three sons were well trained chemists, Cornell graduates, and they undertook the task of developing the product.

They faced not only endless experiments with body material, glazes, methods of burning, etc., but had to design, develop and construct practically all the machinery and equipment needed. Some of the coarser machinery —grinding machinery, for example— was on the market, but all other pottery equipment was far too crude for the high-grade ware which the Coors set out to make. "Coors," they determined, should be the world's standard in chemical porcelain.

Fortunately, the work was crowned with success, though the failures were many, the rays of hope infrequent. It cost the health of one of the sons, but failure, he would probably say, would have been even a worse result—failure to attain an ideal, more serious even than financial disaster.

Today the ware, so qualified chemists state, is without a superior. And yet, with the spirit of true scientists, the Coors are not satisfied. Their research department is constantly at work and, on request of the Government, recently turned out electrolytic porous cells of exceptionally long life, and, more recently, pots for melting optical glass. Experiments on the production of the porcelain part of spark plugs to stand severe tests are now under way.

Other porcelain manufacturers have made progress in chemical ware since the war began, and their efforts are not to be belittled. But no matter what the efforts of others, the pioneering work of the men who without ceramic training or experience worked out through heart-breaking failures a ware that can make us independent of Germany for all time deserves recognition.

Just another romance of the great war. E. J. M.

Wooden Ship Built in 17½ Days

Rapid work on a wooden ship has been done by the Grays Harbor Motorship Corporation, Aberdeen, Wash., as reported to the Emergency Fleet Corporation during the past week. A ship of 4000 tons dead-weight carrying capacity was built in 17½ working days.

Will Discuss Many Phases of City-Manager Plan

The program of the 5th annual convention of the City Managers' Association, to be held at Roanoke, Va., Nov. 6-8, will include discussions of a wide range of subjects dealing with the commission-manager plan of city government. On the first day of the meeting Charles E. Ashburner, Norfolk, Va., past president of the association, will deliver a paper entitled "The Ten-Year Test of the City-Manager Plan." On the same day, it is also expected, papers will be read on "Establishing and Maintaining Commission-Manager Government" and "The City's Relation to Law Breakers."

On the second day of the convention Richard S. Childs, of the War Department, Washington, will deliver an address under the title, "Uncle Sam's Call to City Managers." It is planned to devote the afternoon to an inspection trip through Roanoke and its vicinity.

The morning session of the last day of the convention will be largely given over to a discussion of the duties and problems of the city manager with respect to the finance, safety, welfare, service and utilities departments. The afternoon session of the same day will include an address, by O. E. Carr, Springfield, Ohio, entitled "Progress, Prospects and Pitfalls of the New Profession." Myron H. West, Chicago, will speak on "City Planning for After-War Conditions." The closing business session will be held on the same day.

More Districts Wage War on the Mosquito

Two New Jersey Counties Join Forces Against Pest in Shipbuilding Areas —Plan for Next Season

Camden and Gloucester Counties, in New Jersey, have entered into joint control of the mosquito warfare being waged in the districts around the shipyards on the New Jersey side of the Delaware River, the warfare against the pest being conducted on the lines described in *Engineering News-Record* of Sept. 12, p. 513. In that issue it was told how local authorities are coöperating with the United States Shipping Board in fighting the disease-carrying mosquito. The New Jersey campaign was launched by the Department of Health and Sanitation in coöperation with the State of New Jersey. In this district are two large shipyards and various plants engaged in war industries. The work is being done under the direction of L. F. Cushing, whose salary is paid by the State of New Jersey. It is expected that conditions will be improved so that night work now necessary at most of these plants can be conducted hereafter without annoyance and loss of efficiency due to mosquito pests.

At Chester, Penn., which is an important center of shipbuilding and other war work, the State Department of Health called a meeting of representative industries and a committee was appointed. The support of the Emergency Fleet Corporation has been obtained, following a conference with Howard Coonley, vice-president, and the state has agreed to appropriate $40,000 if $60,000 can be obtained from other sources. Chester expects to spend $100,000 on the project.

The health and sanitation section has actively enlisted the aid of the City of Wilmington, N. C., in mosquito elimination, and private interests have promised funds for the work. This work is considered especially important in the vicinity of the concrete shipyard of the Liberty Shipbuilding Co., as it is expected soon to inaugurate night work there. The steel shipyard of the North Carolina Shipbuilding Co., also in Wilmington, has been included in this campaign. A fund of $30,000 has already been raised in the city.

A mosquito survey has been made in the vicinity of the yard of the Virginia Shipbuilding Co., Alexandria, Va., and recommendations sent to the company by the health and sanitation section.

A survey of conditions has been made in the Gulf of Mexico yards. The mosquito pest is very bad in this district as many of the yards are near a great deal of stagnant water.

In Los Angeles, Cal., fish-canning companies have donated a force of 100 men for work of mosquito elimination under the direction of the State Board of Health. The health and sanitation section of the Industrial Relations Group is endeavoring to organize a mosquito abatement district to cope with the situation next season.

Commission Permits Construction of Weir in St. Lawrence

The International Joint Commission has granted permission to the St. Lawrence River Power Co. to build a temporary submerged weir in the South Sault channel of the St. Lawrence River near the entrance of the company's power canal leading to the power house at Massena, N. Y. The grant was opposed by the Canadian Government on the ground that the construction of the weir would interfere with navigation in the channel, in contravention of established treaties, and that the construction would permit certain control of this international waterway to pass into private hands, which is contrary to public policy. The commission upheld the claim of the company that the weir is necessary to the increased production of aluminum, which is a needed war material. The order allows the weir to remain for five years or until the end of the war, whichever is the latest date, and retains control of the structure in the commission.

Authorize Naval and Marine Sections of Training Corps

Naval and marine sections of the Students' Army Training Corps have been authorized at designated institutions by the committee on education and special training of the War Department. Quotas for the naval section have been assigned to a large number of institutions in practically every state. Marine sections of the corps will be organized at Leland Stanford University, the Georgia School of Technology, Harvard University, the University of Minnesota, Cornell University, the University of Washington, the University of Texas, Yale University, the University of Kansas, the University of Wisconsin, the Virginia Military Institute and the University of North Caroli a.

Head of Canadian Northern to Continue Under Government

D. B. Hanna, who has been operating executive of the Canadian Northern Ry. since 1896, has been retained as president by the Dominion Government, which recently acquired most of the stock. C. J. Mitchell, of the old board of directors, will continue as a salaried executive director, and Maj. Graham Bell, acting deputy minister of railways, will represent the Government in questions of policy. Five new directors have been appointed.

This arrangement is regarded as a temporary expedient, pending the nationalization of other Canadian railroads and the establishing of a single Government system in accordance with the recommendations of the Drayton-Acworth report.

More Engineers Study Cut-Over Lands and Drainage

Reclamation Service Engages and Transfers Men for Various Sections of Country

Progress is being made in the creation of a staff to conduct the investigation of drainage and cut-over lands, outlined in our issues of Aug. 22, p. 361, and Sept. 5, p. 469. For the Southern district, which is in charge of H. T. Cory, D. W. Ross has been engaged. His headquarters will be at New Orleans, and he will give attention to the work in Texas, Louisiana and Mississippi. When the United States Reclamation Service began work, Mr. Ross was state engineer of Idaho. He left that position to take charge of Service work in Idaho and its vicinity. He had charge of the construction of diversion works in the Snake River, Minidoka, Idaho. He left the Reclamation Service about eight years ago, since which time he has been in private work, more recently with an office in San Francisco as consulting engineer.

In the Northern district, F. W. Hanna has added to his staff P. M. Fogg and H. J. Gault, who are now in the field in the middle Western states. Mr. Fogg was with the Reclamation Service most of the time for 10 years. He was in charge of the Minidoka project in Idaho after its completion, and has written papers on operation subjects. Mr. Gault has been in the employ of the Reclamation Service for some time past. For a few years he was on the Rio Grande project, where he had charge of dam and canal construction. For the investigation of cut-over lands in the far Northwestern states there has been employed, also under the direction of Mr. Hanna, Walter H. Graves, who has been engaged in similar work for many years as consulting engineer, with an office in Portland, Ore.

In the Western division, which embraces the whole arid region, F. E. Weymouth will depend largely upon the men already under him in the Reclamation Service. The only addition to his staff thus far is Homer Hamlin, formerly engaged on the Yuma project of the Reclamation Service and recently, for a number of years, city engineer of Los Angeles.

For service in the Washington office and possibly some field work in Virginia, E. C. Vincent has been employed. He was formerly an engineer in the Reclamation Service in charge of the Laguna dam on the Lower Colorado.

Mount Royal Tunnel Opened

After a final inspection by the engineering staff of the Canadian Railway Commission, the Mount Royal tunnel at Montreal, the last link of the Canadian Northern Ry. system between that city and Vancouver, was officially declared open to traffic Sept. 21. The tunnel, which is double-track and 3 miles long, was six years under construction and

Engineer Officer Decorated for Conspicuous Gallantry in Action

LIEUT. A. C. HAWKES, FIRST ENGINEERS, FIRST DIVISION, BEING DECORATED WITH THE DISTINGUISHED SERVICE CROSS

San Francisco Plans Port Improvements

Plans for the complete development of the India Basin-Islais Creek section of the San Francisco waterfront, recently prepared by F. G. White, chief engineer of the California State Board of Harbor Commissioners, have been accepted by the board. As the first unit of construction, which will fit in with a general scheme for improvement Mr. White recommends that the India Basin work be begun immediately. It would consist of (1) a seawall and wharf along the south side of the Islais Creek channel, to a point about 2400 ft. east of Third Street; (2) fill at least 400 ft. in width back of the seawall; (3) wharf shed 100 ft. in width and two-story warehouse, 200 ft. in width, on the wharf and filled ground parallel with the channel; (4) extension of railroad tracks to serve the warehouse and wharf.

According to this plan, provision will be made for the establishment of a new waterfront line 1500 ft. inshore from the existing pierhead line. This will permit of the construction of long piers and a location for the seawall approximately along a line where the bottom breaks off into deep water.

Eight piers are to be constructed, 235 ft. wide and 1000 ft. long, covering a total area of 1,964,000 sq.ft., together with eight warehouses, each with a total area of 300,000 sq.ft. on one floor.

Building of a coaling pier, a wharf for storage purposes, an engine house, shops, etc., for the belt railroad is also contemplated. That portion of the tract which is to be laid out as an industrial district covers 34.5 acres and is to be divided into 31 blocks, all served by railroad tracks and all facing on streets extending directly to the waterfront.

Early Summarization of Proposed Highway Work Desired

Instructions and forms have been sent out by the United States Highways Council, setting forth the manner in which proposed highway work for the year 1919 must be summarized and sent to the council. Several of the states have already begun the summary, with the idea of having it in the hands of the council by Oct. 20, but the council announces that it will be sufficient for its needs if it has the information on or before Dec. 10, and requests that all the state departments endeavor to present it by that time.

The instructions set forth in detail how the forms should be made up. A separate set of schedules is to be submitted for state, county, township and municipal work, respectively, thus making four sets of schedules. Each set of schedules is divided into construction, reconstruction and maintenance, thus making 12 schedules in all, and it is requested that a fourth class be added, to be known as resurfacing, making the entire report, if each set of schedules involves all four classes of construction, consist of 16 schedules. The forms provided are not designed to be sent out to the subdivisions, but are for a summary of the returns made to the state highway departments by the various counties, townships and municipalities. As far as practicable, the council desires the state to send maps with the various projects marked upon them.

As it is realized that all information and authorizations for projects could not be presented at this time, this report is intended to represent the approximate intention of the authorities in case the projects are approved. In fact, it is merely preliminary to a formal application that must be ultimately submitted for each project.

Markets Bureau Coöperates With Motor Truck Routes

Coöperation with responsible operators of motor-truck routes is offered by the Bureau of Markets, United States Department of Agriculture. Operators who agree to work according to the most approved method, and to conform to the general requirements of the bureau, will receive the advantage of advice and information developed through the bureau's investigations, and will receive signs to display on their trucks, stating that they are coöperating with the Government.

Through this coöperation the Bureau of Markets hopes to make it easy to place in proper hands such advice and information as it may obtain; to act as a medium for distribution of information among operators; to stabilize the rural motor business by requiring adherence to certain business practices, and to give reliable operators the business advantage of working with the bureau. The requirements laid upon the truck operators are the maintenance of dependable service and schedules; just

rates based on cost plus a reasonable profit; the furnishing of satisfactory records of operating costs to the bureau; the use of uniform approved bills of lading and the providing of adequate insurance for shipments. No attempt to exercise arbitrary authority or to insist on practices detrimental to properly conducted motor-truck routes is intended. Application blanks for obtaining this coöperation may be had from the chief of the Bureau of Markets, United States Department of Agriculture, Washington, D. C.

Contract Let for Motor-Truck Transportation of Coal

Motor-truck transportation of coal from the mines directly to the consumer has been contracted for by the Birmingham (Ala.) Civic Association, working in conjunction with the County Board of Revenue and the Board of City Commissioners. The contract was closed recently with the Jenkins Motor Co., and the company has agreed to establish two motor-truck lines, to move 200 tons of coal daily. This is reported to be the most extensive utilization of motor-truck transportation, for the hauling of coal from the mines to the consumer, in the United States.

The plan contemplates the establishment of a municipal coal yard to supply domestic trade, and this will be in readiness as soon as the movement of coal starts. To facilitate the movement of the trucks the County Board of Supervisors has passed a resolution authorizing the construction of 4 miles of public highway, and the mine owners and operators will spend, according to reports, several thousand dollars immediately in the construction of two additional miles, connecting the mines with the main highway.

Two fleets of trucks will be immediately purchased by the contractor at an estimated cost of $30,000, and these are expected to add not less than 50,000 tons to the city's winter coal supply.

Coal operations utilizing motor trucks for transportation will be watched with much interest throughout the country, and it is reported that the local fuel administration will make every effort to encourage this method of relief of the railroads.

Society Directory Gives Training and Experience of Members

Classified tables of members compiled on the basis of experience are contained in the first directory put out by the American Association of Engineers. This 6 x 9-in., 190-page, volume is designed to be of definite usefulness to the employer of engineers, who will be able to learn of an engineer-applicant's experience without unnecessary interviews. From the classification, 71.9% of the members have civil engineering experience, 24.8% mechanical, 12.8% electrical, 5.7% mining and 2.9% chemical engineering experience. According to experience the division is as follows: Consulting (practicing engineers), 10.3%; contractors, 1.2%; executives (officials, managers, superintendents, etc.), 40.4%; assistants, draftsmen, etc., 42.5%; students, 5.1%.

More than 20% of the members are in the army service, 421 being the number on July 1. Analysis shows 2 colonels, 2 lieutenant colonels, 15 majors, 47 captains, 107 lieutenants, 21 men in officers' training camps, 24 noncommissioned officers, 142 privates, 61 no information. By far the greater number are in the engineer corps, 168; but 33 are in the signal corps, 11 in ordnance, 12 in aviation, 20 in artillery, 72 in the infantry and 26 in the navy.

That the organization is composed of young men mainly is shown by the fact that on Jan. 1, 1918, of the total applications received (not members admitted), only 41.4% were from engineers above 32 years of age. The membership is wide spread over the country, only two states, Nevada and Maine, not having representation.

New Railroad Devices Will Be Examined

Division of Operation Issues Rules for Submitting Improvements to Track and Equipment

Rules governing the submission of devices or inventions to the United States Railroad Administration for investigation have been issued by the director of the Division of Operation. Complete specifications and detailed drawings, showing fully and clearly the construction, application and method of operation of the device or apparatus, must be submitted. The drawings should preferably be on sheets not larger than 8 x 10½ in. Larger drawings must be multiples of this size.

The plans and specifications should be accompanied by a statement showing (1) the name of the appliance or device; (2) the name and address of the proprietor; (3) the number and date of United States patent or patents; (4) the purpose of the appliance or device; (5) a brief statement of how the purpose is carried out; (6) a general description; (7) a statement of its relation to other appliances; (8) the name of the railroad or railroads on which used or tried, and length of time in use; (9) the name of the town, district or railroad division where used or tried; (10) the name of railroad officers of whom inquiry may be made.

Plans or other descriptive matter submitted will not be returned. Models need not be submitted, but may be, at the proprietor's risk and expense. They will be returned only if the proprietor so requests. Whether or not models are submitted, complete detailed plans and specifications must be furnished. When they have been examined the person submitting the device will be informed of the results of the examination and the conclusions reached.

Correspondence relating to roadway or track appliances should be addressed to United States Railroad Administration, C. A. Morse, assistant director, Division of Operation, Engineering and Maintenance, Washington, D. C. Correspondence relating to appliances for locomotives or cars should be addressed to United States Railroad Administration, Frank McManamy, assistant director, Division of Operation, Washington, D. C.

Labor on Army Work Under Special Board

Announcement has been made of the appointment by the Secretary of War of the Emergency Construction Wage Commission, which is in effect the successor of the old Cantonment Adjustment Commission. This original commission had charge of the adjustment of all labor disputes on the cantonments, but by a recent order of the War Department, the jurisdiction has been extended to embrace all other construction work which may from time to time during the war be carried on by the War Department. The change in name was therefore ordered. To the Emergency Construction Wage Commission has been assigned responsibility for the adjustment and control of wages, hours and conditions of labor in all Army construction work. The personnel consists of three persons appointed by the Secretary of War, one to represent the Army, one the public, and one to represent organized labor. At present the commission is constituted of E. M. Hopkins, chairman, representing the public; Col. J. H. Alexander, representing the Army, and J. R. Alpine, acting president of the American Federation of Labor, representing organized labor.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Chicago.

CITY MANAGERS' ASSOCIATION, Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

The New York Section of the American Society of Mechanical Engineers witnessed a double ship launching Sept. 28 on a trip to the yard of the Standard Ship Building Corporation at Shooters Island, in Newark Bay. The party numbered several thousand. Two 7500-ton steel ships, the "Monmouth" and the "Dallas," went down the ways. The occasion was made especially interesting to the party by the placing

of the observation stands close alongside the keel at the bow of the "Dallas," so that the launching operations—wedging up, knocking out shores, placing jacks, sawing the tie-piece and starting the ship on its slide—could be seen at close range.

The Western Society of Engineers, Chicago, was addressed Sept. 23 by William G. Edens, president of the Illinois Highway Improvement Association on "Good Roads in Illinois." Mr. Edens explained the proposed $60,000,000 bond issue, to be voted on Nov. 5. Stress was laid on the part engineers can play in promoting this program for after-the-war work, as under the terms of the proposed issue the bonds are not to be sold until after the war. The photoplay, "Through Illinois Over Unchanged Roads in a World of Change," taken in celebration of the Illinois centennial, was shown.

The Hamilton, Ont., Branch of the Engineering Institute of Canada was organized at a meeting held Sept. 21, with E. R. Gray, city engineer of Hamilton, as chairman, and H. B. Dwight, of the Canadian Westinghouse Co., as secretary. P. M. Lincoln, of the Westinghouse Electrical & Manufacturing Co., Pittsburgh, addressed the meeting on "The History and Development of Electric Power and Transmission." He dealt with civil engineering phases of the subject. Other speakers were H. U. Hart, C. H. Hutton and L. W. Pratt.

The Technical Societies of Chicago were addressed by Col. Peter Junkersfeld of the Construction Division, United States Army, Oct. 1, on "Emergency Construction for the War Department of the United States." This was the second meeting of the war committee, which is composed of representatives of 19 organizations.

The Kansas State Irrigation Congress held its seventh annual meeting at Garden City Oct. 1-2. Among the subjects discussed were "The Future of Western Kansas Irrigation"; "Comparison of Local Irrigated with Nonirrigated Crops"; "Small Irrigation Plants"; "Central Power Plants for Irrigation"; "Farm Loans and Irrigation in Western Kansas," and "Lessons from Irrigation Development in the West."

The Engineers' Club of San Francisco was addressed at a meeting on Sept. 19 by J. R. Geary, who spoke on "Sidelights on Japan by an American Business Man." Mr. Geary has represented the General Electric Co. in Japan for fifteen years, with headquarters at Yokohama.

The Iowa Section of the American Water Works Association will hold its fourth annual meeting in Iowa City, Oct. 23-24. Arrangements for exhibits are being made by W. H. Hostetler, superintendent of the Iowa City Water Company.

Personal Notes

C. Arthur Poole, city engineer, and John F. Skinner, principal assistant city engineer of Rochester, N. Y., have been commissioned as captains in the Corps of Engineers and the Construction Division, respectively.

H. N. Savage, who has represented the city of San Diego in the construction of the new dam at Lower Otay, has recently been given entire charge of the work, subsequent to the abrogation of the contract with James Kennedy by the city. Mr. Savage's authority extends to laying out and directing a day-labor and force-account plan for rushing the work to completion, in order to catch the run-off of 1918-19.

E. H. Lee, vice-president of the Chicago & Western Indiana R.R. Co., and chief engineer of the Belt Ry. of Chicago, has been elected president of both companies.

Finlay MacFarland has been appointed president and general manager of the Denver water plant. As noted in *Engineering News-Record* of Aug. 15, p. 336, Mr. MacFarland was a member of the board of five citizens selected by the city government to manage the plant of the Denver Union Water Co. after it was taken over by the city in accordance with the election held Aug. 6.

A. B. Edge, district engineer of the Georgia R.R., the Atlanta & West Point R.R. and the Western Ry. of Alabama, with headquarters at Atlanta, has resigned to enter the Engineer Officers' Reserve Corps with the rank of captain. He has been assigned to duty at Camp A. A. Humphreys, Virginia.

William E. Duckering, for the past four years assistant professor of civil engineering, University of Washington, Seattle, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps and assigned to duty at Camp A. A. Humphreys, Virginia.

Frank I. Bennett, commissioner of public works of Chicago, has resigned to become commissioner of public works for the State of Illinois, by appointment of the Governor.

George F. Weighardt, assistant water engineer of Baltimore, who was recommended by the Mayor for appointment as highways engineer and member of the Board of Estimate, now officially becomes highways engineer through confirmation of the appointment by the City Council. Since his graduation from Cornell in 1909 Mr. Weighardt has been almost continuously engaged in municipal engineering work.

P. T. Robinson, assistant division engineer of the Southern Pacific Co. at Los Angeles, has been promoted to division engineer at Bakersfield, Cal. He is succeeded by E. H. Miller.

David J. Howell, of the firm of David J. Howell & Son, civil engineers, Washington, D. C., has been appointed general manager of the Alexandria Water Co., Alexandria, Va. Mr. Howell will continue in private practice in Washington.

R. E. Harrison has been appointed acting sanitary engineer of Lucas County, Ohio, succeeding Louis A. Boulay, who has been commissioned as captain in the Engineer Officers' Reserve Corps.

G. W. Corrigan, division engineer of the Southern Pacific Co. at Bakersfield, Cal., has been transferred to Los Angeles, succeeding W. M. Jaekel, promoted.

Paul Sullivan, assistant city engineer, Cincinnati, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps. It is expected that no successor to Mr. Sullivan will be appointed, in accordance with the city engineering department's policy of economy.

D. J. Kerr, office engineer of the Great Northern Ry., has been appointed corporate engineer for the company.

Lucius E. Allen, consulting engineer, Belleville, Ont., has been appointed consulting engineer, nitrate division, ordnance department, United States Army.

H. S. Freeman, chief draftsman of the Great Northern Ry., has been appointed office engineer, succeeding D. J. Kerr, who has gone with the corporation.

Obituary

Daniel C. Toal, editor of the *Water and Gas Review,* published in New York City by the National Meter Co., died at his home in Brooklyn Sept. 24, at the age of 76. Mr. Toal was born in New York and served through the Civil War in the 71st Regiment, New York Volunteers. He was educated at St. Francis Xavier College and the College of St. Sulpice, Montreal.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

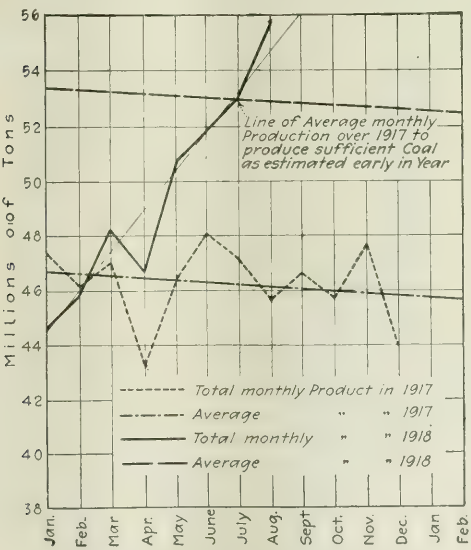
Coal Drive Started by Fuel Administration

Constant Rate of 12,234,000-Ton Production from Bituminous Mines Called for to Avert Famine

A drive which will continue till Apr. 1, 1919, to produce 12,234,000 tons of bituminous coal and more than 2,000,000 tons of anthracite coal per week, has been launched by Fuel Administrator Garfield. These amounts represent an increase of 1,731,000 and 121,000 tons of bituminous and anthracite coal, or 16½ and 6⅓%, respectively, over that of last year. These correspond to the estimates made early in the year.

The proclamation has been sent to the district production managers, who will consult with the mine production committee and apportion a weekly quota to each mine.

Coal production during the first part of September shows a decline, although some of it was due to the holiday.



RATE OF BITUMINOUS COAL PRODUCTION

Production for the year to date is approximately 17,000,000 tons behind the requirements as outlined by the United States Fuel Administration. The average weekly production for the past eight weeks is approximately 12,300,000 tons, which in the season for maximum production is but slightly more than the amounts set for the drive to continue through a season of adverse mining conditions.

Although the accompanying diagram shows an increase over the previous two months, which is probably the result of President Wilson's proclamation it is not yet sufficient to balance the decline or flattening out of the curve that will occur when winter sets in. Economy must therefore continue.

The estimated requirements for the year as made in the spring have been so far exceeded as to raise the average line in the diagram and place a different aspect on the previous production. The production of steel is already so low as to threaten war industries, and the coal situation still further threatens the steel supply. Since the last coal article appearing in *Engineering News-Record*, for Aug. 15, the reported shortage of by-product coal essential to steel production has reached alarming proportions, according to the Fuel Administration. Every ton of this grade of coal is being taken for the war industries, and the industries deprived of their supply will be forced to use other grades of coal. The consumption in a few of the better known activities illustrates the tremendous demand made on the industry. Every time a 15,000-ton troopship carries American soldiers to the fighting front in France it consumes about 3000 tons of coal or 12,000 bbl. of fuel oil, according to information recently published by the United States Fuel Administration in a booklet entitled "Fuel Facts." Continuing, it states that "more than 4,000,000 tons of coal are consumed in a year in transporting the supplies which must go forward in a continuous stream to maintain a single army. Our present shipbuilding program will demand 14,000,000 tons of coal merely to manufacture and transport the steel to be used in ship construction; and, in building 8,000,000 tons of vessels, we will use nearly five tons of coal for every ton of shipping that leaves the ways. Every 3-in. shell fired from an American gun in the war against autocracy represents 80 lb. of coal used in its manufacture, and these shells are being manufactured by the million."

Trade Catalogues Wanted in Australia and New Zealand

A request for trade catalogues, journals and magazines for use in the City Public Library of Sydney, Australia, is sent to the American public by W. H. Ifould, librarian, through the American consul general at Sydney.

Mr. Ifould says that the publications of especial interest are those relating to chemicals, machinery, hardware, steel products, textiles, construction of boats, motor cars, motor car accessories, etc., and says that on account of the frequent requests for such literature made at the library it is believed that the placing of such literature would afford an excellent opportunity for American manufacturers and exporters to get in touch with the Australian commercial public.

The American consul general at Auckland, New Zealand, reports that a special technical and commercial department has been added to the Canterbury Public Library at Christchurch, New Zealand, for the use of the public in that district. The chief librarian has appealed to the American consul general for such literature relating to the trade and commerce of the United States as may be procurable. The literature will be displayed in a prominent position in the library. It may be sent either through the American consulate or directly to the librarians mentioned.

Machinery Salesman Describes Watery Tunnel Ride

Construction plants and all construction materials, except those indigenous to the district, used in building the Gibraltar dam for the water supply of Santa Barbara, Cal., must go through a 4 x 6-ft. tunnel about four miles long. A machinery salesman recently visited the work and reported his experience in the tunnel. The work, known as the Gibraltar dam, is located about eight miles from the City of Santa Barbara, Cal., on the Santa Ynez River. It contains 50,000 cu.yd. of concrete and, owing to the peculiar location and difficult conditions of operation, it will take about two years to complete the job. All of the machinery, cement, men, form lumber and all supplies, except rock, sand and water, had to be hauled from Santa Barbara over a mountain road to a point four miles from the work, where it had to be loaded on small cars and taken through a tunnel 4 ft. wide by 6 ft. high and four miles long. A small railroad track and the water supply of the City of Santa Barbara also pass through the same tunnel, the water running about 3 in. above the tops of the rails, all the way

through. The material is transported by a waterproof electric locomotive drawing three small flat cars. The salesman states that "it is great sport making this tunnel trip, as we have to put on hip boots, rubber coats and rubber hats, and leave all of our regular clothing, money and hope behind when we start. We have to lie down on the cars to keep our heads from hitting the trolley wires, and with the train running through the water you can imagine what a beautiful shower we have playing over us all the way." The contractors for the dam are Bent Bros. & Cramer.

Patrol System Maintains Motor Truck Efficiency

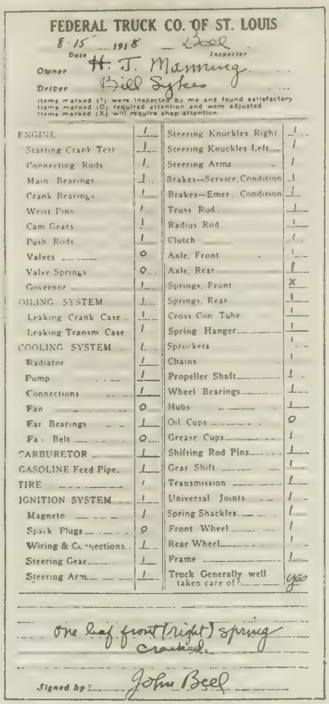
A motorcycle patrol service, whereby a fleet of motor trucks is kept under constant inspection without interrupting operation, and at small cost, has been inaugurated by the president of the Federal Motor Truck Co., St. Louis, Mo. A competent mechanic provided with a motorcycle covers first a regular route in the wholesale commission merchants' and produce market sections, and, later in the day, other sections where trucks operate.

Whenever a Federal truck is encountered he inquires of the truck driver how the truck is running, and makes an inspection of its working parts without holding up the haulage work any more than necessary. Such

MOTOR TRUCK INSPECTOR TAKES NOTES

slight adjustments as the tightening up of the fan belts and other operations that may be made on the spot are effected and, should there be any adjustment on the car or slight repairs that the inspector is unable to make, or should he detect serious trouble, it is noted on a report blank, made out as soon as the inspection is finished. The reports are turned in each night, and the next morning are sorted and inclosed with a letter to the owner of each truck, calling attention to the adjustments made on the road and making recommendations when the items on the reports mentioned require especial attention. The owner is notified when his truck can be taken care of in the service station, and he is requested to leave the truck there at that time if possible.

The idea of the patrol service is



FEDERAL TRUCK CO. OF ST. LOUIS

8-15 1918 Date — Beel Inspector

Owner H. T. Manning

Driver Bill Sykes

Items marked (1) were inspected by me and found satisfactory
Items marked (O) required attention and were adjusted
Items marked (X) will require shop attention

ENGINE	1	Steering Knuckles Right	1
Starting Crank Test	1	Steering Knuckles Left	1
Connecting Rods	1	Steering Arms	1
Main Bearings	1	Brakes—Service, Condition	1
Crank Bearings	1	Brakes—Emer., Condition	1
Wrist Pins	1	Truss Rod	1
Cam Gears	1	Radius Rod	1
Push Rods	1	Clutch	1
Valves	O	Axle, Front	1
Valve Springs	O	Axle, Rear	1
Governor	1	Springs, Front	X
OILING SYSTEM	1	Springs, Rear	1
Leaking Crank Case	1	Cross Con Tube	1
Leaking Transm Case	1	Spring Hanger	1
COOLING SYSTEM	1	Sprockets	1
Radiator	1	Chains	1
Pump	1	Propeller Shaft	1
Connections	1	Wheel Bearings	1
Fan	O	Hubs	1
Fan Bearings	1	Oil Cups	O
Fan Belt	O	Grease Cups	1
CARBURETOR	1	Shifting Rod Pins	1
GASOLINE Feed Pipe	1	Gear Shift	1
TIRE	1	Transmission	1
IGNITION SYSTEM	1	Universal Joints	1
Magneto	1	Spring Shackles	1
Spark Plugs	O	Front Wheel	1
Wiring & Connections	1	Rear Wheel	1
Steering Gear	1	Frame	1
Steering Arm	1	Truck Generally well taken care of?	yes

One leaf front [right] spring cracked.

Signed by John Beel

FORM MADE OUT BY INSPECTOR

based on the principle that a large percentage of truck troubles arise from the neglect of small repairs and adjustments.

Excavator May Serve as Backfiller and Locomotive Crane

A new combination machine for use on construction work, shown in the accompanying view, can be used as a drag-line or grab-bucket excavator, as a scraper backfiller or as a locomotive crane with hoist or bucket. It has a steel frame mounted on caterpillar traction under the swinging circle or turntable, and has a pair of wheels at the front end. A 40-ft. boom with a 10-ft. extension is employed for handling a 6-ft. backfilling scraper, while a 30-ft. boom may be fitted for handling a ½-yd. clamshell or dragline bucket. The boom consists of a pair of 7-in. channels in V shape with top and bottom lacing.

A four-cylinder 30-hp. internal combustion engine drives the machinery through a shoe friction clutch inside the flywheel. The main drums are 12 in. in diameter, are driven by 24-in. band frictions and have 24-in. band brakes. Gear trains operate the swinging and propelling mechanism, the latter giving a speed of nearly one mile per hour. The machine weighs about 13 tons and can hoist a load of 3500 lb. at 30-ft. radius. It is built by the Pawling & Harnischfeger Co., Milwaukee, Wis.

EXCAVATOR USED AS BACKFILLER AND CRANE

Use of Platinum Subject to Limitations of Explosives Act

Platinum, iridium, palladium and their compounds have, by act of Congress, been made subject to the terms, conditions and limitations of the Explosives Act. The director of mines is authorized to limit the sale, possession or use of these materials.

It is stated, however, that the object is to assist the Government in developing an adequate supply of these metals without disturbing the trade any more than is unavoidable

Business Notes

The Lakewood Engineering Co. announces the opening of new offices in Chicago in the Lumber Exchange Bldg. It also announces that the Charles T. Topping Machinery Co. has merged its interests with the Pittsburgh office.

The John C. Herndon Co. has transferred its main office from Leetonia, Ohio, to 502 Keystone Bldg., Pittsburgh, Penn.

Engineering News-Record

October 10, 1918

Devoted to Civil Engineering and Co

McGRAW-HILL COMPANY, INC.

One Hundred and Thirty-Two Foot Derrick Boom Sets Roof Trusses at Minneapolis

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

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Preparing the Profession for a Great Opportunity

The Task of the Civil Engineers' Development Committee

ANNOUNCEMENT has been made of the personnel of the development committee of the American Society of Civil Engineers. Since the resolution creating the committee was passed the members of the society have had a chance to think, and that thinking has served to show the inadequacy for present and future needs of the society's structure. Free from the trammels of detail, they see clearly the needs of the time, and are ready to accept any change, no matter how drastic, provided it fit the society for a worthy part in the wonderful, if troublous, times that are ahead. In fact, they are not only ready to accept an advanced program, but will unhesitatingly reject a weak plan, designed merely to save an antiquated structure.

Let there be no mistake as to the temper of the members or the attitude of mind that the times demand. The development committee's first task is to get away from details and to see clearly the place of the engineer in the new economic and social order. When that is determined, the details will fall into place without effort. President Wilson has specified our peace terms as broad principles only. He will not be drawn into a discussion of details, for details becloud issues. Once the enemy accepts the principles there will be no difficulty about such matters as territorial control and the setting up of new nations. So with the development committee. It must express for the profession its great aim and purpose. That aim and purpose must be so broad, so appealing that it will command instant support and be full justification for the radical rebuilding, if necessary, of the entire structure.

* * * * * *

What will be that great aim and purpose? It is for the committee to say, but we feel positive that it will revolve about the obligations of the profession and the individual to the public. The weakness of our national engineering societies is their selfish purpose, clearly expressed in their constitutions. The new order in engineering organization will recognize that our whole social structure—save what rests on agriculture—is built on and determined by industry. And industry is the creation of engineering. Our laws are made to facilitate and regulate the industrial process and to protect the individual against its abuses.

The industrial structure is to be recast; it was due for recasting even if the war had not come. Those who have controlled it hitherto—the bankers—have made a colossal failure of it; witness the railroads, the attitude of labor, the growth of radicalism. After the war there will be those with solutions to offer. Philanthropists and economists will want to lead, but we who have seen their works will rightfully look askance.

The one true method of attack is a scientific study of all the factors—a scientific study of a structure to be reared on an engineering basis and to function as part of an engineering process.

Can the right solution be reached without the aid of the engineer?

* * * * * *

On other points, also, we feel certain. One is that the autocratic government of the society is at an end. That has been apparent for many a year. In these days a society cannot be strong by merely having a strong headquarters organization—autocratic strength. Real strength, democratic strength, is rooted in virile local and state bodies. National influence is local influence everywhere exercised. Local autonomy is demanded and a delegate body faithfully representative of the autonomous locals. So only can there be a society responsive to the needs, and virile enough to grasp opportunities; so only can there be national influence.

* * * * * *

Yet another point is perfectly clear. The committee cannot discharge its duty properly without laying down an ideal for the whole profession. There will be no desire to *interfere* in the affairs of other bodies, National and local; it will simply be impossible to do a decent job without scrutinizing those other bodies and fitting them into the big plan. Any failure to do that will, of the very fact, condemn the report as inadequate.

No plan less than the integration of the whole profession can possibly be adequate to the opportunities—and responsibilities—of the dawning day.

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Furthermore, we have to urge on the development committee the adoption of open and well-advertised meetings of the full committee and of its principal subcommittees. Through such procedure its work would stimulate the thinking of the members and guarantee in advance the acceptance of the final program. President Wilson's reliance for a permanent peace lies in telling the whole truth to all the peoples of the world. Therefore the deliberations of the peace table will be open, that the peace may be written in the hearts of mankind.

Shall not our revision be worked out in the light of

day, that all may know, that the white heat of society-wide study and criticism may refine and improve and bring forth a truly great result?

Finally, we believe that the development committee holds in its hands the future of the society. If the report does not bring about a rebirth, if it be weak and halting, the society will dwindle into an innocuous technical body and the virility of American engineering will find expression through a new society, raised by the progressive elements in American engineering to accomplish the great purpose.

Support Our Engineers!

OUR engineers have won conspicuous mention in cabled accounts of recent successes on the western front. They have shown the American will and knowledge to do which achieves its aim. Appreciation of these services can take no more expressive form than heavy oversubscriptions to the Fourth Liberty Loan.

College Readjustment

PROBLEMS of readjustment dominate our engineering schools today. It cannot yet be said how many students will take war engineering courses and how many regular work, nor to what extent the two groups will be merged in the classrooms. But it is certain that instructors and students are alive to the needs of the hour.

An Enemy Ally

INFLUENZA is an ally of the enemy. Were it to grip the whole country our war industries would be crippled, our training camps paralyzed, our shipments of troops and supplies overseas heavily curtailed and the surrender of Germany delayed. A patriotic duty of each of us is to see that he does his part in stopping the spread of the scourge. Suggestions to this end were made on p. 607 of our issue of last week.

Reconstruction

APPOINTMENT by President Wilson of a reconstruction commission is urged in a resolution adopted by the American Society for Municipal Improvements last week. Such action has been advocated in these columns for months past. While fighting our way to world freedom we should no longer delay plans for solving the many reconstruction problems which peace will surely bring. This applies also to the municipal field, as was urged by N. S. Sprague in the address abstracted on p. 663.

Water Meter Prospects Are Good at Philadelphia

PROSPECTS for a universal water meter system in Philadelphia within a few years are good. Three ordinances to that end have been introduced in the city councils. The most promising one is printed on p. (?). It is theoretically objectionable in that it provides for private instead of city ownership of the meters, but the financial condition of Philadelphia seems to make such a plan imperative, and as the city would install and control the meter the case is far from bad. The press, civic organizations and many commercial interests favor universal meters. The sooner such a system is adopted the quicker will the strain be taken from Philadelphia's pumping and filtration plants, her enormous water consumption and coal bills be cut down, and a fair means of paying for water be introduced.

The Things That Count

NO PEACE proposal from Germany, however specious, can be heeded by the engineers of this country till we read the news of unconditional surrender forced by our armies in the field. Throughout more than four years of war the German government has consistently and adequately demonstrated that it cannot be trusted. However it may hide behind statesmen formerly in disfavor because of their "liberal" views, we know Potsdam is using these men as tools to rake out of the fire what of autocracy might yet be saved. However its lips may repeat, parrot-like, the words of our own President, we know them for a decoy to lure us within reach of German claws around a German "peace" table.

The only successful way to discuss peace with such an enemy is across a thousand miles of battle front with divisions as superior in numbers as they already are in spirit, with an overwhelming preponderance of artillery and the engines of war, supplied and maintained by increasing production and adequate transportation.

Engineers are responsible for this production and transportation. The country looks to their organizing and producing genius for guns, equipment, munitions airplanes, rolling stock, ships, the terminals and factories and railroads to increase the flow of these things into a tide that will sweep over the foe of civilization and blot out forever all trace of its sinister influence.

Now the country must look to her engineers for something more. Theirs is the job of flattening the rosy insinuations of "peace," made in Germany, which are designed by their authors to paralyze our production, to interfere with the loan now being raised to increase that production, and to draw us, unthinking, into a "peace" discussion during which Germany will grow stronger as we slacken our effort, and from which it can emerge intact, to heal its wounds against the day when it will again be ready to assault the peace of civilization.

Nail down the idea that Potsdam is ready to quit. Do not allow it to show its head in your plant, on your job, among your staff. If that idea takes hold in America, it will be a worse defeat than if our forces in France had been blotted out overnight. If, by calling in a few political tools who have shown liberal tendencies at times, and by emitting a cloud of poisoned words whose sincerity is disproved by an unbroken succession of crimes, Berlin can make us pause, the Kaiser will have already avoided the necessity of quitting.

The end of the war is in sight—a real end, which will be the grave for all time of the ideals and methods of the outlaws who at this moment control more surely than ever the policies of the German empire. But this end is going to be forced by the quickening of every phase of war production—never can we reach it by accepting the poisoned gifts offered us today on the Kaiser's silver platter.

At the moment, German surrender talk is not worth the ink being wasted on it in our own newspapers Two things count—and we look to our engineers for a

man's share in the accomplishment of both—put the Fourth Liberty Loan over the top and quicken production till our boys in France have war material enough to pave the Junker's way from Belgium to oblivion, and to hurl him down it.

Rational View of Sewage Disposal Held by Joint Commission

MUNICIPALITIES generally and particularly those located on the waters between the United States and Canada may congratulate themselves on the rational view of sewage disposal shown in the final report of the International Joint Commission. True, the Commission holds that all sewage discharged into those waters should be treated, but it leaves for determination in accordance with local sanitary and economic conditions the degree of treatment in each case, except that it proposes a tentative standard for use where public water-supplies are involved. Even here the standard is no arbitrary rule expressed in terms of the character of sewage effluent. Instead, the intent is to insure a sewage effluent that will not pollute the water course beyond the safe working load of water-purification plants.

Notable is the assumption that a water-purification plant will be provided wherever there is a public water-supply to be protected from sewage pollution. This is in striking contrast with contentions long current in some quarters that sewage must be so treated as to bring it to a drinking-water standard. Providing safe drinking water, the commission rightly assumes, is the function of water purification, not of sewage treatment.

Significant and fortunate is it that the tentative standard of bacterial burden placed on water filters by sewage effluent appears to be readily attained by a sewage dilution, or a sewage treatment equivalent to a dilution, which will insure absence of nuisance. Thus if pollution is kept sufficiently low to prevent a nuisance it will not be an undue burden on a water-purification plant—broadly speaking. (The degree of dilution proposed by Professor Phelps as an equivalent to the tentative bacterial standard is the same as was advised nearly thirty years ago for Chicago by Rudolph Hering at a time when bacteria were only beginning to be considered as an objective in either water or sewage treatment.)

That the tentative standard safe bacterial load for a water-purification plant recommended by the Commission, on the advice of its advisory engineers—an annual average of 500 B. coli per 100 c.c.—will prove to be more than tentative seems unlikely. Further study of boundary waters is needed, as the Commission's own engineers realize, to differentiate soil and grain bacilli, thus possibly lessening the significance of B. coli. It may yet be found, as was suggested at the meeting of the American Society of Municipal Improvements Oct. 3, that with the lowering typhoid rates so notable in the last few years more than 500 B. coli per 100 c.c. would be permissible, since these germs are only an indication that those of typhoid may also be present.

Engineers, Rudolph Hering urged, should go slow in spending millions of the people's money to reduce the bacterial load on water filters until more is known of the real significance of the B. coli in water. To this we may add that there will be all the more need for caution in making heavy expenditures for sewage treatment during the coming reconstruction period in view of the huge outlays that must then be made.

For the present and probably for all time water purification will afford far better insurance against sewage pollution than will sewage treatment. But no mistake can be made in planning sewage-works which may be extended from time to time in order to provide any desired degree of treatment.

The Commission, aided by its able engineers and other sanitary advisors, has contributed in no small degree to the enlarged rational view of sewage disposal which recognizes that each sewage-disposal problem is a law unto itself, controlled by a variety of local economic and sanitary conditions, and that so far as public health is concerned water purification is the main line of defense.

War May Put Railway Track Work on a New Basis

AS A result of war conditions railway maintenance of way seems likely to attain a higher plane and to be accorded the attention which its importance to railway service demands. Such result will come, however, only through a trying and strenuous period of change. This radical change has been foreshadowed for some time and is indicated anew by the proceedings of the recent Roadmasters' and Maintenance-of-Way Association's convention.

These war conditions have compelled attention particularly to the vexed problem of labor supply and labor efficiency in railway track work. A direct outcome of this is the establishment of higher wages and the introduction of new methods of obtaining and controlling labor. This, together with the growing tendency to distribute maintenance work over the entire year instead of concentrating it within a few busy months, may mean that railway maintenance will become a field for permanent gangs rather than for the shifting and ever-changing forces which have been characteristic of American railway service.

Supplementary to this is the wider consideration and use of labor-saving machinery and appliances which is the opening of a broad field of development. Such devices serve two different purposes. They may release men for military or other essential service, and they may enable a small force to do as much work and as good work as a larger force without such equipment. Furthermore, they may result in better work and greater permanence with consequent reduction in maintenance and increase in economy. Appliances that contribute to the stability of the track may be classed as labor-saving devices from the fact that they tend to reduce the amount of maintenance work required.

Conservation of material used in track is another improvement forced by the shortage due to war conditions. Special care must be given to the proper use of existing supplies in order to make the most of what we have and avoid all unnecessary requisitioning of new material which is badly needed for other purposes. Much old material which once would have gone for scrap can be made available for use again if proper care is given to it. That which cannot be utilized directly must be collected to add to our stores of raw material.

Fourth Successive Hydro-Electric Plant Nears Completion at Rumford, Maine

Development Began in 1892, and Capacity Has Been Increased from 200 to 30,000 Horsepower in Four Steps—Hydraulic Conditions Unusually Favorable—Provision for Future Growth

ON THE Androscoggin River at Rumford, Me., the Rumford Falls Power Co. is now bringing to completion the fourth hydro-electric plant at this particular site. Each of the earlier plants gave way to a larger installation as the market for power developed, and each made use of the improvements in hydraulic and electric practice since the completion of its predecessor. The latest plant is built so that it can be extended to utilize the full normal regulated flow of the stream. Two new units are now installed, while two of the earlier ones are continued in use. This gives all the capacity, 30,000 hp., for which there is either immediate or immediately prospective demand. Moreover, this is the total capacity available with the present storage at the headwaters. Increase in the plant by the later addition of three new large units is dependent on further storage development on the stream or change of load.

The features of the plant are the historical associations referred to, the completeness of the new installation and the exceptionally favorable hydraulic conditions.

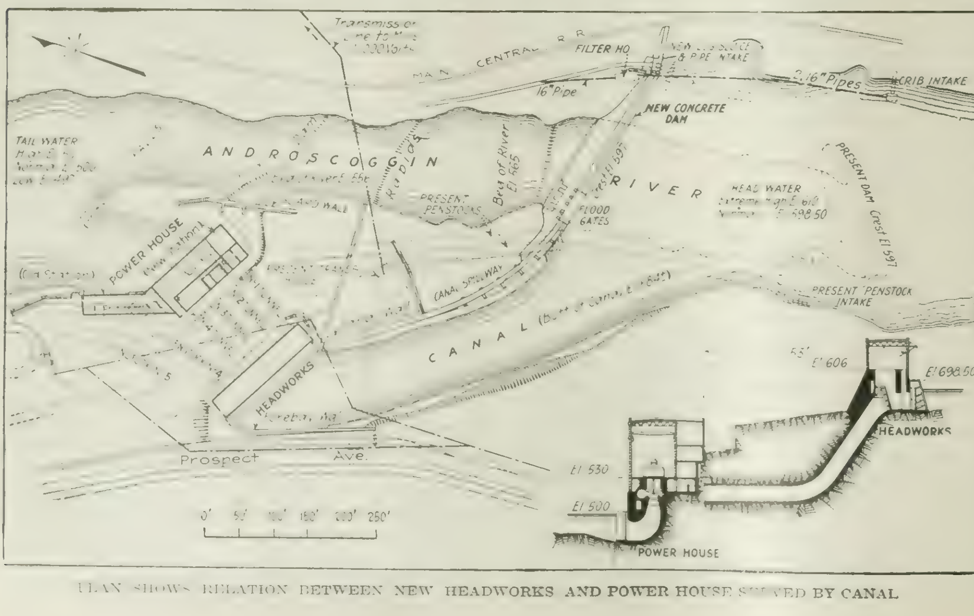
Rumford Falls consists of a series of three rapids extending over a distance of about a mile, the total drop being 180 ft. The fall over the first group, 100 ft., is that developed in the hydro-electric plant herein described, and is obtained with the aid of a dam 25 ft. high at the head of the rapids. The second drop, 50 ft., is used chiefly mechanically in the mill of the International Paper Co., a small part of the power being converted into electric energy, for use, however, in the mill itself. The remaining 30-ft. drop is developed mechanically within the mill of the Oxford Paper Co., which finds it necessary, in addition, to buy electric power from the Rumford Falls Power Company.

Excluding a very crude wheel installed more than a hundred years ago, the development began in 1892. The designs were those of J. Herbert Shedd of Providence, R. I., then one of the leading hydraulic engineers of New England. The first unit consisted of a 200-hp. wheel, belted to four generators and using only 55 ft. of the available 100-ft. head. The rapids at this drop are divided by a shelf which afforded an excellent opportunity for taking off water at the 55-ft. level without the use of a dam.

When the market justified it this wheel was supplemented by a 600-hp. double-runner horizontal-shaft unit also operating under 55-ft. head. Like all the subsequent wheels, except the two just now put in service, the turbine was a Hercules, built by the Holyoke Machine Works. Then followed soon an 800-hp. unit and then the substitution of an 800-hp. for the first 600 machine and of a 1200 for the 200.

The third stage of the development, starting in 1908, was an important one; the full fall, 100 ft., was used, the water being brought to the new wheel, a 5000-hp. horizontal shaft pair, through a 13-ft. penstock, 1125 ft. long.

There had been constructed at the head of the rapids



PLAN SHOWS RELATION BETWEEN NEW HEADWORKS AND POWER HOUSE SERVED BY CANAL

LOOKING UPSTREAM AT NEW WORK WITH NEW POWER HOUSE SEEN PRACTICALLY COMPLETED ON RIGHT

in 1892 a 25-ft. timber-crib dam, with the purpose of creating a pond from which logs were sent into a canal running to a paper mill below. A concrete intake for the penstock was built at one end of this structure. In 1910 a 14-ft. penstock was added, serving two new wheels, of 3000- and of 5000-hp. capacity, these two superseding the 1200- and the two 800-hp. units of the second development.

The final step of the third stage came with the changing of the 5000-hp. runners to 6000, using the same casings. This could be done without changing the generators, for at the time of installation it was found economical to buy certain standard generators, though they were somewhat greater in capacity than the wheels chosen. The plant, then, when the present installation was begun consisted of one 3000- and two 6000-hp. units. Of these the two 6000's are being retained, being augmented by the two 9000-hp. wheels, giving a total plant capacity of 30,000.

Hydraulic Conditions

Hydraulically (as well as electrically) the plant operates under favorable conditions. The demand at Rumford is chiefly for 24-hour power—for electric furnaces and paper mills—so that storage for heavy peaks or for part-day demand is not needed. Consequently, the chief service of a pond (the one created by the dam is about 8 miles long) is the prevention of ice troubles, from which the plant has been entirely free.

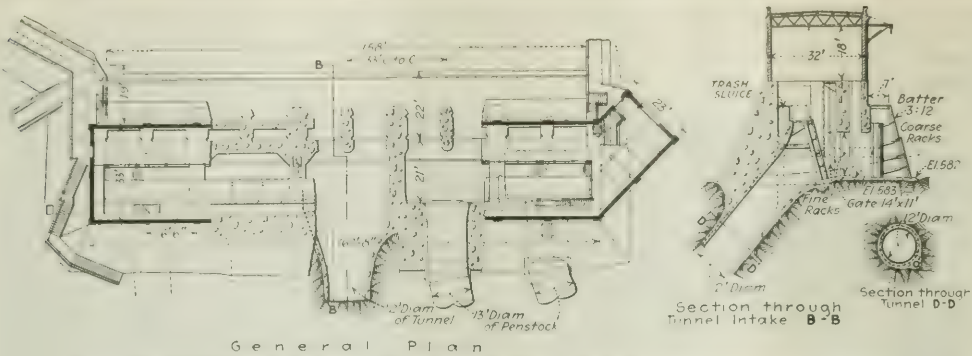
Seasonal storage is afforded by a system of lakes—the Rangeley chain—for which the Androscoggin River forms the outlet. These have been improved by regulating dams at each lake, raising the natural level 4 ft. in one case, 12 ft. in another, 20 ft. in three of them and 45 ft. in one, creating an available storage capacity of 30,000,000,000 cu.ft., with a surface area of 125 square miles. This storage system has been developed jointly by four of the interests on the river, the Union Water Power Co., Lewiston, Me.; the Brown Corporation, Berlin, N. H.; the International Paper Co., Berlin, Rumford and Chisholm, and the Rumford Falls Power Co., owner of the hydro-electric development herein described. The amount of water released to the river is fixed by agreement among these parties at a minimum of 1550 sec.-ft. at Berlin, but at Rumford it has not been less than 1850. The ultimate limit, therefore, of the new plant at Rumford is set by this amount of water, plus the run-off from the basins below the lakes, some 84 miles above Rumford.

Further storage, however, can be created, and will probably be taken in hand as the demand for power on the stream increases. The capacity now provided by the reservoirs takes into account the many conditions incident to such a problem and all the reservoirs are normally filled annually. The storage system was developed under the direction of Walter H. Sawyer, Lewiston, engineer and agent of the Union Water Power Company.

New Plant

The chief differences between the present development and its immediate predecessor (two wheels of which, as above noted, are to be kept in service) are the substitution of a canal and concrete-lined tunnels for the long steel penstocks, and the use of vertical-shaft instead of horizontal-shaft units. Needless to say, there are many minor differences and improvements, embodying the advances in practice since the third installation was designed.

An accompanying plan drawing shows the major changes in the physical layout. The old dam is drowned out, though the crest of the new structure is at the



PLAN AND SECTIONS OF NEW HEADWORKS SHOW ENTRANCES TO PENSTOCKS AND TUNNELS

same level as the old, there being no advantage, all things considered, in raising the crest. A canal, 100 ft. wide and 15 ft. deep, blasted out of rock, carries the water to a gatehouse, whence concrete-lined tunnels lead to the wheels and power house on the bank of the lower river.

All the structures rest on or are built through a solid granitic ledge, which lies so that it was of material assistance in obtaining a canal location. Approximately 47,270 cu.yd. of rock were taken out of the canal excavation, most of it being used in the concrete of the dam, canal wall and other structures. The canal wall for 250 ft. of its length is of spillway section, 3 ft. higher than the crest of the dam section, affording additional capacity for passing freshets.

NEW CANAL WITH POWER HOUSE ON LEFT—WATER RAISED TO SUBMERGE PARTLY OLD PENSTOCKS

For the dam, a solid concrete structure was chosen, the maximum height being 40 ft. Four sluice gates, both power- and hand-operated, are reached from a girder-and-slab bridge supported by piers carried on the canal wall. The spillway capacity provided by the dam and overflow section of the canal wall is approximately equal to that of the older structure, which successfully passed the maximum flood of 55,000 sec.-ft. with 10 ft. of water on the crest of the dam proper. The old spillway consisted not only of the dam itself but of the canal wall at the old intake, the ledge of rock on the right bank and a crib dam beyond, a length of about 500 ft., the rock section being about 3 ft. above the dam crest. The new dam is 250 ft. long, while an equal length of spillway, 3 ft. higher than the dam crest, is formed by part of the canal wall.

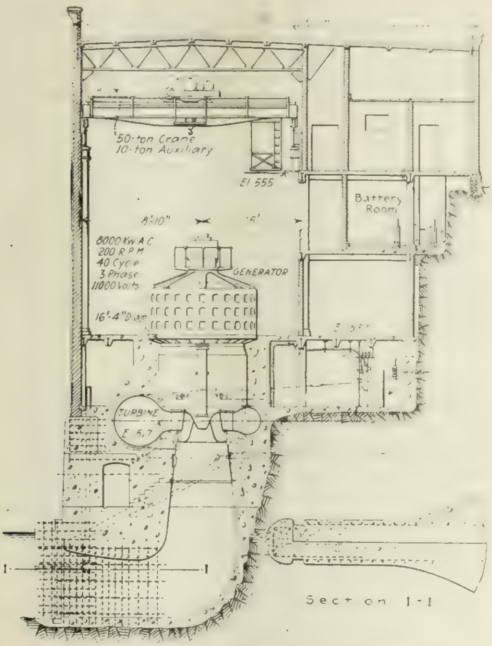
The relation of the gatehouse, tunnels and power house is clearly shown in the accompanying plan and cross-sectional drawings. Of the two sets of racks the outer is composed of bars 5 in. apart for catching coarse material, and the inner has 2⅝-in. spacing. Trash discharge flumes are provided for both sets.

Three tunnels have been excavated and two of them completed by a reinforced-concrete lining; and the power house is so built that the third unit can be installed without altering or adding to the structure. For the fourth and fifth units the tunnels are started at each end; the gatehouse structure is complete, but the power house will be extended to accommodate them after the two horizontal units are removed. It will be noted that the headworks for the fourth and fifth units are now used for the two old units continued in service. Sections of the old penstock are used for building the new penstocks, leading from intakes 4 and 5 in the new gatehouse to the old wheels. These will be removed and the old power house dismantled when the power market demands the extension of the new station.

OLD DAM AND PENSTOCKS—WORKING ON NEW DAM IN FOREGROUND

Each of the two new units consists of a Westinghouse generator of 6500-kw. rated capacity, a 9000-hp. Wellman-Seaver-Morgan turbine, and a 95-kw. exciter, all supported on a Kingsbury bearing, mounted above

the generator. Though rated at 6500 kw. the generators have a continuous capacity of 8000 because of the special mica insulation used. It is expected that the wheels will run above the guarantee and that the reserve electrical capacity will thus be utilized. Separate excitation is provided by an independent water-wheel unit, the penstock of which is carried in the tunnel excava-



CROSS-SECTION OF NEW POWER HOUSE

tion for unit No. 2. Generation is at 11,000 volts, which is also the line voltage. Maximum length of transmission is only 6000 ft. However, with future exigencies in view, the line equipment is built so that 22,000 volts can eventually be used. The General Electric Co. built the switchboard, the oil switches and the other equipment pertaining to the control. The older units generate at 2300 volts stepped up to line voltage through Allis-Chalmers transformers.

The auxiliary equipment of the governors, pumps, filters, etc., has no special novelties. All the equipment is housed conveniently in fire-resisting structures.

One of the essential conditions met in designing the new plant was, of course, that the old plant must at all times be kept in operation during the period of construction. This condition was particularly difficult to comply with from the fact that the new canal necessarily had to cross the line of the old penstocks, and the conduits supplying water from the end of the new canal to the new turbines again had to cross the line of the old penstocks. These penstocks had to be retained in operation and the new units placed in regular service before the old units could be temporarily shut down and the penstocks removed and reconstructed to connect the turbines with the new canal.

These conditions, together with other considerations, suggested the use of tunnels driven through the rock from the new headgates to the new units, which would be passed beneath the line of the old penstocks and would not interfere with their temporary use.

A condition was foreseen where the canal would be filled with water for operating the new units before the old units were shut down, and during this period those portions of the old penstocks which crossed the canal would be submerged. As it was frequently necessary to empty them for making inspection and repairs to the old turbines, the problem of keeping them from floating had to be considered. This was accomplished by constructing a temporary forebay of small area around the old penstocks at the point where they passed through the new canal wall, cutting the penstocks inside the temporary forebay and inserting temporary gates at this point, in order that the tubes could be emptied below the gates and always kept filled where they were submerged.

All the power required for the construction work, amounting at times to more than 700 hp.—for the operation of cableways, rock drills, derricks, pumps, carpenter shop, stone crushers, concrete mixers, etc.—has been supplied by the operating station. No fuel was used except a little in winter for heating. About half the construction equipment was driven by electric motors, and half by compressed air from an ample compressor plant driven by one of the small generators removed from the station and used as a synchronous motor.

The new plant is being built under the general direction of Hugh J. Chisholm, president of the Rumford Falls Power Co., to whose vision is due the replacement of the older plant with the present modern development, thus carrying on the policy of his deceased father, Hugh J. Chisholm, Sr., in keeping the development in step with advances in the art. H. S. Ferguson, New York, designed the new work, which was built under the immediate direction of Charles A. Mixer, engineer of the Rumford Falls Power Co. N. J. Neall, Boston, now in Government service, was the consulting electrical engineer. Originally the work was let to the H. P. Cummings Construction Co., contractor, Ware, Mass.; but the war made it advisable to complete the work under force account.

At the time of writing the two new units are in operation as well as the two earlier ones, the new penstock connections having been completed. One section of the dam remains to be finished.

High Typhoid Rates Not Due to City Water

In Terre Haute, Ind., the water company purveys a filtered water approved by the State Board of Health, which takes samples weekly, and by the United States Public Health Service. The city is built over a sandy soil from which water is easy to get. In consequence there are numerous wells, privy vaults and plenty of typhoid. Rates per 100,000 for the 10-year period which ended with 1917 are as follows: 34, 59, 26, 29, 27, 26, 25, 21, 25 and 15. Excluding fatal cases where there was no city water on the premises, and imported cases, the corresponding rates for the same period were: 0, 8.6, 7, 1.7, 5, 3.4, 3.3, 1.6, 4.6 and 3.

Development Committee of American Society Appointed

Onward Bates Chairman of Board of Twenty-eight—President Talbot Gives His Conception of Purpose, Procedure and Field of Committee

APPOINTMENTS have been completed to the committee on development of the American Society of Civil Engineers. The committee is expected to prepare a program of work and to propose topics for discussion by Nov. 1, the date set for a preliminary report in the resolutions which gave rise to the committee and which were passed by the board of direction June 18. By the time of the annual meeting of the society in January it is believed that progress in the work will have been made, and it is thought that much will be accomplished at this meeting.

The committee consists of 28 members—seven appointed by the president and one chosen by each of the 22 local associations of members, with the exception of the Utah association, which has made no appointment. Onward Bates of Chicago is chairman of the committee. The other members are Paul G. Brown, Charles Hansel, Clifford M. Holland, Frederick C. Noble, H. R. Safford, S. Everett Tinkham, Richard L. Humphrey, J. C. Ralston, Robert A. Cummings, George R. Putnam, Baxter L. Brown, William H. Hoyt, George C. Mason, H. L. Haehl, George G. Anderson, E. B. Thomas, Edgar S. Nethercut, W. L. Darling, John L. Hall, Arthur Pew, J. H. Brillhart, Thomas L. Wilkinson, C. J. Tilden, F. T. Darrow, Arsène Perrilliat, George Butler and Gardner S. Williams. Photographs and short sketches of the lives of most of the members will be found in the news section of this issue.

President Talbot's Precept

An extended statement of his conception of the purpose, procedure and field of the committee is addressed to the committee by Prof. Arthur N. Talbot, president of the society. He first quotes the preamble and resolutions adopted last June, which were published in *Engineering News-Record* of June 27, p. 1200. Therein it was stated that "the development and application of the sciences in recent decades have caused profound changes in the social and industrial relationships of all peoples," and that "a broad survey of the functions and purposes of the American Society of Civil Engineers is needed in order that an intelligent and effective readjustment may be accomplished, so that the society may take its proper place in the larger sphere of influence and usefulness now open to the profession"; and it was resolved "that a committee be created to report on the purposes, field of work, scope of activity and usefulness, organization, and methods of work of the American Society of Civil Engineers, and to make recommendations concerning these matters. . . ."

President Talbot's interpretation of the action of the board of direction is as follows:

It is intended that the committee on development shall make a survey of the fields of usefulness which are or should be open to the society, consider what functions may properly be assumed by the society, define its purposes, formulate policies and methods of work to be recommended, and consider the needs in organization and constitution. This means taking stock and making plans. The resolutions contemplate an examination of present-day conditions and an outlook into the future. They involve considering the changing social and industrial relations of the times and the opportunities and responsibilities which devolve upon the society and its membership. The relations of the society to other societies and to the profession generally are also included. The outcome of the work of the committee may be modifications in the activities, functions and methods of work, or in the emphasis in these matters, and possibly the addition of new ones. Naturally, the resolutions assume that the views of the membership of the society will be asked for and its aid obtained in determining what the society's purpose and activities should be and how they may best be carried out. It is expected that the committee will report definite recommendations in the field of its work, and these recommendations may include proposals of fundamental changes which may involve amendment of the constitution of the society.

The Committee's Field

It would be premature to outline the ground to be covered in the committee's work; this may best be found by the committee as its work progresses. It may serve a good purpose, however, and aid in starting effective deliberations more promptly, if some expression is made of the possible content of the work. With this advantage in mind the following is suggested as representative of the field of the committee's work:

1. Relations of the society and its membership.

(a) The relations of the society to its membership and to the profession of engineering.

(b) The relations of the society to other engineering societies and to related organizations.

(c) The relations of the society, its membership and the members of the profession to public affairs, to the welfare of its members and the public, to the work of communities and nations and to movements of the times related to industry and society.

2. Organization of the society and the profession.

(a) The functions of the central organization of the society and its relation to other organizations.

(b) The functions of the local associations of members (including the membership at New York) and their relations to the society, to other societies and to groups of organizations.

(c) The organization of the engineering profession as a whole.

3. Technical activities of the society and its possible branch organizations.

(a) Meetings, papers, publications and committee work.

(b) Activities related to engineering progress and engineering problems.

(c) Sections or divisions of the society for specialized lines of work.

(d) Coöperation with specialized engineering societies and other organizations.

(e) Relations to other technical activities such as those of the proposed standards committee.

4. General activities of the society and its possible branch organizations and coöperative organizations.

(a) Activities related to public affairs and public welfare.

(b) Activities related to the welfare of its members.

(c) Relations to organizations dealing with industrial and Governmental problems.

5. Functions of the society in relation to the younger members of the profession and to those in executive, contracting and other lines.

6. Miscellaneous needs of the organization.

7. Proposals for changes which will involve making amendments to the constitution and formulating rules and methods of procedure.

Topics Interrelated

These general topics, which are mostly self-explanatory, are necessarily interrelated in a variety of ways. The subject of the relations of the society to its membership, the profession, the public, and the times involves questions of the purposes, functions and organization of the society. The organization topic relates to ways of managing activities and functioning with other organizations. The technical-activities topic embraces means for carrying on the technical functions of a great engineering society, contributing to engineering knowledge, creating or developing new engineering policies, originating and bringing about constructive, progressive movements, and developing engineering practice and engineering influence. The general-activities topic relates to the work of the society in connection with public affairs and the welfare of the profession and of society. The functions of the society with reference to the classes of members of the profession are bound up intimately with the topics already referred to. It will be noted that this outline of the field of work of the committee is not in the form of a program of work or order of procedure; the topics are too closely related to make it applicable to such uses.

Certain matters of policy which have been called to the attention of the board of direction have been referred to the committee, such as the rewriting of the code of ethics of the society, the suggested organization of American engineers abroad, and the question of what policy the society should take toward the adoption of standards, and doubtless other matters will be so referred. It seems probable that many members of the society will have proposals which they will desire to present.

Policies and Methods

The great questions before the committee, then, are (1) What are the functions which the American Society of Civil Engineers should assume? and (2) how should they be carried out?

It goes without saying that a society should consider and determine the functions it will undertake and the working policies it will pursue. In considering these matters, it is apparent that the formulation of a proposition is a step which may aid in judging of the value of the proposal, since the mere attempt at making the statement may bring out its impracticability or its undesirability. The formulation of propositions, too, takes the mind away from indefinite generalities and to definite proposals which should have much the same significance to all readers. It will be evident, too, that some proposals must be accepted only as principles or ideals and not as working rules, and a distinction between these two classes may well be made. Definiteness of statement of course is essential in a report of a committee such as this. Doubtless the committee will carefully consider functions and policies and their formulation.

Not less essential is the determination of the methods and ways of executing proposed functions and carrying out policies. In devising administrative plans it is well to keep in mind that organization should be left as simple and flexible as possible; elaborate or complicated organization and methods are likely to be ineffective; they are not self-propelling; and time makes changes in needs and scope of work.

In the course of its work the committee will doubtless find it desirable to consider whether changes should not be made in the constitution of the society, even though, as has been found true in the past, changes in methods and new activities may be put into effect without amending the constitution; the securing of the views of the membership of the districts on their choice for members of the nominating committee and the establishment of Engineering Council are examples of what has been done without modifications of the present constitution. It seems likely, however, that the committee will want to recommend ways in which the constitution should be changed. Here again it is suggested that simplicity, flexibility and breadth should be kept in mind, and that details be left for by-laws and regulations. It will be necessary to learn whether proposals for activities and methods come into conflict with the charter or conditions of incorporation of the society. Possibly the conditions governing the incorporation may limit somewhat activities which the committee may think desirable, and possibly the committee may conclude that modification in the articles of incorporation should be made or other steps be taken to give legal strength to their recommendations.

Coöperation With Committees of Other Societies

Proposals have been made that the other national engineering societies appoint committees to take up similar work for those societies. In case such committees are formed it will be the duty of the Committee on Development of the American Society of Civil Engineers to coöperate with these committees on subjects of common interest. The committee may also find it desirable to confer with representatives of local engineering societies over the country concerning the relations which the American Society of Civil Engineers and its local associations should bear to these local societies. It would appear that much may be accomplished through conferences with both national and local organizations.

Committee Procedure

The committee is so large and so widely distributed over the country that its work may best be done partly by correspondence and written discussion, partly through subcommittees, and partly at meetings of the whole committee. To insure that adequate progress be made at the first meeting of the committee, it is important that

preliminary work be done in advance of the meeting. This may well cover matters relating to the field of work, to the organization of the committee, and to proposals for the committee's consideration. At the first meeting, which will be called by the chairman, the organization and program of work may be completed and questions formulated on which it is desired to have preliminary discussions by the society. For the preliminary report requested for Nov. 1 the committee can hardly expect to do much more than record a program of work, propose questions on which the views of the membership are desired, and submit topics for discussion. Before the time of another meeting, which possibly may well be held at about the time of the annual meeting of the society in January next, progress in the work will have been made, and it may be expected that much will be accomplished at this second meeting.

In its work the committee will doubtless make a study of the engineering society organizations of this and other countries and of professional and scientific organizations of various kinds. Information concerning the society and its work may be obtained from the secretary.

The method adopted for selecting the committee gives a wide geographical distribution and an opportunity for the representation of local views. It has the advantages of giving a channel by which discussions of the problems at meetings of the local associations of members may reach the committee, and it is hoped that the local associations will be helpful in the work. It will be borne in mind, of course, that the committee is a committee of the whole society, and it is expected that it will give careful and impartial attention to the interests of every part of the society. The method of selection used should not be taken to mean that members of the committee are delegates of the local associations of members; and it also may be noted that the three geographical districts of the society which do not have local associations of members have much less than a proportionate representation on the committee. Necessarily proposals for new activities and for modification of old ones must take into consideration the financial resources of the society, and the financial side of all questions of course will receive the careful attention of the committee. The questions before the committee are the broad questions of policy, and personality will not enter into their discussion. With a variety of points of view and with the opportunity for widespread consideration of the proposals of the committee, it may be confidently expected that the final report of the committee will receive substantial approval from the society.

The committee has a great opportunity to be of service to the American Society of Civil Engineers and its membership. It is hoped and believed that the work of the committee will have significant and far-reaching results in the development of the society and the usefulness of the profession of engineering.

Should Treat All Sewage Going Into Boundary Waters

International Joint Commission Sets Tentative Standard for Safe Load on Water Filters—Recommends It Be Given Control Over Pollution

AFTER considering the pollution question for six years the International Joint Commission on Boundary Waters Between the United States and Canada has issued its final report on that subject. Its main conclusions are that the Great Lakes and other boundary waters are being polluted, in contravention of the treaty between the United States and Great Britain; that all sewage discharging into the boundary waters should be treated to some degree; that sewage entering the Detroit and Niagara Rivers should be so treated as to reduce to safe loading the burden on water-purification plants; that the treatment elsewhere should vary with local sanitary and economic conditions, having due regard to "the economic value of stream pollution" and to the public health; and that power to control the pollution of boundary waters should be given to the commission. As a tentative standard for the Detroit and Niagara Rivers the commission adopts the recommendation of its advisory engineers that the average load on water-purification plants should be kept down to about 500 B. coli per 100 c.c. as an annual average, or that B. coli should be absent in 50% of 0.1 c.c. samples. As a more ready standard, it is proposed that the stream receiving sewage should afford a dilution, or the sewage be diluted to give the equivalent of a dilution, of 4 cu.ft. per second per 1000 of sewage-contributing population. No attempt at even a tentative standard for other than the Detroit and Niagara Rivers is made by the commission.

The first report of the commission is dated Aug. 12, 1918. The report has not yet been printed, but extracts from it were presented at the convention of the American Society for Municipal Improvements on Oct. 3, in a paper by Capt. F. A. Dallyn, lately engineer of the Ontario Board of Health, and one of the engineering advisers to the commission. From Captain Dallyn's paper the conclusions and recommendations of the commission, seven in number, together with its discussion of the permissible limits of pollution and the standard of sewage treatment, all as given below, have been taken:

Seven Conclusions and Recommendations

1. The Great Lakes beyond their shore waters and their polluted areas at the mouths of the rivers which flow into them are, except so far as they are affected by vessel pollution, in a state of almost absolute purity. With the exception of these pure areas, the entire stretch of boundary waters, including the Rainy River, St. Mary's River, the St. Clair River, the Detroit River, the Niagara River, the St Lawrence River from Lake Ontario to Cornwall, and the St. John River from Grand Falls to Edmunston, N. B., is polluted to an extent which renders the water in its unpurified state unfit for

drinking purposes. This pollution has its origin chiefly in the sewage and storm flows from the riparian cities and towns, and the sewage from vessels. It is very intense along the shores of the Detroit and Niagara Rivers, and in the contaminated areas, in the lakes. Throughout the whole length of boundary waters, where sewage is discharged from the sewerage works of cities and towns, the pollution is almost all concentrated in the shore waters on the side of the boundary on which it originates. These shore waters, besides being in places unsightly, malodorous and absolutely unfit for domestic purposes, are a source of serious danger to summer residents, bathers and others who frequent the locality. So foul are they in many places that ordinances have been passed prohibiting bathing in them.

Health and Welfare of Both Countries Imperilled

2. In the Detroit and Niagara Rivers conditions exist which imperil the health and welfare of citizens of both countries, in direct contravention of the treaty. This is true, though in a less marked degree, of the Rainy and the St. John Rivers.

3. In St. Mary's, the St. Clair and the St. Lawrence Rivers pollution exists which is in substantial contravention of the spirit of the treaty, and unless these conditions are improved and the rivers placed under the control of competent authority, the resulting injury will be much more pronounced as population increases.

4. Vessel pollution in certain parts of boundary waters exists to an extent which causes substantial injury to health and property. It is derived from two sources, sewage waste from vessels and "water ballast" which is taken in by lake vessels at their ports of departure and emptied into those waters at or near their ports of destination. Vessel pollution is distinctly traceable in boundary waters in lakes and canals which vessels traverse in navigating them, their waters being thereby rendered unfit for drinking purposes.

5. In some cases sawmill and other mill wastes, garbage, offal, carcasses and other refuse matters are discharged into boundary water. This practice results generally in a contravention of the treaty.

Feasible to Prevent or Remedy Pollution

6. It is feasible and practicable, without imposing an unreasonable burden upon the offending communities, to prevent or remedy pollution, both in the case of boundary waters and waters crossing the boundary: (a) In the cases of city sewage, this can best be accomplished by the installation of suitable collecting and treatment works, the latter having special reference to the removal of bacteria and matters in suspension; (b) In the case of vessel sewage a feasible and inexpensive remedy lies in the employment of recognized methods of disinfection before it is discharged. In the case of water ballast suitable rules and regulations should be prescribed with a view of protecting the water intakes; (c) The discharge of garbage and sawmill waste into boundary waters should be prohibited, and industrial and other wastes, which are causing appreciable injury, should be discharged subject to such restrictions as may be prescribed.

(7) In order to remedy and prevent the pollution of boundary waters and to render these waters sanitary and suitable for domestic purposes and other uses, and to obtain adequate protection and development of all interests involved on both sides of the boundary, and to fulfill the obligations undertaken in article IV of the treaty, it is advisable to confer upon the International Joint Commission ample jurisdiction to regulate and prohibit this pollution of boundary waters and waters crossing the boundary.

Limits of Permissible Pollution and Standards of Sewage Purification

Two distinct lines of policy with regard to the disposition of sewage in boundary waters were suggested to the commission. (1) To look upon them as open sewers for the reception of riparian pollution of all kinds, and (2) to restore the purity of the boundary waters as far and as fast as a comprehensive and adequate appreciation of all interests involved will permit.

The first policy would not only be contrary to the treaty and the principles of international law, but the continued discharge of untreated sewage into boundary waters by either country would, especially in the cases of the Niagara and Detroit Rivers, be increasingly injurious to its own riparian communities farther down stream.

The advisory engineers in their résumé say:

"While realizing that in certain cases the discharge of crude sewage into boundary waters may be without danger, it is our judgment that effective sanitary administration requires the adoption of the general policy that no untreated sewage from cities or towns shall be discharged into the boundary waters.

"Water-supplies taken from streams and lakes into which the sewage of cities and towns is directly discharged are safe for use after purification, provided that the load upon the purifying mechanism is not too great and that a sufficient factor of safety is maintained; and, further, provided that the plant is properly operated.

Disposal by Dilution a Natural Resource

"In waterways where some pollution is inevitable and where the ratio of the volume of water to the volume of sewage is so large that no local nuisance can result, it is our judgment that the method of sewage disposal by dilution represents a natural resource, and that the utilization of this resource is justifiable for economic reasons, provided that an unreasonable burden or responsibility is not placed upon any water-purification plant and that no menace to the public health is occasioned thereby."

This "burden of responsibility" is a very important element to be considered in arriving at a standard of purification or the limits of permissible pollution. The advisory engineers were interrogated very fully on this subject at the New York conference and were pressed to define this limit in as exact terms as possible. Their answer is:

"While present information does not permit a definite limit of safe loading of a water-purification plant to be established, it is our judgment that this limit is exceeded if the annual average of B. coli in the water delivered to the plant is higher than about 500 per 100 c.c., or if in 0.1 c.c. samples of the water B. coli is found 50% of the time. With such a limit the number of

B. coli would be less than the figure given during a part of the year and would be exceeded during some periods."

It is scarcely necessary to remark that the engineers are speaking of bacterial pollution only. In view of the present stage of progress in sanitary science this limit or standard must be regarded as tentative. This evidence shows that they regarded the question as profoundly affected by conditions and in no sense capable of absolute generalization. The commission agrees with the statement of principles set forth in the four paragraphs quoted. It therefore recommends that *all sewage should before being discharged into boundary waters receive some purification treatment, the degree of such treatment to be determined in a large measure by the limits of safe loading of a water-purification plant.* [Italics ours.—Editor.]

To determine the extent of remedial treatment required in each particular case would involve consideration of the varied lines that have been followed by the commission throughout the present inquiry; the existence of pollution and of harm, actual or potential, to domestic or other uses, to public health or property; the results of the engineering studies of feasible remedies; and the economic facts relating to the conservation of stream resources. It would require the balancing of the value of remedial measures in the terms of public good against the cost of the requisite improvements.

On the one hand, it is evident that the paramount importance of public health and the binding obligations of the treaty must be borne in mind. These make impossible the recommendation of such lenient remedial measures as would work economic injustice or would indorse officially the continued spoliation of a natural resource to the injury of the citizens upon both sides of these waters.

Requirements Must not Be Excessive

On the other hand, sewage treatment requirements must not be made so excessive and unreasonable as to involve the cities and towns along these waters in an expenditure entirely unjustifiable. They should be reasonable and feasible from the standpoint of engineering construction or adaptability to local conditions, of the availability of necessary lands, of outfalls and incident structures, and of costs.

In view of the fact that pollution in the Detroit and Niagara Rivers, and its transboundary effects therein, are much greater than in the other boundary waters, these two rivers will be treated in one class, and the remaining boundary waters as another class.

The problem of necessary bacterial purification of the sewage discharged into the two former is one of extreme perplexity, owing to the difficulty or impossibility of obtaining definite and ample data and the relative importance to be attached to many of the factors which enter into it.

Safe Loading of Water-Purification Plants

After a great deal of consideration the commission has, in view of all the circumstances of the case, come to the conclusion that for the present, and as an immediate step in the way of restoration of the purity of these streams, the communities responsible for the discharge of raw sewage into them should purify it to such an extent that the resulting average cross-sectional pollution in each river will not exceed the limit of safe loading for a water-purification plant. In other words, the standard of purification required of these communities should be such that the streams after receiving their treated sewage would have a mean annual cross-sectional average of B. coli not exceeding 500 per 100 c.c. Compliance with the requirements of this standard would not impose upon the riparian communities along these rivers, discharging their sewage therein, a burden which would be unreasonable or greater than that ordinarily imposed upon urban communities which purify their sewage.

It necessarily follows that this standard of sewage purification, being based upon a tentative standard of safe loading of water-purification plants, must itself be tentative. The growing appreciation of sanitation, the consequent demand for a higher degree of purity in water supplies, and the constant improvement that is taking place in the processes of sewage treatment, tend to make a proper standard of sewage purification one of ever increasing stringency. The discovery of a new and much more economical, or possibly a profitable, method of disposal of sewage would naturally lead to the adoption of a stricter standard of permissible pollution in heavily polluted streams. Furthermore, any limit of permissible impurity that might be established even temporarily for a given stream must be influenced largely by strictly local considerations.

The data necessary for the formulation of a fixed standard either of sewage purification or of water purification are not sufficiently well established at the present time. By more precise methods of experimental study there will doubtless be obtained in the future a more ample and accurate command of facts which will admit of the determination of a more definite standard.

A Simple Working Standard

In view of the difficulties and uncertainties of bacteriological technique, it is distinctly advantageous to have, if possible, a working rule which is more accurate and readily determinable than the bacterial standard suggested. Professor Phelps, the consulting engineer, taking the results of the extensive investigations reported upon in the progress report as an index of the conditions actually existing, worked out such a rule or standard.

He found that if the sewage of the cities be diluted in a stream flow to 4 cu.ft. per second per capita of the population [per 1000 population?—Editor] the resulting water will contain approximately 500 B. coli per 100 c.c. If the dilution is proportionately less than this a corresponding degree of purification of the sewage will be necessary to maintain the final stream condition. Further investigations will no doubt make possible a more accurate statement of these relations, but, as the entire matter of standards is always subject to revision in the light of accumulated knowledge, it is considered that for all purposes of a present inquiry the practical equivalence of the dilution and the bacteriological standards may be accepted.

These standards are not applicable to rivers other than the Niagara and the Detroit, but it is in no sense

to be inferred, however, that remedial or protective measures are not required in their case where the dilution based upon the entire cross-section of the stream exceeds in every instance 4 ft. per second per capita [per 1000?—Editor] of the population.

As has been stated, the opinion of the board of advisory engineers is adopted that no untreated sewage should be discharged into boundary waters, but the commission considers it inadvisable at the present time to prescribe what the amount of treatment should be in the case of these remaining rivers. The sewage from each community along their banks must be considered by itself in respect of the degree of purification that is necessary, basing the standard on the reasonable use of the waters, the practical possibilities of remedial and protective measures, the economic value of stream purification, and also the economic value of stream pollution, proper regard being had to the public health.

After giving much attention to the question of standards of purification in these six boundary rivers the commission has come to the conclusion that the fixing of standards for them, and the subsequent modifications of these standards from time to time, should be left as recommended in the report to some authority clothed with the necessary power to deal with the question. This authority should also have power to vary, from time to time as conditions demand, the standards of sewage purification in the Detroit and Niagara Rivers.

Pavement Construction and Maintenance Considered

Abstracts of Papers Read Before the American Society for Municipal Improvements at Buffalo Last Week, Prefaced by Extracts from Presidential Address—Buffalo Reduces Cost of Street Cleaning by Adopting Motor Apparatus, Keeps Useful Asphalt Repair Records, and Improves Concrete Base by Scientific Sampling and Testing

Planning for Reconstruction Period

FROM PRESIDENTIAL ADDRESS BY N. S. SPRAGUE
Chief Engineer, Bureau of Construction, Pittsburgh, Penn

DURING the early stages of the war some cities and towns, recognizing the importance of conserving man power and use of materials for such work only as is essential to the prosecution of national government purposes, reduced their program of municipal improvements to what was then considered the minimum. Now we all have come to a realization of the necessity for still further curtailment. The time has arrived when all municipal projects, nonessential to the winning of the war, or not needed for the preservation of the public health, must be deferred. The thousands of men thus released are needed in essential industry.

But what, may we ask, shall those of us who are retained in public positions find to do, outside of our regular official duties, to help our country? It occurs to me that the congestion on the railroads, emphasized by a more general use of highway thoroughfares for transportation of freight by motor trucks, points to work for some of us to do. An opportunity is here presented for highway engineers to study the effect of this motor truck traffic upon the various types of pavements now in use and to apply to their reconstruction the knowledge so acquired.

Public officials may also prepare plans for necessary municipal improvements, so that after the war is over work will be provided for the men returning home. This can be done by the reduced municipal engineering force. Neglected records of construction can be plotted and record plans completed. Pending the suspension of municipal improvement construction, there are, in addition to the foregoing, many ways to maintain and use to good advantage the municipal engineering staffs.

After the war will come the reconstruction period, and the American municipal engineer will, no doubt, be called upon to assist his European brothers in the gigantic task of rebuilding the cities and towns which have been destroyed. There is much which this society can do at present to help win the war, and the future offers even larger opportunities for work in our chosen profession.

Buffalo Reduces Cost of Street Cleaning by Use of Motor Apparatus

BY WILLIAM F. SCHWARTZ
Street Commissioner, Buffalo

MOTOR apparatus is being used by the City of Buffalo in its street cleaning department and has effected a saving. Sweeping, flushing and snow-removal equipment has been used, and a two months' demonstration in ash and garbage collection showed satisfactory results.

The city at the present time has two motor sweepers. These were bought and placed in operation Oct. 1, 1916, replacing six horse-drawn sweepers and two sprinkling wagons, and consist each of a combination sprinkler, sweeper and pick-up. They are each equipped with a 200-gal. tank, a large circular broom and a 1½-cu.yd. box. During the fiscal year which ended June 30, they cleaned approximately 72,000 great squares (a great square consisting of 10,000 sq.ft.). We found that they did the best work on smooth pavement, and that the cost per great square was about 2c. lower than in horse-swept districts; this in spite of the fact that there was considerable trouble in getting competent drivers and the machines did not work as satisfactorily as under normal conditions.

Three motor street-flushing equipments were installed during the past year to replace the old method of flushing and to do street cleaning in some districts. Each equipment consists of a 5-ton tractor with power take-off from the transmission to the pump that produces pressure for the flusher, and a trailer with a 2000-gal. tank capacity which sits upon the fifth wheel on the tractor. The trailer tanks have four nozzles which are controlled from the driver's seat, and the centrifugal pump, driven

from the power take-off, produces a pressure of 35 lb. at the nozzles. It is found that this pressure will not injure the pavement and at the same time does work cleanly. When the street is very dirty four nozzles are used which gush 525 gal. per minute, but, as a rule, only two nozzles, flowing 150 gal. per minute are used. Under the old system of flushing with portable line hose the cost per great square was $1.40. With the two-man reel, as used in New York City, we found the cost to be 56c., while with the motor equipment the cost was reduced to 20½c. per great square. This includes everything, such as operating labor, supervision and pick-up wagon.

Three additional flushers have been contracted for, and it is the intention of the department to do away, as soon as financial conditions warrant, with all horse-drawn sweepers and sprinklers and flush the entire city, with the exception of the cobblestone and macadam pavements. The cost per great square for sweeping was found to be 27.8c.; thus, flushing is not only economical but leaves the street in a more sanitary condition.

Snow removal is accomplished by removing the trailers from the tractors and equipping the tractors with snowplows. It is estimated that during the past winter these three tractors saved the city at least $15,000 on snow-removal work alone. The cost of operation per 16-hour day, including operating charges, maintenance and fixed charges, was found to be $24.96. This was increased to $26.96 during the winter, on account of extra gasoline and oil used to run on low gear in bucking heavy snowdrifts.

For two months the department tested trailers and tractors in the ash and garbage division and found that it could cut the expense aproximately 25%, while getting greater efficiency. The system followed in the demonstration was to start empty trailers, drawn by horses, from the various barns to the different districts. When the trailers were loaded, the tractor with a train of four empty trailers would start picking up the loaded trailers and dropping of the empties, proceeding with the loads to the reduction plant. This operation was continued until a district was cleaned up.

Asphalt Repair Records Kept and Methods Followed at Buffalo

By C. E. P. Babcock, First Assistant Engineer AND J. A. Vandewater, Assistant Engineer in Charge of Repairs, Buffalo, N. Y.

TABLES containing detailed cost records of pavement repairs have gone beyond the merely interesting stage and have become a necessity to the Department of Public Works of Buffalo, and are more referred to than any other tables, for this reason. They form a basis for argument and determination when there is a disagreement as to the advisability of expenditures on streets. During the 15 years up to June 30, 1917, about 3,000,000 sq.yd. of asphalt pavement were maintained annually, and detailed records were kept. Recently changes were made in the method of payment for repairs, which changes were made by the department after the data available were collected as to the thickness of the top and binder courses in repair work relative to the original construction.

With the expiration of guaranties on the first asphalt pavements and the assumption of repairs by the city out of its general funds, a detailed record was entered and carried on. From the printed report the cost of each street each year can be ascertained. As the life of asphalt pavements in Buffalo is (with few exceptions) 20 years or more, these records have assumed a considerable volume, and the question arose as to whether their value justified the space and the cost of printing them year after year. Fortunately, it was decided to continue the record, leaving off the early details and publishing the area and cost in detail for 10 or more years back.

These tables have been found a valuable basis for argument when the question arises, as it always does, as to whether a street has received an adequate repair or whether the city should continue repairing or should reconstruct the pavement. As two-thirds of the cost of repaving is assessed, of course the local desire is to postpone the local expense, regardless of the engineer's advice. Besides this, we locate and plot on cross-section paper every patch repaired, using different colors for each year. These plottings show not only the yearly repair, but, more important, where repair overlaps previous repair. The contractor guarantees his work for one year from Dec. 31 of the year in which it is executed; therefore, if a repair is made overlapping the joint of a repair under guaranty, an allowance of 6 in. is made and not charged to the new guaranty.

Repairs on Asphalt Pavements

The tabulations show that up to June 30, 1917, $2,899,-781 has been expended on repairs for asphalt pavements, the average rate per square yard in area of the streets repaired being $0.0653, and on the area of streets maintained, $0.0451. The contract price has varied from 74c. to $1.39 per square yard laid up to Dec. 31, 1917, and, on account of labor and material conditions this year, the rate may run somewhat over $1.80 per square yard laid. Various curves have been plotted from the information collected showing the relation between the cost per square yard yer year and the age of the pavement in years. They were published in *Engineering News* of Sept. 26, 1912, p. 562. The present average age of all asphalt pavements under city maintenance is about 21.7 years.

Heretofore our contracts were made on the basis of a square yard repaired. For our resident asphalt contractors this seemed a fair basis, because they knew about the amount of the season's work and the material required for it. In 1908 investigation showed that of the original depth of asphalt, namely, 1½ in. of binder and 2 in. of wearing surface, about 52% depth of binder was used in repair, and about 82% of top. If an outside company wished to bid on the square-yard basis it would not have had this experience, and with our knowledge of the condition we felt that our contract should be made on something different from the square-yard measurement, thus eliminating the opportunity to manipulate to the contractor's advantage the lower priced binder and the higher priced top. Therefore, after collecting the data available, the Department of Public Works authorized new specifications, the principal factors in which are that both the top and binder be purchased at a price by

cubic measure delivered on the work; that asphaltic cement containing joints be paid for by the gallon delivered; that the cost of the street labor of chopping out patches, laying material and cleaning up be paid for by the square yard.

By this specification the city uses all of either the binder or the top, as its engineer requires, and pays for the amount actually used. The specifications quote for the information of the bidder, that the average depth experience for binder is 1.12 in., and for top is 1.57 in., or 75 and 78% of the original depth. For 1917 work the percentages were 58 and 78, respectively. The reduction in binder is partly due to the fact that our pavements are becoming thin. When the old pavement is less than 2 in. deep the specifications provide that no binder shall be used for repair.

Bids are received and inspection of all pavements are made early in the year, the endeavor being to repair all asphalt pavements at least once a year, and when necessary, where traffic is unusually heavy, twice a year.

Work is begun about Apr. 1, and usually continues until about Dec. 1. Pavements to be repaired are marked out by what we term an "asphalt locator," who marks the patches to be repaired, measures them and makes a complete record. The contractor also makes a record which must correspond with that made by the city's locator. The repair gang then follows, chopping out, relaying the new material and cleaning up. A gang of 75 or 100 men will lay from 750 to 1000 sq.yd. per day, depending on the sizes of the patches.

Concrete Base Improved by Scientific Sampling and Testing

By George F. Fisk

Resident Engineer in Charge of Pavement Construction, Buffalo, N. Y.

INSTALLATION of complete sampling and testing methods by the bureau of engineering, Department of Public Works, Buffalo, N. Y., has resulted in great improvement in the quality of concrete base produced by paving contractors. Accurate proportioning is obtained, both by studying materials according to the measuring method of determining voids, and by a comparison of specially plotted logarithmic curves with Fuller's curve plotted to the logarithmic scale. Examination of the results obtained in many tests, while not conclusive, tends to show that local gravel concrete is equal to crushed stone concrete, that aggregate obtained by breaking up and screening old concrete bases is acceptable, and that the amount of water used has a direct relation to the compressive strength of the concrete obtained. It is also shown that the use of stone screenings for sand has a detrimental effect.

Buffalo is fortunate in being able to obtain a gravel which is nearly ideal for making concrete. It is obtained from sedimentation banks in the Niagara River, near Strawberry and Squaw Islands, and was delivered in South Buffalo last year at a cost of $1.55 per cubic yard. Another supply of gravel known as Buffalo Creek gravel is taken from the banks along the creek. While the Niagara supply is very clean, with scarcely a trace of organic matter, the Buffalo Creek supply is unreliable in respect of evenness of run and cleanness. In the same bank may be found a clean gravel and a gravel carrying loam running as high as 15%. It also contains considerable débris and shale. It can be delivered at a cost of $1.25 per yard, and contractors desired to use it in their concrete.

These conditions led the city to purchase a 200,000-lb.

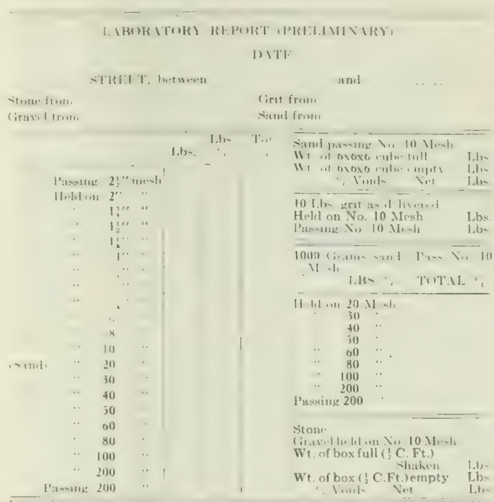

LABORATORY REPORT (PRELIMINARY)
DATE
STREET, between and
Stone from Grit from
Gravel from Sand from
Lbs. Lbs. Tot. %
Passing 2½" mesh
Held on 2" "
" 1¾" "
" 1½" "
" 1¼" "
" 1" "
" 8
" 10 "
(Sand) " 20 "
" 30 "
" 40 "
" 50 "
" 60 "
" 80 "
" 100 "
" 200 "
Passing 200 "
Sand passing No. 10 Mesh
Wt. of 6x6x6 cube full Lbs.
Wt. of 6x6x6 cube empty Lbs.
% Voids Net Lbs.
10 Lbs. grit as delivered
Held on No. 10 Mesh Lbs.
Passing No. 10 Mesh Lbs.
1000 Grams sand Pass No. 10 Mesh
LBS. % TOTAL %
Held on 20 Mesh
" 30 "
" 40 "
" 50 "
" 60 "
" 80 "
" 100 "
" 200 "
Passing 200 "
Stone
Gravel held on No. 10 Mesh
Wt. of box full (½ C. Ft.) Shaken Lbs.
Wt. of box (½ C.Ft.) empty Lbs.
% Voids Net Lbs.

FIG. 1. PRELIMINARY LABORATORY REPORT ON COARSE AND FINE AGGREGATE

hydraulic testing machine to ascertain whether concrete made with Buffalo Creek gravel was satisfactory as a permanent pavement foundation. Contractors were informed of this purpose, and not one of them has made a request to use Buffalo Creek gravel since the machine was installed.

Sampling starts as soon as the material is delivered on the job, the assistant at the laboratory is notified and he obtains samples of the gravel or stone and the sand and cement. He makes his screen analysis and delivers a preliminary report the same day to the engineer in charge of the work. The form for this report is reproduced herewith. The screen analysis is made by means of a sieving machine, while the voids in the material are measured by the amount of water which can be held by a certain cubical content. A 6-in. cube is used to obtain the voids in material passing the No. 10 mesh, this size having been found as accurate as a cubic-foot box and much easier to handle.

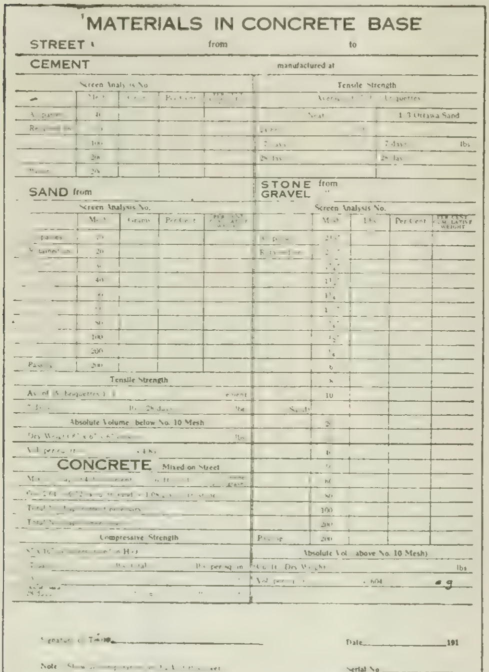
For testing unsifted gravel a 1-cu.ft. box is used. The gravel is put in the box, a small amount being thrown at a time, water being added and tamping done lightly. When the box is full, the measured cubic content of water indicates the voids which should be filled with cement.

It is thought that this analysis forms a fair comparison for proportioning where the gravel is used as it comes, but if the sizes of coarse and fine aggregate are not in proportion, in either case it means the requirement of an excess of cement in the mass. For

this reason, a screen analysis of all material is made.

By referring to the cut, Fig. 1, it will be seen that the dividing line between fine and coarse aggregate is placed at the 10 mesh. Making the division at the ¼-in. mesh leaves that portion held on the 6 and 8 mesh to be included in the fine aggregate, and it may be that the cement proportioned 1:3 for the fine aggregate passing the ¼-in. mesh may not be sufficient for that portion held on the 6 and 8 mesh.

Upon receipt of the preliminary report, and before concreting begins, the engineer in charge figures the


MATERIALS IN CONCRETE BASE

STREET from to

CEMENT manufactured at

Screen Analysis No. Tensile Strength

1:3 Ottawa Sand

SAND from

STONE from GRAVEL

Screen Analysis No. Screen Analysis No.

Tensile Strength

Absolute Volume below No. 10 Mesh

CONCRETE Mixed on Street

Compressive Strength

Absolute Vol. above No. 10 Mesh

Date 191

Serial No.

FIG. 2. FORM OF REPORT ON CONCRETE AND CONCRETE MATERIAL. FORM SIZE 8½ X 13½ INCHES

proportions necessary to make a concrete of maximum density. The voids are determined by weight, the specific gravity of the sand and gravel being taken at about 2.65. If the sand appears dirty the colorimetric test is used for organic material.

After the proportion to be used is tentatively decided on, a logarithmic analysis curve is plotted representing the per cent. passing the different screens. This was first done because it was found that a clear idea of the gradings below the 40 mesh could not be obtained by using a standard screen scale. In the chart plotted the abscissas are the logarithms of the mesh opening in inches, while the ordinates are the logarithms of the per cent. passing the mesh by weight. Fuller's curve of the parabolic form plots on this chart as a straight line, and the fine gradings are shown in a very distinct manner.

This curve shows how the mix may be improved, using Fuller's curve of maximum density as a standard. The analysis curves of the local gravel have invariably shown that below the 60 mesh the gravel is deficient in fine material from 1 to 6%, and between the 1 mesh and the maximum size the gravel is often deficient in coarse material between 5 and 15%. Between the 60 mesh and the 1-in. the curve will follow very closely the standard curve of maximum density. From a practical standpoint, it is easy to add a small amount of coarse aggregate, but adding from 1 to 6% of material passing the 60 mesh is difficult, and for paving work is not economical. In any event, the compressive tests have shown that the cement probably makes up for the deficiency, as 87% of the gravel concrete and 96% of the stone concrete of 1:2:4 mix have shown a test of 2000 lb. per square inch in compression at 28 days. The specific gravity of this concrete was about 2.366, as determined by numerous tests.

How Concrete Is Sampled

Sampling of the concrete as actually laid in the street is done as soon as the concrete gang has the work well started. The laboratory assistant, who has been notified, makes up his samples, five in all, in cylinders 8 in. in diameter and 16 in. long, one cylinder being filled for every 25 or 30 ft. lengthwise of the street. In filling the cylinder, one-fourth of its cubic content is taken from each of four batches, to get a better average of the mix. The cylinders are left on the street where made for 24 hours, then they are stored in water and tested at 7 days, 10 days and 28 days, three being averaged for the 28-day result. The inspector each day sends in a report of the number of square yards of concrete laid and the number of bags of cement used, and all these tests and data are entered upon the form as shown in the cut, Fig. 2, where the results obtained can be readily compared with the theoretical amounts which have been previously figured. When the data for the street are complete, the report is filed for future reference.

Throughout the tests, the results have shown that there is a direct relation between the compressive strength of the concrete and the amount of water used; in fact, the greatest variation in strength can be traced to the different amounts of water used. This does not mean, however, that the strength of the concrete is dependent solely upon the materials used, for the best materials with careless workmanship, such as inefficient mixing, will give concrete of low compressive strength. On the other hand, with an inferior material, but with scientific proportioning and a proper amount of water and mixing, good results may be obtained.

The tests further indicate that the old natural-cement foundations can be broken up and screened and the old stone used as a coarse aggregate for new concrete base, with excellent results. Tests on samples taken from concrete using this coarse aggregate showed an average of 1729 lb. per square inch for the 28-day test. It is also shown that broken limestone or broken sandstone paving blocks, using stone-sand, do not make a satisfactory concrete unless a greater proportion of cement than 1:3 is used. Better work is obtained where Niagara River grit is used with the crushed stone. This is because the stone-sand carries too much fine material between the 100 and 200 mesh to mix properly with the cement.

Recent Erie Flood Similar to Inundation of 1915

Though of Greater Intensity, 1918 Storm Was of Shorter Duration—Flood Prevention Structures Helped

BY FARLEY GANNETT
Harrisburg, Penn.

MILL CREEK, at Erie, Penn., rose in flood on Monday, July 29, 1918, the result of a heavy rain in many ways similar to the rain which caused the great flood of Aug. 3, 1915. The recent flood, however, did little damage, whereas that of three years ago killed 35 persons, destroyed $2,000,000 worth of property and tied up traffic and business throughout the city for several days. A comparison of the two storms and their results is interesting.

The two storms started at nearly the same hour of the day and on nearly the same day of the year, and by reason of these facts the storm of 1918 caused consternation in the city. With the memory of the previous flood in mind, the citizens lined the banks of the creek for hours, watching the flood. The creek kept within its banks except for one point where a building spans the stream and restricts the channel. Here the water was diverted and flowed down French St. some 6 in. deep, filling cellars and stopping traffic.

After the flood of August, 1915, works were designed by the writer's firm, and the construction of these works has been under way for about a year. A drift catcher, consisting of a structure resembling an Ambursen dam without a deck, was constructed about ½ mile above the city, and a reinforced-concrete conduit 22 x 18 ft. inside dimensions, about 2½ miles long, is being built through the city to carry the creek.

The storm of 1915 came in three waves, while that of 1918, fortunately, was in only one. The storm, however, was similar to that of 1915, and of even greater intensity at times, as shown by Table I.

The 1915 storm gave 4.27 in. in three hours, while that of 1918 in two hours gave 2.60 in. of rain. For the two hours of greatest intensity in 1915 the precipitation was 2.89, or only 0.29 in. more than that of 1918. Table II shows the periods of greatest intensity for both storms and strongly indicates their similarity.

In 1915 the rain started at 3:30 p.m. and the crest of the flood occurred at 9:30, the rain continuing with few letups until 7:30 and beginning again about 9:30. In 1918 the rain began ½ hour later and the crest occurred at 7:30, ½ hour after the rain stopped. The drainage area is practically 11 square miles.

The precipitation during the first hour of the recent storm was greater than that during the first hour of that of 1915, 2.07 in. falling during the first ½ hour

DRIFT CATCHER BUILT AT ERIE AFTER 1915 FLOOD WORKS IN 1918 FLOOD

as against 1.5 in. in 1915, and 2.75 in. up to the end of the second hour, as against 2.84 in. in 1915. The 1915 storm continued so violently after the second hour that 4¼ in. had fallen at the end of three hours. The 1918 storm was practically over at the end of one hour, whereas after three hours of rain in 1915 another violent storm descended, making altogether 5.77 in. of rain falling between 3:30 p.m. and 5:30 the next morning. Over the watershed above the city the rain in 1915 was even heavier than in the city at the Weather Bureau gage. At some points indications and fairly good evidence pointed to a total maximum rainfall of about 9 in. during the afternoon and night.

The flow of the creek at the peak of the flood of 1918 was not measured, but estimates were made indicating that the discharge was at the rate of 5000 cu.ft. per second, or 450 sec.-ft. per square mile of watershed, as against approximately twice as much in 1915.

Several factors are responsible for the much less serious results of the 1918 flood. In the first place, the

TABLE I RAINFALL IN TWO STORMS

Storm of Aug. 3, 1915 — Time of Day	Rainfall, In.	Storm of July 29, 1918 — Time of Day	Rainfall, In.
3:30–3:45	0.12	3:57–4:12	0.63
3:45–4:00	0.19	4:12–4:27	0.92
4:00–4:15	0.40	4:27–4:42	0.28
4:15–4:30	0.51	4:42–4:57	0.40
4:30–4:45	0.16	4:57–5:02	0.26
4:45–5:00	0.07	5:02–5:07	0.11
5:00–5:15	0.12		
5:15–5:30	0.64		
5:30–5:45	0.40		
5:45–6:00	0.22		
6:00–6:15	0.03		
6:15–6:30	0.16		
6:30–6:45	0.74		
6:45–7:00	0.51	......	..
Accumulation	4.27		2.60

TABLE II PERIODS OF GREATEST INTENSITY

	1915	1918
5 min.	0.39 in. rate 4.68 in. per hr.	0.38 in. rate 4.56 in. per hr.
10 min.	0.66 in. rate 3.96 in. per hr.	0.65 in. rate 3.90 in. per hr.
15 min.	0.87 in. rate 3.48 in. per hr.	0.94 in. rate 3.76 in. per hr.
30 min.	1.38 in. rate 2.76 in. per hr.	1.55 in. rate 3.10 in. per hr.
1 hr.	1.50 in. rate 1.50 in. per hr.	2.07 in. rate 2.07 in. per hr.
2 hr.	2.84 in. rate 1.42 in. per hr.	2.62 in. rate 1.31 in. per hr.

storm came in a single period of about one hour. The soil was dry from a long period of comparative drought, so that the first part of the precipitation was absorbed and did not contribute to the flood crest. An important factor, also, was the drift catcher, mentioned above, which caught débris from the upper watershed and prevented the blocking of culverts and bridges as in 1915. This structure, illustrated, was described in *Engineering News-Record* of Oct. 25, 1917, p. 793.

Even with the comparatively favorable conditions, business was upset to a certain extent, street-car traffic from east to west across the city was tied up, and this flood, serious enough in itself, although far less so than that of 1915, illustrates well the necessity for the flood-control projects under way.

The contractor now on the work is the Alskogg-Folwell Co., Chicago, who succeeded the original contractors. Their bid is on the basis of unit prices and on these prices the work will cost at least 50% more than at the prices in the original contract. The first contract was let in December, 1916, and the new contract in July, 1918. The engineers who made the preliminary report and detailed designs and are now supervising construction are Gannett, Seelye & Fleming, of Harrisburg and Erie, Penn.

Valuation of the Railroads—Is It Worth While?

Likely to Cost $50,000,000 More Without Helping Win the War—Should Be Discontinued, at Least Until the War Ends

BY A FORMER GENERAL MANAGER

ABOUT four years ago the work of valuing the railways of the United States was begun under the direction of the Interstate Commerce Commission, and to date not a single line of railway has had its valuation completed, in the sense that the valuation has been subjected to the final test required by law.

At the recent hearing before a committee of Congress the director of valuation requested an appropriation of $3,750,000 for the fiscal year ending June 30, 1919. There has been expended to date $12,800,000, which, with the appropriation requested, will make a total of $16,550,000 appropriated for this work to June 30, 1919. The director estimated that the field work would be completed by Jan. 1, 1920, and the office work by Jan. 1, 1921, and that the total cost of work would not exceed $20,000,000. The director stated at the hearing that at the beginning selection was made of a small road in Texas, the Texas Midland, 111 miles in length, in the expectation that in about six months the valuation on this line would be completed and sent to Congress as a specimen of the valuation work. The result has been that the valuation on this small railroad has not yet passed through the various processes required by the act, the most important of which is the final determination of the matter in the courts.

The making of the physical valuation by the commission, and the filing of a tentative valuation, is only a part of what the final valuation will be. The carrier has a right to protest, has in every case so far protested and will in the future cases protest, so that before the final legal valuation is determined it will drag its weary way through the courts. It is safe to assume that even if appropriations are made by Congress to carry on the work of the commission to the presenting of tentative valuations, this work alone will not be completed short of five more years, or about Jan. 1, 1924. After that the valuation of each separate road will pass through the courts, and if the litigation is followed as diligently as it has been by the commission it will require ten more years to establish the final valuations in court, which will place the date about 1934 before we shall know finally what is the valuation of our railroads.

$20,000,000 OR $50,000,000?

The cost, estimated by the director of valuation at $20,000,000 for the completed work, has been estimated by competent engineers as likely to reach $50,000,000 before the final results are secured. The railways are, independently in many instances, making complete valuations, largely duplicating the work of the commission and the cost of the work. The cost of litigation to determine the value finally will add enormously to the expense, so that the estimate of $50,000,000 and 20 years' time to settle this matter may not be excessive.

The question as to the real value of this work has been argued pro and con for years. That it has some value is evident, but that value lies chiefly for purposes such as taxation, entirely outside of the original intention of the commission, which was to determine the matter of reasonable rates of transportation.

The establishing of rates is such a complicated problem and involves so many elements entirely distinct from the value of the property that it would be impossible to make any use whatever of this information as a guide in establishing rates. For illustration, the cost of operation of a property forms one of the elements in the cost of the service, aside from the cost of the use of the property, which is the only element which the value of the property can affect, so that only a very small part of the problem of rates is known where the value of the property is known. Again, what applies to one property will not apply to another, and it would be impossible to establish a system of rates, based on one line or a number of lines, which would be applicable to all alike.

If the object of the commission is to ascertain the value for the purpose of Government ownership, then the valuations which the commission is determining are incomplete, as many important elements have not been established nor taken into account—elements which the carriers will seek to have determined by the courts.

If, then, the valuation is only a partial one, and consists mainly of the physical property, which can be determined in almost every instance from the existing records of the railways, what purposes can be accomplished in continuing a work of such doubtful value, and at this particular time when every ounce of energy should be devoted to winning the war? The Government itself has enjoined every one to dispense with all unnecessary or nonessential work and expense during the war. If there is any activity that falls within this class it is the valuation of the railways, which nearly every practical railway and business man has long ago concluded was of no definite value for the purpose for which it was designed.

The director of valuation recommends not only the continuance of the work but an additional staff to follow up the cost of additions and betterments from Jan. 1, 1918, and during Federal control of the railways. This will be a duplication of work, as the operating staffs of railways under Federal control are now Government employees, and the carriers are specifically charged to perform this work. What is the necessity of having this same work done by the bureau of valuation? It will be an unnecessary waste of money and of man power.

Resumption Possible After the War

Discontinuance of the work during the war will not prevent its resumption after the war if it should be shown to be of value or necessary. The additions and betterments made during Federal control of the roads will be accurately determined, and the work of obtaining the physical units will not be affected by a suspension for the duration of the war.

A small office staff of men not available for war duty could be assigned for working up the field data, which are already a year behind the field work, so that at the end of Federal control the valuation work would be in better shape than it is at the present time. But if the work is continued after the war it should be done along common-sense lines, and much of the present system, which goes with refinements not warranted to secure the essential results, should be eliminated. If this is done the work can be shortened about one-third, thereby decreasing the cost and hastening its completion. As a matter of fact, with few exceptions the physical value of almost any railway is as definitely known by the records of the respective roads as can be determined by the methods possessed by the commission. The physical value is only one element in the whole problem, to which must be added the intangible values which will be recognized and determined by the courts.

We are passing through rapid economic changes, and no one knows what the public policy will be toward the railway problem during the reconstruction period following the war. One thing is looming up large on the horizon, brought about by Federal operation of the roads during the war; this is that the private owners of the railroads would welcome the taking over of the title to the property, thus relieving the owners of the present uncertainty as to its value after the war.

The English policy toward the owners of railways is totally different from that followed in the United States. In England the integrity of the roads under various ownerships is being maintained, and full payment is being made for their use by the Government during the war. The English stockholders are not on the anxious seat as to what will become of their property, the Government realizing full well its obligation to the owners and what the effect upon the financial stability would be if any course were taken that would affect the financial status of railroad property. This is certainly a wise and conservative policy, and lies at the fundamental principles of English financial history—principles that have placed England in her position of strength as a financial world power.

The railway problem in the United States is the coming large problem and must be carefully handled to prevent a financial disaster to this country.

Heavy Rainfall Tests Mill Creek Sewer at St. Louis

Relief Sewer Pressure Tunnel Comes Into Full Play —Automatic Water-Level Recording Gages Found Useful

By W. W. Horner
Engineer Design and Construction, Sewers and Paving, St. Louis, Mo.

THE extraordinary downpour which occurred in St. Louis on Aug. 24, described on p. 672, offered the first actual test of the flow through the Mill Creek sewer relief tunnel, completed two years ago. A full description of the design of this tunnel appeared in *Engineering Record* of Oct. 10, 1914, p. 405. The relief tunnel is a second main sewer for the Mill Creek valley, the total drainage area of which is about 5000 acres. The original main sewer had a maximum capacity of about 3500 sec.-ft., and the critical time was about 52 min. In designing the relief tunnel the engineers intended to provide through it an additional main sewer capacity of about 3300 sec.-ft., or a total capacity for the two sewers of 6800 sec.-ft. This represents a run-off coefficient of about 1.35 cu.ft. per second per acre, as compared with an estimated rainfall, for which it was economical to provide, of a 2.2-in. rate for the 52-min. period. This latter rate lies on a rainfall curve the ordinates of which had at that time not been exceeded more than once in the life of the recording stations.

Sewer Tunnel Under Pressure

Upon completion of the tunnel four automatic water-level recording gages were installed. These gages consisted of one pair about ½ mile apart in the lower section of the sewer and another pair about the same distance apart near its upper end. On account of the operation of the sewer as a pressure tunnel very high ranges were required, the extreme western gage having a range of 50 ft. The tunnel operates as an overflow from the existing surface system and only comes into play during rains of moderate intensity. For that reason very few records have been obtained since the installation of the gages, and these of only very small amounts.

During the excessive rain of Aug. 24, however, the old main sewer was running under head, the manhole covers being blown off throughout most of its length. It undoubtedly carried considerably more than its rated capacity. At this time the tunnel came into full play, the recording gages indicating the hydraulic gradient very close to that for which it was designed. The two lines are remarkably close, the most radical difference being at the outlet, where an observer reports that the sewer did not run full at the mouth. This was evidently due to the low water in the Mississippi and to the establishment of a backwater curve in the sewer. It also seems to indicate that the roughness coefficient throughout the lower 2000 ft. of the sewer was greater than was anticipated. This may be due to the fact that this particular section was constructed in cut and cover through quicksand, while the remainder was in tunnel through rock.

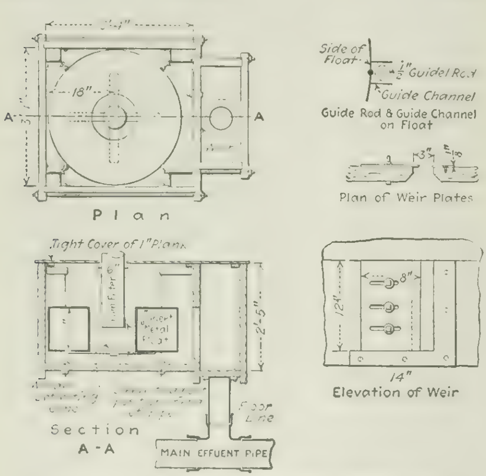
Because of the fact that even the old and the new

sewers combined failed to offer sufficient outlet capacity for this system, any accurate estimate of the rate of run-off would be futile. The run-off certainly far exceeded the capacity of the two sewers, which was 6800 sec-ft. It was probably double this amount, or say 13,600 sec.ft., or a rate of 2.7 cu.ft. per second per acre compared with a probable average rainfall rate throughout the 52-min. period of 3.4 inches.

Build Filters for Fighters in France From Odds and Ends

Greatest Difficulties Are Uncertainty of Delivery and Scarcity of Supplies—Design Layouts to Fit Four Types of Filters

FOR the construction of a filtered water-supply of 700,000 gal. for a French village crowded with American troops, France had to be combed from one end to the other to obtain the necessary pipes and pumps. But the filters gave the greatest difficulty, writes an engineer who knows. Four kinds of filters were possible, and the layouts had to be made so that accessory piping would fit whichever type finally should prove available. Improvised rate controllers, float valves from globe



FILTER RATE CONTROLLERS ARE HOME-MADE

valves, and reinforcing rods of iron and steel scraps welded together, were some of the expedients used.

Most of the water projects are relatively simple and involve little that is novel. Water is generally easy to obtain in sufficient quantity from springs or shallow wells, but sometimes stream water must be used. Tubular wells are rare and usually of small yield. Labor is scarce and material hard to obtain. Then there is the virtual impossibility of getting all the material and all the labor on the job at the same time. These difficulties are an inevitable part of war, because if all the material and all the men wanted were available the enemy would not last long. The material and labor situation has more and more forced the use of simplified installations. The 50-gal. allowance for the cantonments in the United States has been cut to 10-gal. in France. It has been found that one of the best ways to stimulate economy of water is to make it somewhat difficult to obtain, and that in turn simplifies the waterworks construction.

At first it was expected that made-up filters of the wooden tub type would be received from America. Then it looked as though mechanical or drifting sand filters could be obtained from England. Later it appeared that it would be unwise to count upon receiving either the English or American filters, and that a special design utilizing wooden tubs would be more desirable, and still later it became evident that the delivery of wooden tubs could not be definitely relied upon and that reinforced concrete might have to be used. After tentative layouts had been made for each one of these types as a basis for ordering connecting piping, valves, specials and other accessories not furnished with the filters, the continued uncertainty of what kind would finally be available, together with the urgency of placing orders for connecting piping, valves, specials and accessories to insure timely fabrication, preparation and delivery, made it necessary to prepare plans for the four types of mechanical filters so coördinated that the same accessory material could be used for any one of them.

It was the intention to place orders at once for all the material common to all the layouts, and locate material suitable for filter equipment, should it be necessary to employ the special designs for either wood or concrete. Just as necessary plans and lists of materials were completed it became evident that made-up filters of any type would be unobtainable; also that wooden tanks could not be procured. This left the coast clear for the installation of a specially designed concrete layout as the only remaining practicable scheme.

The gathering of the miscellaneous material required for the filters as well as other parts of the project was no easy matter. Only certain standard pipes and fittings were available through normal supply channels, and it became necessary, to obtain what was needed, to visit by means of automobile or motorcycle side car nearly all the foundries, machine shops and supply houses in this section of France.

"That has all been done now [our correspondent's letter is dated Aug. 16.—Editor] and the work is nearing completion. The final layout will be neat and effective, but I do not believe there was ever a filter plant built in the United States of ten times the size that required so much designing or embodied such a choice assortment of odds and ends of material."

One of the interesting little problems was to obtain a satisfactory filter sand from a rather dirty and nonuniform river sand, the only sand available. This was accomplished by drying the sand, double-screening it in a single operation to exclude that which was too fine and that which was too coarse, and finally by washing to remove fine particles of clay and silt that were not removed by screening. The sand could have been completely graded by water action, but this would have required more water than could be spared during the unusually dry season and also larger and more elaborate apparatus.

A rate controller had to be designed involving no machine work and using up a minimum of head. The apparatus shown in the drawing behaved steadily and

apparently reliably under preliminary tests. The inlet pipe to the apparatus is carried below the water level in the center of the doughnut-shaped float. The float carries a properly supported wooden cone which, rising against the end of the inlet pipe, constitutes the cut-off valve. The rate of flow through the apparatus is controlled by a short crested weir with a relatively high head. The total head lost in the apparatus is the head on the weir, or about 8 in. under normal conditions. The water in the clear-water basin may rise to within practically this distance of the water level maintained in the controllers, before the rate of filtration is cut down. The loss of head may be made still less by lengthening the crest of the adjustable weir, but this tends to decrease the accuracy of the apparatus.

A float-controlled inlet valve into the coagulating basin was necessary to maintain the water level constant both in the basin and in the filters. A suitable commercial valve could not be found anywhere, but with very simple modifications of a 6-in. globe valve a very good balanced float valve was obtained.

For reinforcement for the concrete practically all the iron and steel rods available in a nearby city were purchased. They were of various lengths, sizes, cross-sections and strengths, but by welding, piecing and adjusting there was obtained the virtual equivalent of the reinforcement computed as being necessary.

Plant Prepares Slag for Roads and Concrete

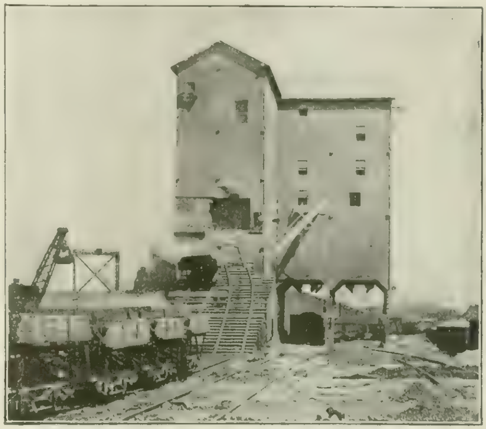
Material Combines Strength With Light Weight—Crushing, Screening and Iron Removal Form Principal Treatment

PREPARATION of blast-furnace slag for road construction, track ballast and concrete work, at a plant in South Chicago, Ill., is in general similar to the preparation of broken stone, the material being crushed and screened, but special provision is made for cooling the hot slag and recovering particles of iron. This plant supplies slag for territory within a radius of about 100 miles, beyond which the freight charges are too high.

Molten slag and hardened skulls are dumped from ladle cars on high fills built of rough slag blocks cemented together with molten slag. The slag when poured spreads out in the pits between these fills and gradually attains a depth of about 20 ft. A steam shovel with 5-yd. dipper excavates it when about three months old. The mass is laminated and breaks up readily, no blasting being required.

Side-dump cars of 6-yd. capacity are loaded by the shovel, and are taken in six-car trains by small locomotives to the foot of a cable incline at the crushing and screening house. Each car in turn is hitched to the cable, and before ascending it passes through a water spray from a perforated pipe forming a gallows frame across the track, in order to cool the slag and remove the dust. At the top of the incline two men release the chains on one side, and as the car body has the bulk of its load on the other side it promptly dumps into the bin around the head of a gyratory crusher. The car is then lowered, being switched automatically to the empty-car track at the foot of the incline.

Crusher-run product is elevated by a bucket conveyor and delivered to a 48-in. rubber belt conveyor which discharges it through a hopper to a rotary screen from which four sizes are spouted to storage bins. The remainder passes to an inclined flat rocker screen which



CRUSHER HOUSE WHERE SLAG IS PREPARED

grades it into the smallest sizes. The several sizes of the product are given in the following table:

PRODUCTS OF SLAG SCREENING PLANT

No.	Size	Use
1	Passing 4-in. screen; retained on 2½-in. screen	Base course, paving
2	Passing 2½-in screen; retained on 1½-in screen	Base course, paving
3	Passing 1½-in. screen; retained on ¾ in screen	Concrete and roads
4	Passing ¾-in. screen; retained on ½-in. screen	Concrete and roads
5	Passing ½-in. screen and containing chips and dust	Waterbound paving and macadam maintenance
6	Passing ½-in. screen; retained on ¼-in. screen	Macadam finish
7	Passing ¼-in screen and containing dust	Screenings instead of sand

The bins are arranged over two loading tracks, so that the material can be discharged directly into cars for shipment. The crushing and screening plant can handle about 1200 tons daily. An electric motor of 100 hp., with rope drive, operates the cable hoist. A similar equipment with 125-hp. motor operates the crusher, elevator, belt and screens.

Removal of iron particles from the crushed slag is effected by a magnetized pulley at the discharge end of the belt conveyor. Thus, while the slag falls freely into the chute leading to the screen, the iron is retained on the belt until it has passed this point, where it is released and falls through another chute to a car for return to the furnace plant. With 1200 tons of slag handled daily the iron recovered is about 25 tons. Analysis of this Chicago slag is as follows:

Iron	None
Phosphorus	0.13%
Manganese	0.40 to 0.72%
Silica	36.50 to 37.50%
Alumina	12.60 to 13.20%
Lime	42.50 to 43.70%
Magnesia	5.10 to 6.70%
Sulphur (combined)	0.80 to 1.03%

The weight of the screened slag is about 2000 lb. per cubic yard, as against 2500 lb. for the limestone of the Chicago district. With its lighter unit weight, the slag will have greater bulk than an equal quantity of stone. For the same yardage, the lighter weight of slag will have a lower freight charge. The market price per yard is somewhat lower than that of stone.

The plant described above is that of the France Slag

Co. and is situated at the works of the Federal Furnace Co. The former company contracts to dispose of the entire slag output of the works, about 1200 tons per day. Some of it is prepared for concrete and road work, as described above, the remainder being used as filling for industrial and building sites, railway yards and similar purposes.

Extraordinary Rainfall Flooded Portions of St. Louis

Value of Numerous Gages Shown — Maximum Record of 3.6 Inch in One Hour More than Double Weather Bureau Record

BY W. W. HORNER

Engineer of Design and Construction, Sewers and Paving, St. Louis, Mo.

ON AUG. 24, 1918, there occurred in St Louis an intense rainfall, which caused general flooding and damage to property throughout the city. The sewer system for the older portions of St. Louis has for a number of years been inadequate to carry off intense storms, even such as are liable to occur once a year, and in 1912, 1913, 1915 and 1916 a great deal of damage was caused on account of inadequate sewers and flooded cellars. In 1917 no severe rain occurred, and in 1918, up to about the middle of August, the city, in common with the Middle West, experienced a serious drought.

Beginning about Aug. 14, a period of moderate rains set in, resulting in a very high total of precipitation for the latter part of August and the early part of September. Aside from the high total, these rains were of little interest except that of Aug. 24, which was so unusual that a new record was set for intensity during a number of time intervals. In the southwestern portion of the city this rain began in the early morning, became a general downpour between 11 a.m. and 1 p.m., and degenerated into a light drizzle which continued until evening. At about noon all the sewers had become overcharged, the cellars in the lower part of town were generally filled, and water began to stand in the streets at the low points in grade. In front of the city hall the water was about three feet deep and covered the first floors of several stores. At the union station the flood was much worse, the water ran on to the main concourse and filled the baggage and express subways. Traffic was impossible across the 13th St. valley and the 20th St. valley, both street car and vehicular traffic being stopped. This condition was of short duration, and within a half hour after the storm ended surface conditions had become fairly normal.

Telephone reports of the rainfall record at the Weather Bureau indicated a maximum hour, between 12:35 and 1.35, of 1.52 in., and the total between 11 and 1 o'clock was slightly under 2 in. This entirely failed to explain the extent of the flood and the consequent damage. Fortunately, however, the city has for some time maintained a number of automatic rainfall stations, using a tipping-bucket gage. The record from the city gage at 613 North Garrison Ave. showed a maximum precipitation, for the hour between 11:20 and 12:20, of 3.60 in. Another gage, belonging to St. Louis University, about ½ mile distant from that at Garrison Ave., recorded a maximum hour's precipitation of 2.80 in. The Garrison Ave. value is much higher than any previous record of an hour's rain in St. Louis, and, of course, far above the points on the adopted rainfall curve for the city. The same is true of the intensities shown by the Garrison Ave. gage for all time periods between 20 and 80 minutes.

The interesting features of this rain, from the viewpoint of the municipal engineer are (1) the excessive and record-breaking intensity; (2) the fact that these intensities did not occur at the official Weather Bureau station in St. Louis; and (3) the opportunity which the number of gage stations in service gave for study-

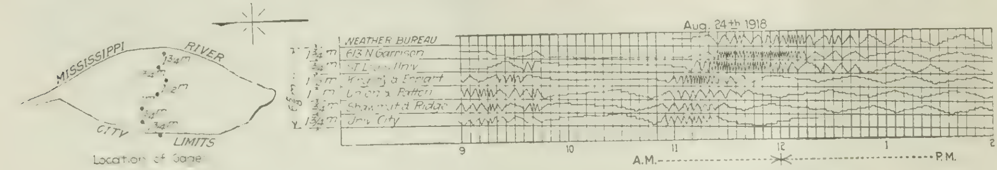


FIG. 1 RAIN GAGE CHARTS CLEARLY PICTURE THE CHARACTER OF THE STORM

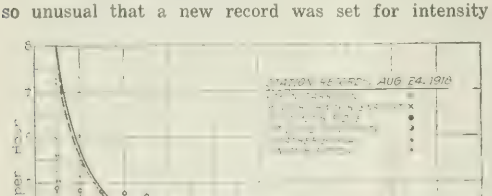
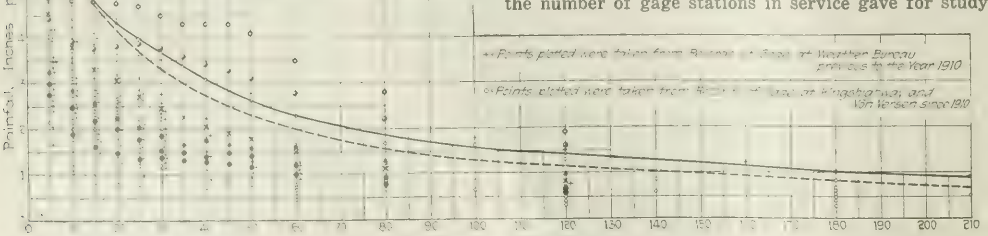



FIG. 2. RAINFALL INTENSITY RECORDS AT ST. LOUIS ON AND PRIOR TO AUG. 24, 1918

The full line rainfall curve was adopted for the design of the River Des Peres storm water sewer, November, 1916. The dotted line curve is the standard intensity curve for sewer design at St. Louis

ing the extent or area covered by the intense downpour. To illustrate this last phase Figs. 1 and 2 have been prepared. Fig. 1 shows the simultaneous records of seven stations situated in a general east and west line across the city. The distance between the extreme gages, that at University City and that at the Weather Bureau, is about 6.8 miles. The distances between the intermediate gages are approximately as shown on the margin of the chart. The record at University City is not taken from a tipping bucket, but from a standard gage collector attached by a drip pipe to a self-reading glass tube in the engineer's office. The actual mechanical record of the stations, shown in Fig. 1, indicate as clearly as can be done the relative intensities, duration and rate of motion of the storm.

The interesting points brought out on the chart are mainly the similarity of the first two records, the gradual lengthening at first indicated at the third station, the increasing intensity of the fourth, and the very severe intensities at the fifth and sixth stations, with the breaking up into two connected showers at the Weather Bureau gage. Note also the variation in the time of beginning of the heavy downpour, from 10:55 at the extreme western gage to 11:10 at St. Louis University, 11:20 at Garrison Ave. and 11:30 at the Weather Bureau.

On Fig. 2 are plotted intensity records for various time intervals at St. Louis. These records, except those of Aug. 24, were taken from the Weather Bureau gage up to 1910, and from the city gage at Kings Highway and Von Versen Ave. (Enright Ave.) since 1910. The two rainfall curves used in St. Louis are shown on this sheet, the lower one having been used for general sewer design, while the upper was proposed for the River des Peres main drainage project. Note that ordinates on the upper curve have never been exceeded more than once, while the great majority of records are much below it. When the Kings Highway-Von Versen Ave. records for Aug. 24 are plotted on this sheet, as usual they fall among the big bank of points and do not in any way affect the drawing of the rainfall curve. The records of the Weather Bureau are still lower. Considering either of these records, which would be the logical ones to compare with those previously plotted, there would be no occasion to modify the previously adopted rainfall curves. When the excessive values given at the St. Louis University and Garrison Ave. gages are also plotted on this figure they indicate clearly how inadequate a system designed for the values on the curve would have been to carry off this storm.

The writer is of the opinion that rainfall probability must be determined from continuous records at a single gage station and does not feel that even the excessive records caught at the two stations should be permitted to affect the economics of choosing a curve for sewer design. It is interesting to note, however, that the records of the single gage very easily fall short of predicting the extreme possibilities of precipitation and intensity, or that if this particular storm had passed over the Kings Highway gage it would have been logical to consider modifying the rainfall curve.

Unfortunately, there were no satisfactory gages on the north or south of this line through which the actual path of the storm can be determined. The best indications, however, seem to indicate that the path was a curve to the south of the line, striking the line at about the Garrison Ave. gage. Very clearly, it came from the west and probably south of the western gage. From the best evidence it would be judged that the intense downpour, at any one time, probably covered an area between 2000 and 4000 acres. In addition to the effect of the extraordinary intensity, the effect on the sewer system was accentuated by the movement of the storm in the direction of the flow through the sewer mains and at an approximately equal velocity. It may have been entirely possible, therefore, in so far as the effect on certain main sewers was concerned, for the severe intensity to have been active simultaneously over the whole area.

What Causes Railway Curve Resistance?

EXPERIMENTS conducted on the Canadian Pacific Ry. to determine the cause of curve resistance in railroad equipment and the character of any skidding of the wheels that may take place as a car rounds a curve, are described by John G. Sullivan, consulting engineer of the Canadian Pacific, in the July *Bulletin* of the American Railway Engineering Association.

Believing curve resistance to be due to the tendency of a cylinder to roll in a straight line, Mr. Sullivan had a car fitted with wheels of unequal diameter—those on the inside of sufficiently less diameter than those on the outside so that the diameters were exactly proportional to the radii of the two rails of an 8° 10′ curve. When the curve had been perfectly lined the car passed around it at speeds varying from 5 to 25 miles per hour without the wheel flanges on either side bearing against the rail heads, and the resistance, measured with a dynamometer, was 40 or 50% less than on straight track.

To get at the question of skidding, a car with wheels of equal diameter was run slowly around the curve, and the distance along the rail traversed by each wheel in making 70 revolutions measured; after which the car was moved back to the starting point and the distance traversed by each wheel in 70 revolutions measured again. The distance traveled in each direction was about 600 ft. The tabulated figures indicate differences as great as 4.87 ft. between theoretical and actual distances traveled, but Mr. Sullivan points out that if the outer wheel climbed the rail so as to ride ⅛ in. high that would give it an additional distance to travel of 4.862 feet.

The following conclusions are drawn by Mr. Sullivan from the experiments:

1. All outer wheels of railway equipment exert a pressure against the outer rail when rounding a curve.

2. The cause of this pressure is the tendency of a cylindrical body to rotate in a straight line at right angles to the axis of rotation.

3. There is never any skidding of either wheel of the leading axle of a truck unless it is a forward skidding of both wheels caused by the resistance to rotation being great enough to cause a slight retardation to rotation, which results in an apparent forward skidding.

4. There is no skidding of the outer wheel of a rear axle; in general, any skidding that does take place is on the inner wheel of the rear axle.

Engineering Colleges Teach Fighting Mechanics for Army

Housing, Equipment, Instruction Staff and Curricula Quickly Assembled—Automobile Mechanics Made in Eight Weeks

NEW educational curricula for making "fighting mechanics" in eight weeks, plant, equipment, staff, students and housing—all involving problems without precedent—were the main desiderata of various colleges, mostly engineering, last spring, when the army sent out through the committee on education and special training a call for auto mechanics, repair men, concrete foremen, gunsmiths, truck drivers and the dozen and one other classes of men skilled as to hand. Men who could do certain things well and on whom the army officers could depend to do those things; men with definite knowledge, rated and classified by others than themselves, so that their talents and ability could be placed properly and to the best advantage, were wanted. Most of the industries containing those men were already working at top speed, so that those who took the courses started in with no preconceived ideas. It was the intention that only those with fair common or grammar school educations should be trained, but at some schools it has been found necessary to give a course in simple arithmetic before men could proceed in a concrete foreman's course involving simple calculations as to volume, proportions of mix and form construction. These skilled workmen will all add greatly to the country's reconstruction ability after the war and will be worth many times the cost for that purpose alone, although the present demands for them both here and abroad is insatiable.

Typical of the auto mechanics' schools, and one of the first to get into the work, is the University of Pittsburgh's, described in *Engineering News-Record* of May 30, p. 1062. It contracted with the Government to teach, house and feed students at so much per capita per day. Seven two-story barracks of the regulation cantonment type, one 320 x 50-ft. one-story machine shop, and one 600 x 65 ft., a mess hall to seat 1643, an administration building and several smaller structures, were rushed through to completion last May in record time. No general contractors were employed, the university handling the work on a day's pay basis.

The machine shops were divided into bays 20 ft. wide and 25 ft. long, extending into the center of a runway. A bench with drawers for tools runs along the whole length of each side of the building at the window end of the bays. Storage space for car bodies, which are removed from the chassis as soon as the cars are delivered, is provided on a mezzanine floor. Slag is used for floors, although concrete and wood were considered. The slag absorbs grease quickly and is fairly clean—much more so, in fact, than any condition that may be expected with the Army in the field—and the expense is nominal. Also, the care necessary to keep bearings and wearing parts out of the slag is considered an essential part of the student's training.

Equipment consisted of thirty makes of old trucks and passenger cars, specimens of which were purchased outright. Arrangements were made whereby department stores, corporations and private owners of trucks and cars would lend their vehicles to the school for repair and complete overhaul, for a period of not less than 30 days nor more than 60 days. An overhead charge of $5 is made. The owner must buy and bring in parts to replace those broken or worn out. There is no charge for labor.

CROWN OF HILL AT UNIVERSITY OF PITTSBURGH UTILIZED ENTIRELY IN MAKING

No difficulty has been encountered in obtaining all the vehicles necessary, 165 cars and trucks having been overhauled up to Sept. 5, when a representative of *Engineering News-Record* inspected the school. The future policy will be to take in only trucks, for the work on trucks is considered more utilitarian, and plenty are available.

While the barracks are built from the plans of the cantonment barracks, the material used is of somewhat better grade, and the outsides of the buildings have been painted—the university authorities feeling that there would thus be more salvage value. Plumbing in the concrete-floored bath houses, for instance, is of enamel ware rather than of the galvanized iron used in many of the cantonments. Located on the highest of the university grounds, the wall-board finish inside will be appreciated by the occupants in zero weather.

Speed in feeding without confusion was the dominating thought in designing the mess hall, which is different from that of the cantonment type with kitchens at the ends. The kitchens here are at the center of one side, with storerooms and a built-in refrigerator room at each end of the same side. Students enter from a double door at the opposite side from the kitchen and at a pair of double doors at each end, making five entrances in all.

Tables for 10 men are supported by two 4 x 4-in. standards at each end. These are secured to the table proper by a pipe nipple, one end being screwed into the table board and the other into a coupling sunk into the 4 x 4-in. standard. This arrangement makes them easily removed and nestable. For legs, a 2 x 6-in. piece 30 in. long was let into the lower end of the standard, and a portion of the side next the floor was cut out to make a short bearing at the ends. The benches are separate from the table.

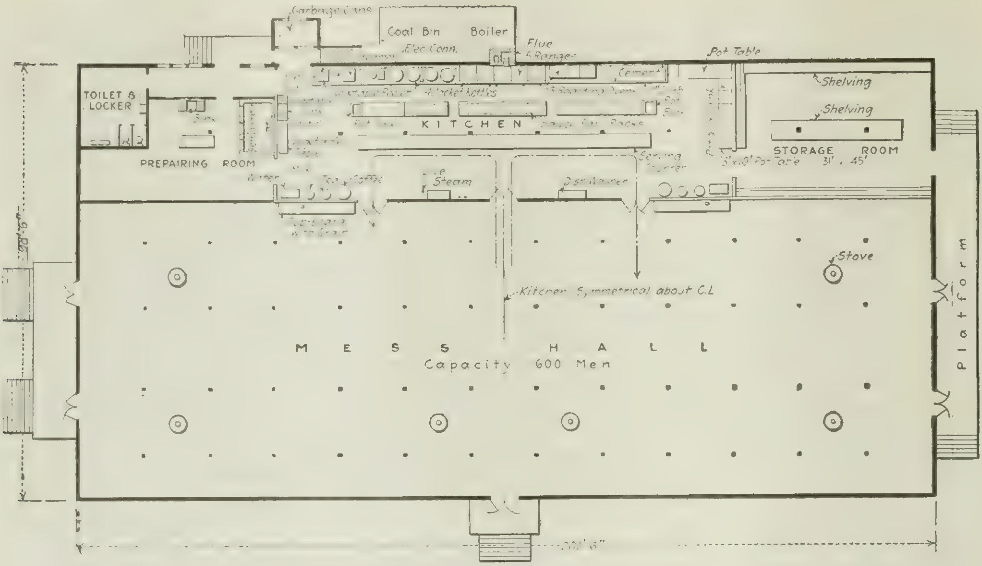
Time of the students in the shops is considered too valuable to require much kitchen police duty, but one man to each table of 20 men is detailed as a waiter. His only duty is to report 20 minutes before the companies march in, to set out the food. After everyone has been helped he estimates the additional amount needed and gets it from the kitchen. Every man must eat everything he puts on his plate, so the garbage from left-overs is a minimum. Everybody gets all he can eat and the steward states that some of the large men consume fully 100% more than others.

Kits of tools given each man, consisting of six wrenches, a cotter pin puller, a screwdriver and pliers, cost $1.78 each. A common stock room for each laboratory, with a storekeeper, has a complete assortment of tools necessary in automobile and truck work, besides a plentiful supply of nuts, bolts, cotter pins, etc. Each man is supplied with eight brass checks, on presentation of which, with the order from the instructor, he may draw tools. He must ask for them by the exact name, otherwise the storekeeper refuses his requests. Thus the training shades into the commercial end.

For the course which the men of better grade get toward the end of the period forty different makes of engines have been provided, so that intensive instruction can be given in ignition systems, carburetion and "trouble shooting." These engines are mounted in one of the permanent university buildings.

The staff consists of a chief instructor, a former superintendent of shops, and about 100 instructors. The procedure is to dismantle a car completely, so that no two parts are together. An inspection for new parts which the owner brings in, is then made. Ten men work on each car, usually apportioned as follows: Four on the engine, three on transmission and three on the rear end. After two days the men are switched, the instructor sizing up the men all the time, trying to find out the aptitude of each man. As each essential part is handled its function, wear, maintenance, etc., are explained with it in hand. Oral and written quizzer

FIGHTING MECHANICS FOR THE ARMY (1500 SOLDIERS ON THE WINDING ROADWAY)



THREE MESS HALL ENTRANCES PERMIT ENTRANCE, EATING AND EXIT IN EIGHTEEN MINUTES

are given nearly every day. As each instructor has the 20 men for a week only, the men get eight different instructors and a chance to work on 16 different cars.

Lectures, strictly nontechnical but given by technical graduates, are given three times a week, and these the student is required to study one hour each night, in connection with the text of Hobbs and Elliott's "Gasoline Automobiles," a copy of which is lent to each student for the duration of the course. Three complete sets of slides of every cut in the text have been made, so that the student has the identical illustration he has studied explained to him in lectures.

Each day's work is reported by the instructor, and at the end of the week he rates his men as apprentice, journeyman or expert on the type of work the man can do best. He is also rated on mechanical ability, speed, resourcefulness and personal qualities.

After eight instructors have rated a man it is usually

ALL KINDS OF WORK ON ALL KINDS OF CARS IN THE CHASSIS LABORATORY

easy for the office staff to fill up the final rating or transfer record. At the end of each week the groups of 160 are all broken up, so there is little chance for pairing off or "leaning on the other fellow."

In the instructions to the instructors rigid rules of conduct are laid down. All conversation is limited to the work of instruction, no familiarity between students and instructors being permitted. The conduct of commissioned army men is emulated, with good effect. In fact, each instructor is considered an officer during class hours. As they are accustomed to military discipline, little difficulty in this regard has been encountered. The men are most eager to learn.

When a student leaves this school his record indicates what he can do best: also his second, third and fourth best. If a man already is a skilled butcher, from years of experience outside, this is usually put down first, for the school authorities realize that an eight weeks' training cannot compare with years of actual experience. Thus the man does not lose the benefit in rating of what he had done previously. In fact, he has a definite rating on his general aptitude, in addition.

A new shop is now being added for a motorcycle contingent of 100 men, and the second unit of 100 sheet-metal workers is now in training at the Schenley High School, under management of the University of Pittsburgh.

This vocational work is under the general direction of Dean F. L. Bishop of the college of engineering, with Prof. H. E. Dyche as assistant director.

Concrete Floors Combine Steel and Concrete Frame

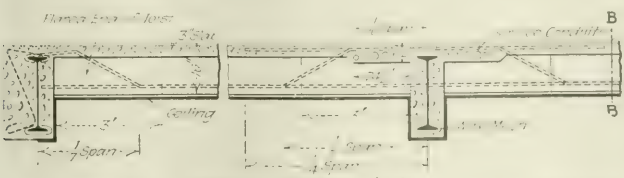
Slab-and-Joist Construction Carrying Loads of 300 Pounds to 150 Pounds Has Minimum Spacing of 4½ Inches Between Joists

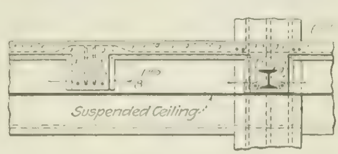
CLOSELY spaced joists for heavy loads, recessed slabs to accommodate electric cables, and concrete joists reinforced by steel H-beams to act as struts, are introduced in the concrete floor construction of a new office building for the Chicago Telephone Co. The building is 180 x 130 ft. in plan and 12 stories high. All columns are of steel, of H-section, but the floor framing is of a composite character. Part of the floor area has steel I-beam girders framed between the columns, but in a large area the transverse girders are omitted, the slab-and-joist construction being continuous. The panels are approximately 20 x 20 feet.

One panel width of 20 ft. 8 in. along the entire 180 ft. length of one side of the first floor had to be designed for a load of 300 lb. per square foot, as it will carry rows of heavy lead-covered electric cables arranged on distributing frames. For this portion of the floor the 3-in. slab has joists 3½ in. wide spaced only 8 in. on centers. The depth is 17 in., this depth and the thickness of the slab being exclusive of the ¾-in. finish on the top of the slab. In the 4½-in. spaces between the joists are 4-in. vertical fiber sleeves through which the cables are led down to the basement and cable vault and thence to the underground ducts.

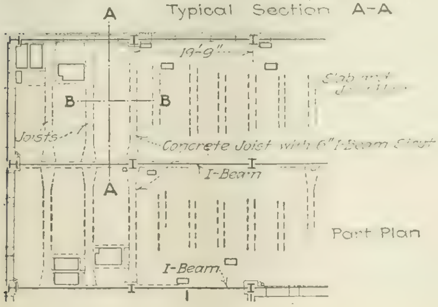
This panel is continuous, without transverse girders between the columns. On one side it is carried by a girder composed of a pair of 24-in. I-beams framed between the columns, while on the outer side it is carried by the retaining wall of the basement. Wood forms were used but were somewhat difficult to build on account of the depth, narrow width and close spacing of the joists. It was found easy to remove them, however, after the concrete had set.

The slab of the tenth floor has to provide for a network of electric cables for the service of the American District Telegraph Co., on this floor. These cables cannot be embedded in the concrete, like those which carry wiring for light and other service. The slab is depressed, therefore, to form recesses or raceways, 3 in. deep, to accommodate the cables, so that on this floor the slab does not form a continuous horizontal plane. These raceways are covered with precast 2-in. concrete slabs reinforced with wire mesh, the joints being calked with an elastic cement. The tops of these



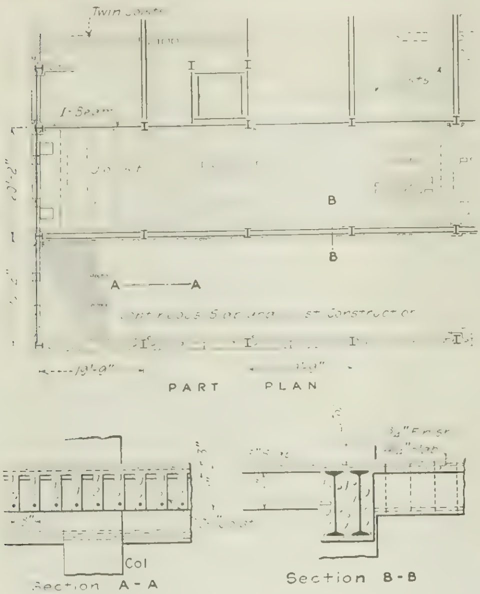


FLOOR HAS I-BEAM GIRDERS AND CONCRETE JOISTS



slabs are flush with the finished surface of the main floor slab. Openings into the raceways are covered with checkered plates. This floor is designed for a load of 175 lb. per square foot.

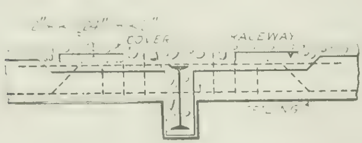
Typical floor construction of the other ten stories consists of a 3-in. slab with three joists in each panel, the combined depth being 15¾ in. All these intermediate floors are to be used for telephone switchboards, and are designed to carry 150 lb. per square foot. In general, their framing consists of steel I-beams fitted between the columns and cased in concrete. At several locations, however, the slab-and-joist construction is



CONCRETE FLOOR HAS VARIED DESIGNS OF JOISTS

continuous over several panels. Where this occurs on floor levels where column splices are made, H-beams are embedded in certain of the joists in order to act as struts between the columns.

In some of the outer panels only two joists are used, in order to allow of cable wells or other floor openings of specified dimensions. These joists are wider than the others, but are of the same depth. Widening of the joists at their ends by flaring out the sides is an unusual construction employed for the purpose of taking care of the shear, which is estimated at 60 lb. per square inch. Some of the joists also have inclined haunches at the ends, extending to the bottoms of the girders. Twin joists, half the normal width and about



RACEWAYS IN FLOOR SLAB CARRY TELEPHONE CABLES

12 in. apart, are used at certain parts of the first floor to permit of long narrow floor openings for cables leading between apparatus on this floor and the basement.

A suspended ceiling flush with the lower faces of the joists forms a flat surface and conceals the joist construction. This has a framing of $\frac{3}{4}$-in. steel channels spaced on 12-in. centers and laid at right angles to the joists. They are attached to hangers on horizontal rods projecting from the sides of the joists. Increased thickness of the floor slab along the sides of the girders provides for the placing of electric light and telephone service conduits, which are embedded in the concrete, as shown.

The construction in general was designed according to units specified in the Chicago building ordinance, taking steel at 18,000 lb. per square inch and concrete at 700 lb. per square inch. Both the architectural and structural designs for this building were prepared by Holabird & Roche, Chicago.

Steel Derrick with 132-Foot Boom Handles 122-Foot Trusses

A DERRICK boom of exceptional length has been used in shifting steel truss spans carrying a belt conveyor system between a grain elevator and storage bins at the plant of the Russell-Miller Milling Co., Minneapolis. An extension of the plant made it necessary to rearrange the conveyor galleries, and after the spans had been stripped and disconnected the trusses were shifted singly by a stiff-leg derrick placed midway between the old and the new positions.

As the trusses were 80 ft. above the ground and had to be moved about 80 ft. to the new and parallel posi-

BOOM LENGTHENED TO 132 FEET FOR SPECIAL WORK

tion, the derrick boom was extended to a total length of 132 ft. by bolting up intermediate sections. This gave a horizontal reach of 40 ft. with full load. Box-lattice construction was used for the boom, stiff-leg and 37-ft. mast.

The trusses are 122 ft. long and weigh about four tons each. Owing to their length and light construction it was necessary, before moving them, to reinforce the chords by lashing heavy timbers to them, as shown

in the view. A cable sling carried by the hoisting block was lashed to the top chord, and guy lines controlled the movements of the truss while being swung. A 20-hp. steam hoist operated the derrick.

This work was done by the Minneapolis Steel & Machinery Co., Minneapolis.

Machine Dress Railroad Ties Before Treatment

Santa Fe Has Both Stationary and Portable Plants That Saw, Adze, Bore and Brand Ties in One Continuous Cycle

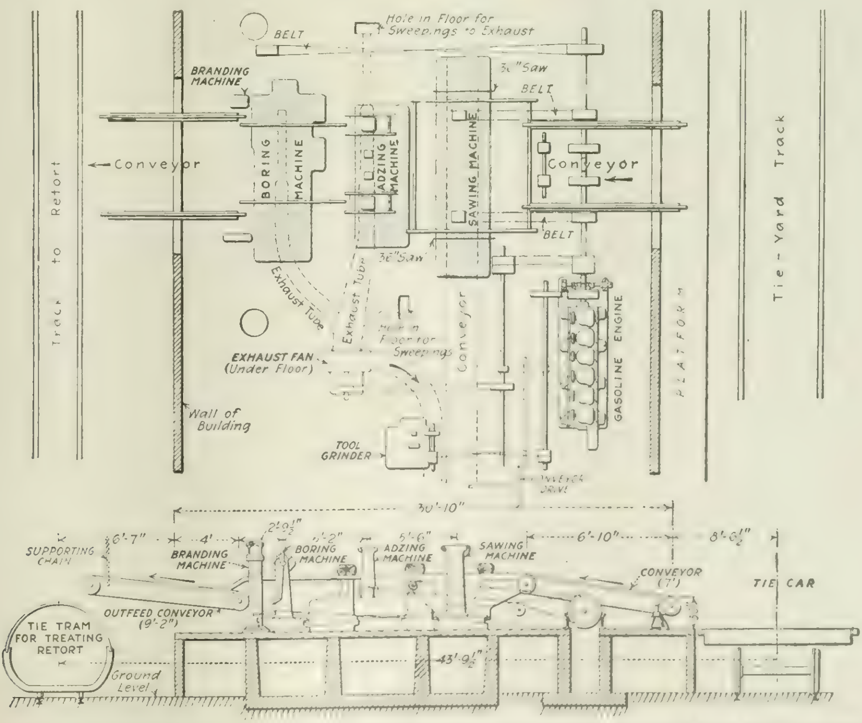
MACHINES have been developed to do all the cutting necessary to fit railroad cross-ties for their work before the application of chemical preservatives, in order to avoid subsequent removal of well treated parts of the wood. The Atchison, Topeka & Santa Fé Ry. has three stationary and two portable plants. In each case the machines are grouped to perform four operations, sawing, adzing, boring and branding, in a continuous cycle.

One of the stationary installations is shown in one of the drawings reproduced below. The tie first passes between saws which crop the ends. The seats for the rails or tieplates are then adzed or trimmed to a level surface, holes are bored for the spikes and finally the tie is marked or branded. For the special work of fitting hardwood spiking plugs in softwood ties there is a machine which bores and threads the holes, screws in the plugs and trims them off flush with the face of the tie. Conveyors automatically feed the ties through the machines and transfer them from one machine to the next.

At the receiving side of the plant seasoned ties from the storage yard are placed by hand or by a hoist upon a conveyor which delivers them to the first machine. The finished ties are fed to a conveyor which delivers them to the trucks for the heating retort or to railway cars for shipment. This discharging conveyor is mounted on a hinged boom, the end of which is raised as the car is loaded in order to prevent dropping the ties from a height. To avoid checking the discharge while cars are being changed, an accumulator conveyor has been devised, upon which the ties may be held temporarily. Cars and trucks may be shifted by a cable on a power-operated hoist or niggerhead.

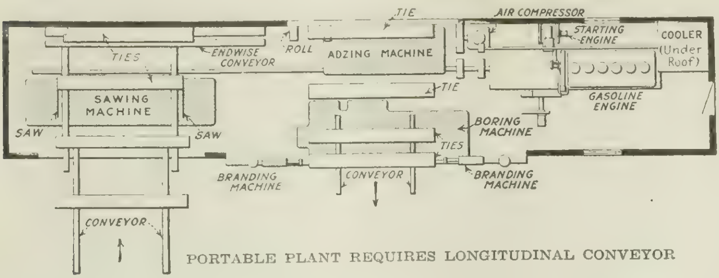
Cropping the ends of the ties by a pair of 36-in. circular saws removes weather-hardened surfaces which would retard penetration of the preservative. It also exposes indications of interior decay which may make it desirable to reject the tie. The two saws are mounted and driven independently. One is carried in a movable side frame, so that the width between the saws can be varied from 7 ft. 3 in. to 10 feet.

In the adzing machine the tie is passed over a pair of 11-in. expansion cutters which form a level face 10½ to 14 in. wide at each rail seat. While the tie is being fed



IN THE STATIONARY PLANT THE FOUR MACHINES ARE SIDE BY SIDE AND THE TIES ARE CARRIED STRAIGHT ACROSS FROM YARD TRACK TO RETORT TRACK

across the cutters it is held down upon its guides by a pair of weighted pantagraphs which operate automatically. Pneumatic cylinders or dashpots prevent shock from the drop of the pantagraphs as the tie passes from under them. Proper facing of ties which are crooked or irregular in surface is obtained by means of a compensator device or cradle. This automatically adjusts the guides on which the ties rest, so that the



PORTABLE PLANT REQUIRES LONGITUDINAL CONVEYOR

proper depth of cut will be made at each end. One of the cutters is carried in a sliding frame, so that the adzing can be done for different gages of track.

In the boring machine the tie is held stationary by means of an intermittent conveyor while groups of bits or augers bore the spike holes from below. Each group may have two, three or four bits, mounted on spindles which are adjustable to fit various spacings of spike holes. To obtain proper location of holes in ties which are not straight there is a centering device having jaws which shift the tie horizontally so it will lie approximately on the center line between the two groups of spindles. Without such adjustment, a crooked tie might have some of the holes bored too near the side. The same device clamps the tie and holds it down while it is being bored.

Treated ties are usually marked with the date of treatment, in order that records of life may be kept. In the branding machine, the tie is held momentarily while the ends are stamped by dies fitted to the plungers of a pair of compressed-air cylinders. The hollow standards on which the cylinders are mounted serve as reservoirs for air at 60-lb. pressure. The characters are about 2 in. high and ¼ in. deep. It is common practice to stamp one end with the year and the other end with a mark designating the rail or tieplate for which the tie is bored. To prevent injury to the machine by ties which have S-irons driven into the ends to prevent splitting, the operator can cut out this device, allowing such ties to pass unmarked.

Ties from 5 to 10 in. thick and 7 to 14 in. wide can be handled without adjustment. Different lengths of ties and different gages of track are provided for by the adjustments noted. Removal of dust and shavings at the tools is effected by chutes, connected to an exhaust pipe, which may deliver to a cyclone separator or to a box car. Blocks from the saws fall upon a conveyor.

The second drawing shows one of the Santa Fé's portable plants, which permits dressing the ties in the storage yard, to save transporting them to stationary plants. This consists of a 50-ft. steel-underframe box car, fitted with the four machines already described and with an exhaust fan to remove shavings. The fan may deliver the waste to a separator or to a car which conveys it to the boiler house for use as fuel. An oil engine of 105 hp., using distillate, operates the tie machinery and a pair of niggerheads for cables handling the tie trucks. It is started by a 1½-hp. gasoline engine.

The car can be moved along the yard tracks at a speed of about 100 ft. per minute by means of chain drives on two axles, operated by the main engine. For transfer to another yard, these chains are disconnected so that the car can be hauled in freight trains. An auxiliary car or trailer contains two machines for sharpening the cutters and saws, an electric lighting plant with gasoline engine, and tools for ordinary repairs. Both cars are wired for electric lights on the inside and outside.

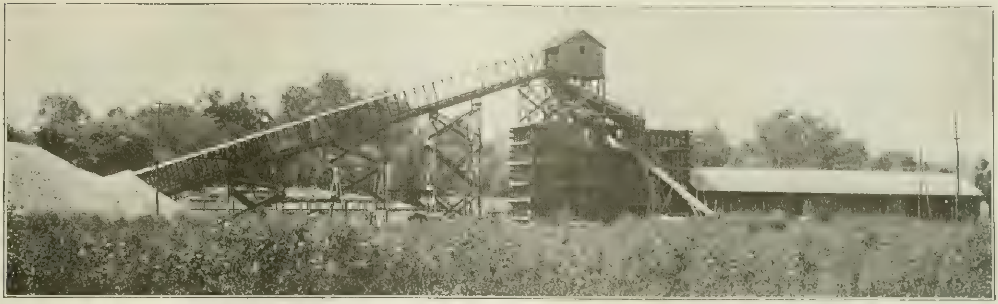
These tie-dressing plants have a capacity of 3000 to 3300 ties per 10-hour day. The machines, with their conveyors and other auxiliaries, have been developed by Greenlee Brothers & Co., Rockford, Illinois.

Concreting Plants Standardized for Five Miami Valley Dams

Pit Gravel Washed and Screened to Three Sizes Including Sand at Each Dam—All Processes Mechanical from Pit to Forms

MIXING plants identical in all principal features will place the concrete on the five retarding basin dams of the Miami Valley flood protection works. Available deposits, at each dam, of bank gravel, and substantial similarity of the concrete structures to be built permitted this standardization. Gravel brought from the pit in cars is elevated by a belt conveyor to the washer and screens. The excess sand and over-size gravel are chuted to spoil cars or waste banks, while the screened sand and pebbles drop into elevated storage bins which discharge by gravity through measuring boxes to the concrete mixer, the charging platform of which is connected by a runway to a cement house in line with the bins. Cars take the concrete to the work, where it is placed by derricks or chutes, according to the local conditions.

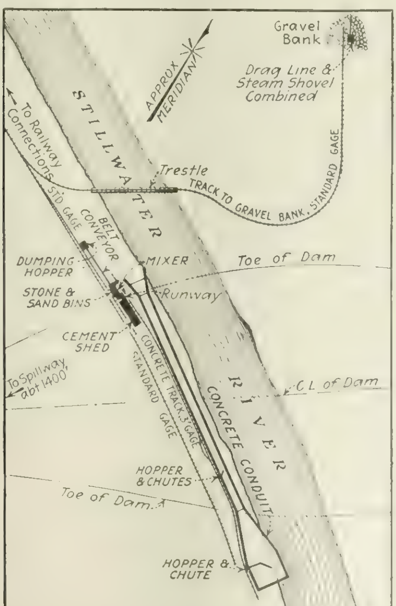
Concrete construction is farthest advanced at Englewood dam. Here the plant is completed, and concreting the outlet conduits was begun Aug. 10. Other plants are not far behind in construction, as the accompanying picture of the plant at the Lockington dam indicates. In fact, concreting at the Lockington and Englewood dams started the same day, after several weeks of good-natured rivalry on preparatory work. Except for surrounding topography, this picture might serve for the plant at Englewood or for that at any of the other dams. Also, the description of the Englewood operations applies, so far as the washing and screening outfit,



GRAVEL-WASHING AND SCREENING AND CONCRETE-MIXING PLANT IDENTICAL FOR FIVE DAMS

bins and mixer and cement house are concerned, to every one of the five plants.

At the Englewood dam the volume of concrete to be placed is 38,000 cu.yd., the larger part in the outlet conduits and the next larger part in the structures of the spillway around the west end of the dam, about 1400 ft. distance as the crow flies. The shortest average haul for mixed concrete, therefore, determined the location of the plant near the headworks of the outlet conduits, as indicated by the sketch map. From one end of the outlet work to the other end is about 1000 ft., making the average concrete haul approximately 500 ft. The spillway is a channel about 1400 ft. long, with concrete side walls, an overflow weir and an apron. Its whole curved length is within a radius of perhaps 1500 ft. from the mixer plant, so that a track running its full length and to the mixer would measure perhaps three-fifths of a mile. The exact average haul of spillway concrete will depend on the track location. The distances given serve principally to indicate the fairly long haul of mixed concrete at Englewood and bring out the importance of the hauling outfit to be mentioned.



MATERIAL HANDLING A CONTINUOUS MECHANICAL PROCESS FROM GRAVEL PIT TO FORMS

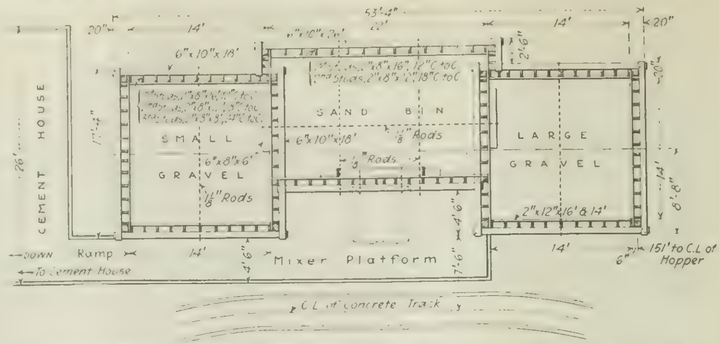
Concrete is now being placed only in the outlet works, and the track layout given on the plan is tributary to this work. The map shows the continuous routing of materials from the gravel pit to the conduit forms. The supply and preparation of the concrete materials are the first link in the chain of operations, mixing and transporting concrete are the second link, and distribution to forms is the final link.

Bank gravel is excavated by a small drag-line excavator, equipped as a steam shovel, from a pit above the dam and some 1500 ft. by railway from the dumping hopper of the gravel washing plant. Four-car trains of 12 cu.yd. air-dump cars and a 40-ton saddle tank locomotive, carry the gravel from the pit to the hopper. This same type of equipment does practically all the job hauling. This statement does not of course refer to materials and supplies coming to the work from the outside. These are brought in by standard rolling stock. The switch to the dumping hopper reaches alongside and past the bins and the cement house. This permits cars of cement to be shunted in front of the cement house and dump cars to be spotted beside the bins to receive the waste washings and the oversize stones from the gravel washer and the screens.

Sand and two sizes of pebbles are produced by the washing and screening unit. A pyramidal hopper set at ground level in a concrete pit receives the pit gravel by side dumping from the cars. The hopper is 19 ft. 2 in. x 7 ft. 10 in. inside the top and is built of timber. An opening at the bottom feeds the gravel onto a 20-in. belt conveyor. This belt rises on a 20° incline on a trestle to the washer above the bins, traversing a horizontal distance of 161 ft. The washing and screening equipment above the bins comprise three screens in a row, each screen 54 x 27 x 72 in., a 60-in. conical sand separator, and a 4-in. centrifugal pump. A 25-hp. motor is direct-connected to the pump, and the belt and screens are operated by a 20-hp. motor. Screened sand and gravel drop into the bins, and washings and oversize stones are chuted to one side into spoil cars or waste bank.

Solid-wall bins from the ground up were constructed as shown by the general view and the plan drawing. It will be noted in respect to the bin layout, besides

the three-compartment construction, that the mixer skids are not set much above ground level and the concrete track is in a cut below ground level, so that the mixer has room to tilt and discharge. A 1-yd. mixer receives its sand and stone by chutes designed so that both materials are measured in the chutes. Cement is wheeled from the cement house with which the mixing platform is connected by a runway and ramp. At Englewood the outlet conduits are being built in a deep rock trench, with the sides nearly vertical. Direct chuting from the track level was therefore possible in concreting the greater part of the length of the conduit structures. A 3-ft.-gage track from the mixer was carried alongside the trench and close to its edge. On this track, hopper cars arranged for side gate discharge are hauled by a gasoline locomotive. At points where concrete is being placed, platforms are bracketed out over the edge of the trench and fitted with floor hoppers into which the cars discharge. Chutes on trestles deliver the concrete from the platform hoppers to the forms.



THREE-SIZE AGGREGATE BINS FEED MIXER THROUGH MEASURING CHUTES

About 300 cu.yd. a shift is the capacity of the concreting plant, and some 20,000 cu.yd. of concrete is the season's scheduled work. The dam is part of the flood protection work of the Miami Conservancy District, of which Arthur E. Morgan is chief engineer, Charles H. Paul assistant chief engineer and C. H. Locher construction manager. H. S. R. McCurdy is division engineer on the Englewood dam.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Des Moines Engineers' Club Widens Ideas

To bring engineers in closer touch with civic and industrial matters, the Engineers' Club of Des Moines, Iowa, is planning to have at each meeting a speaker from one of the city departments or one of the various industries in the city, and occasionally speakers from other cities. The speakers will be expected to explain in detail such matters as the management or organization of their respective activities, their factory or plant methods, machinery equipment, accounting and financing, and efficiency methods, used or contemplated. At nearly every meeting some officer in Government service speaks in regard to army activities, especially along engineering lines. Social activities are recognized as necessary to the development of the club, and these are taken care of at each meeting by the committee on entertainment and program. A new constitution and by-laws have been prepared and will be discussed. After their adoption steps will be taken to increase the membership. Monroe L. Patzig is secretary and treasurer.

Twin City Engineers Find 80,000 Tons of "White Coal"

THAT horsepower equivalent to 80,000 tons of coal per year can be developed at the High Dam on the Mississippi River within six months is the gist of a constructive report made by a committee of the Engineers' Club of Minneapolis through the Civic and Commerce Association to the War Industries Board. This summer there was a deficiency of water power in Minneapolis due to extremely low water, and prominent citizens woke up to the fact that war orders could not be handled unless more power was available. Other sources of power, steam and hydro-electric, being developed were tabulated by the society's committee for the use of the Government body. Undoubtedly, upon these data will depend order placements.

The report was not hidden and the Minneapolis papers printed abstracts on the front pages. Publicity of this kind is easy to get.

Army Engineers Want Societies Kept Up

From a captain of engineers in France came a letter recently about society service. It speaks for itself.

"Just as you in the States are inclined to look to us over here for the heroic stuff, so we in France are inclined to feel that the real big things in the awakening of the nation and the shaping of its future course in world affairs are taking place over there, and that we in France constitute only the producing arm of force actuated by the new national consciousness. Those of us who have been in France for over a year have difficulty in visualizing the war-vitalized United States of to-day, and therefore letters that convey direct personal impressions are particularly welcome.

"When the war came on and the services of so many engineers were needed in various capacities, I rather expected that interest in meetings of technical societies, more particularly of the mutual betterment kind, would lag, but I am agreeably surprised to learn from your

letters, and from occasional copies of *Engineering News-Record* that reach me, that such is not the case. Now is the time to advertise the usefulness of the engineer in a way that will make an impression. We who are now in the Army will be looking for a means of livelihood when the war is over, and hope that those who have remained behind will be able to convince the country that the great amount of beneficial constructive work that has been stimulated by the war ought to be continued in time of peace."

A number of societies are reporting a serious impairment of finances, and in consequence are considering a curtailment of activities. The dross should be eliminated. Wise council should be sought. Directors should meet frequently and be sure that the really live, essential work proceeds. Some organizations have reserve funds built up for a "rainy day." The boys over there are looking to the States for constructive effort, now as never before. If new blood cannot be drawn in, and if expenses eat into the reserve, it is well to remember that it's "raining" now, and appropriate the reserve without stint or qualms. W. W. DEBERARD.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

National and Local Societies

Sir—Mr. Hoyt's interesting and timely letter in your issue of Sept. 5, p. 463, touches upon a subject in which the whole engineering profession is profoundly interested. The organization of the many national and local engineering societies so as to harmonize and coördinate their efforts, and so that the engineering profession may be mobilized locally or nationally whenever its influence or its service is required by the community, is the most vital problem before the engineering profession today.

Mr. Hoyt's pessimism with regard to the national societies, however, I cannot share. The momentous resolutions recently passed by three of the founder societies, appointing committees on "development" or "aims and organization," is the clearest indication that the importance of broadening the scope of our activities and the necessity of national organization are appreciated. A thorough and general discussion will be carried on by the national societies this winter, and it is confidently hoped that a crystallization of ideas will result, and a plan of liberal coöperation among all engineering organizations.

There is an important feature in the formulation of such a plan that must not be overlooked. Mr. Hoyt emphasizes the desirability of national organization under the leadership of the large national societies. That these societies are able and willing to assume such leadership can hardly be doubted, in view of recent developments. However, any program of organization must be the result of discussion and coöperation actually nation-wide. Only in this manner can a plan of organization be worked out that will meet with the hearty indorsement and support of the whole engineering profession and that will not be suspected of a desire for centralized government, so odious to localities removed from New York. In full recognition of this situation, the resolutions creating the committees of the national societies provide for representatives of all their local sections and from all parts of the country.

May we suggest to each one of these committees the motto "to discuss aims and purposes in the light of modern development and in the light of present-day thought, and to help toward finding a method of coöperation with the rest of the engineering profession best suited to attain these aims." LOUIS C. MARBURG.

New York City.

Surface Heaving Caused By Segregation of Water Forming Ice Crystals

Sir—The differential lifting of the surface of the earth, in regions where the temperatures fall below freezing, frequently results in the development of cracks in hard surface pavements and the displacement of piers and other structures. Such phenomena are almost universally ascribed to frost action, but the mechanics of the process has not been clearly understood. The annual damage to concrete pavements by frost is considerable, and if this loss is to be prevented highway engineers must learn the true cause of the trouble.

Expansion in volume due to the freezing of water is commonly given as the cause of heaving, but this theory does not furnish a complete explanation of all the facts. In a paper in *Engineering News-Record* of Feb. 7, 1918, pp. 262-263, the present writer attributed the lifting of certain concrete piers to the segregation of water to form ice crystals, rather than to the expansion in volume which occurs when the water freezes. The latter theory has been discussed by several engineers in recent issues of engineering journals, and a number of interesting observations on heaving by frost have been placed on record.

It is obvious that expansion due to the freezing of water in soils must usually result in some elevation of the surface, but the changes in elevation caused in this way should be approximately the same wherever the soil saturation is uniform. Most of the damage resulting from heaving is due to strain induced by the unequal lifting of the different parts of a pavement or structure. In fact, this unequal elevation of the surface is the most noticeable phenomenon associated with frost heaving. J. L. Harrison in *Engineering News-Record* of Feb. 28, 1918, p. 419, has called attention to the fact that after the heaving of a concrete pavement "it is often possible to push sticks between the blocks and the base," while some cases have occurred "where it was possible to see clear across the subgrade under concrete blocks."

Another characteristic phenomenon is that in many instances the depth to which freezing extends is insufficient to account for the amount of heaving observed, if the latter be attributed solely to the expansion accompanying the freezing of ground water.

C. D. Norton in *Engineering News-Record* of May 30, 1918, p. 1058, cites several cases, which he states "seem to demonstrate that the ground heaves or rises in the winter because the water in the soil expands," but the

writer cannot agree with him. In only one instance does he give exact figures and, in this case, the evidence apparently disproves his theory. According to Mr. Norton, in a region where the ground freezes to an average depth of 4 ft. one of the sills supporting a cottage was lifted 4 in. Now, the change from water to ice is accompanied by an expansion of 8.55 per cent., and therefore it would be necessary to freeze a column of water 46.78 in. high in order to raise the surface 4 in. Assuming that the soil was completely saturated with water and that the pore spaces averaged 40 per cent. of the total volume, which is certainly an excessive estimate, then freezing would have to extend to a depth of *nearly 10 ft.* in order to raise the surface 4 in. Moreover, the heaving was very uneven, for, according to the diagram accompanying the paper, one of the posts under the cottage was heaved only 1 in., while another was heaved only ½ in. Mr. Norton refers to the absence of ice between the sheathing and the ground, but this is to be expected where the sheathing and sills are of wood, for wood is a poor conductor of heat. He would probably have found some ice below the surface if excavations had been made.

In the writer's experiments, which have already been described, a layer of ice was formed immediately under a metal weight, because the latter radiated heat rapidly and therefore acted as a refrigerating surface. In much the same manner, ice will sometimes form between a concrete pavement and its sub-base. The formation of ice veinlets in clay, as shown in the photograph published by Lewis B. Wyckoff in *Engineering News-Record* of Mar. 28, 1918, p. 627, is an excellent illustration of the fact that under certain conditions ground water, on freezing, will segregate to form relatively pure ice. In the Yukon and other very cold places masses of clear ice several feet in thickness are sometimes formed at shallow depths below the surface. Now, in all such cases it is evident that the segregation of the water took place simultaneously with its crystallization as ice, for soil and other materials of high specific gravity will not float on a layer of water.

When ground water in freezing segregates to form clear ice, it is due to the fact that the growing ice crystals are able to extrude the foreign material with which they come in contact. The formation of layers of relatively pure ice is necessarily accompanied by an elevation of the surface which bears no relation to the average depth of freezing, and in many instances the amount of elevation may be practically equal to the thickness of the ice layers that are formed. In most instances the ground water freezes in the interstitial spaces so that the soil particles become inclosed within the ice. Where this takes place the elevation of the surface results from the expansion in volume that accompanies the freezing of water, and the amount of elevation depends chiefly on the depth to which freezing extends and the percentage of water that is present in the soil.

The conditions under which the water present in soils segregates to form masses of relatively clear ice must be understood before preventive measures can be intelligently formulated. The experiments of the writer, which were not confined to ice but also included a large number of crystalline substances, indicate that the size of pore space is usually the most important factor in determining whether the formation of ice from ground water is accompanied by the inclusion or the exclusion of soil particles.

When a growing crystal is surrounded by foreign material in which the pore spaces are large, as for example in clean sand or gravel, the pressure is unevenly distributed over the crystal surface, and while growth is relatively rapid on the exposed areas it is much slower on the surfaces which, because of their close contact with the foreign bodies, are less accessible and therefore require more time for the supply of new material through the infinitesimal spaces. Under these conditions the crystal tends to grow around the foreign bodies. On the other hand, when the pore spaces are small, as in clay, pressure is more uniformly distributed over the crystal surface, growth is slow and new material may reach practically the entire surface of the crystal with equal facility. Under these conditions the growing crystal tends to exclude the foreign bodies.

Noticeable heaving by frost, so far as the writer has been able to ascertain, is practically confined to clays and other soils in which the pore spaces occupied by water are extremely small. Where the interstitial spaces are relatively large, no appreciable heaving seems to occur. This observation has been confirmed by several of the writers in recent issues of *Engineering News-Record.*

In order that freezing may take place, the temperature must be sufficiently low, and the freezing point is lowered by pressure at the rate of 0.133° F. for each additional atmosphere of pressure. During the formation and enlargement of masses of ice in soil, pressure is exerted against the inclosing material, and therefore the ice tends to form along planes of cleavage or weakness. In other words, concretionary ice tends to form at those places where the least energy is required in making room for the growing mass.

At a given depth the freezing temperature will be reached first at those points where radiation of heat is most rapid. Also, since water does not freeze so readily when confined in very small capillary spaces, the ice will form first in the larger openings in soils. After ice begins to form at a certain point there is a tendency for crystal growth to continue at this point rather than form new centers of crystallization.

The thickest layers of clear ice resulting from the freezing of ground water seem to form under objects that radiate heat rapidly, and at times when the temperature of most of the ground water near the surface is considerably above freezing while the temperature of the air is well below freezing. Under these conditions a film of ice forms first on the under surface of the refrigerating object and gradually increases in thickness because of the freezing of additional water that slowly reaches the lower surface of the ice through the small capillary and sub-capillary spaces in the soil. A relatively high temperature of the ground water at lower depths lengthens the time required to bring the temperature to the freezing point, and thus retards the development of new centers of crystallization at points which are otherwise favorably located.

STEPHEN TABER,
State Geologist and Professor of Geology. University of South Carolina.
Columbia, S. C.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Keep Steam Shovel Crews Unchanged and Cut Moving Costs

MONEY is saved moving steam shovels by keeping always the same crew on the shovel. For this reason, on a large excavation job visited not long ago shovel crews are never changed if it is possible to avoid change. By practice, a crew thus becomes expert and quick in shifting the shovel. In some cases a reduction from 5 min. to 2 min. in moving time per move has been accomplished. It costs from 3c. to 12c. per minute to operate a steam shovel, including the wages of the pit crew. Let us say that ten shifts of the shovel are made per ten-hour working day. Three minutes per move saved, then, aggregates a saving of 30 min. per day. Assuming an average cost of operation of 6c. per minute, the saving in cost per day is $1.80, and per month, 26 working days, it is $46.80. Working two shifts per day, the saving per month is $93.60. Of course, if poor spoil-train service or carelessness in many other possible ways keeps the shovel alternately idle and busy, this gain in speed of shifting the shovel counts little. On the work visited the other factors of plant coördination had been figured quite as closely. Incidentally, one of the most interesting problems of plant coördination in all engineering construction confronts the superintendent of a steam shovel excavation job. C. S. H.

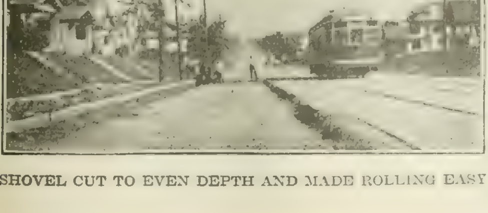
Other Articles of Interest to Contractors In This Issue:

Shallow Street Excavation Cost Cut Seventy Per Cent by Shovel

By George Biggs

Kansas City, Mo.

THE cost of excavation was reduced 70% when a steam shovel was substituted for wheel scrapers and an elevating grader on shallow street grading at Kansas City, Mo. The material removed was Tarvia macadam, containing a comparatively small amount of rubble for this type of pavement, and the depth of cut was about 13 inches.



SHOVEL CUT TO EVEN DEPTH AND MADE ROLLING EASY

Before putting the shovel on the work an attempt was made to use the wheel scrapers, and later an elevating grader was tried. The wheelers failed on account of the difficulty in loading the hard, compact material. The elevating grader was seriously handicapped by the heavy street-car traffic, which interfered with the receiving wagons. However, it is believed by the engineer in charge that this latter method of handling old macadam would be entirely successful on wide streets without car tracks. After one block had been graded and costs had mounted to 42c. per square yard, operations were shut down pending the arrival of the shovel. Immediately after its installation, costs fell to about 14c. per square yard, and on certain days were as low as 12c. per square yard. Upon a high fill costs were further reduced by wasting over the wall at the side. Labor, fuel and rental of the shovel, at $50 per day, were included in the cost as given.

Excavation by shovel was found to give a better grade than was obtained by either the wheelers or the elevating grader, and the fine grade, which is shown in the illustration, was easily obtained. The type of pavement constructed was 4-in. vertical fiber brick on a 1-in. sand cushion and an 8-in. concrete base.

The work was done by the A. Jaicks Co., under the superintendence of Wilson A. Jaicks, and the cost data were compiled by the writer.

Engineers Who Design Also Supervise Work

Preparation of plans and estimates for sewer projects under the Board of Local Improvements, Chicago, is in the hands of the engineer force of the division in which the project is located. The adoption of this system gives the construction engineers familiarity with designing and the purposes of design. When followed closely, it will enable the division force to work out details, and then design them and make the necessary drawings, so that when construction is in progress under the same men they will have become familiar with all details. One drawback is that the drawings made by the engineers and rodmen have not as finished a style as if prepared by regular draftsmen, but it is expected that this defect will gradually disappear as the men become experienced in drafting.

NEWS OF THE WEEK

New York, October 10, 1918

Jubilee Convention Held by American Society for Municipal Improvements

Revised Constitution Accepted—Paving and Sewage Discussed—History of Society Reviewed—Resolutions Adopted

Celebration of the twenty-fifth anniversary of the organization of the American Society for Municipal Improvements was a feature of the convention held by that organization Oct. 2 to 4. Fittingly, the meeting place was Buffalo, where the first meeting was held in 1894. On the technical program, pavements and sewage treatment were the main topics.

A revision of the society's constitution, prepared by a committee having George W. Tillson as chairman, was adopted. The word "of" in the name of the society was changed to "for." Under the new constitution, standing committees will continue to guide the constructive work of the society. Reports of the various committees on specifications will be circulated, so far as practicable, before the annual meetings. There will be hearings on the reports during the meetings, after which reports will be presented for general discussion on the convention floor. After discussion, the convention will vote on submitting the specifications in question, or amendments, to letter ballot, subject to adoption by a majority of those voting.

Buffalo Paving and Street Cleaning Practice

Among the papers on paving and street maintenance presented were three on Buffalo practice, which are abstracted on p. 663. In discussing the paper on concrete base by George F. Fisk, the question was asked whether concrete bases are not made unnecessarily thick. C. E. P. Babcock, Buffalo, said that question could be answered in the light of local conditions only. G. H. Norton, Buffalo, believed that it would be impossible to limit the loads over payments, and if heavy loads are allowed on heavy traffic streets it would be impossible to keep them entirely off the light traffic streets. He cited the fact that the pavements of Buffalo are being used by the Pierce Arrow Co. in testing its large trucks, which receive a 100-mile test run when loaded to capacity with cast-iron cubes. In answer to a question as to how the contractors' gamble could be eliminated, when the system is used of changing concrete mixes after delivery of material, Mr. Norton said that the contractor should get well-graded material in which there would be no need for change.

In discussing the paper on asphalt maintenance by Messrs. Babcock and Vandewater, a question was raised as to whether old asphalt taken up could be used again if more asphalt were added. Discussion indicated that trying to use old asphalt costs as much as or more than using new.

A paper by J. R. Draney, New York City, on standardizing the consistency of asphalt, urged that a smaller variety of penetration standards is desirable. The author recommended that steps to reduce the number be taken by the various societies interested.

William C. Perkins, chief engineer of the Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio, read a paper on prevention of longitudinal cracks in hard surface pavements. He proposed the use of a course of hollow tile on the subgrade to insulate the subgrade so that frost will not penetrate it, and to collect and direct to the gutters any water that may rise through the subgrade.

Thomas E. Collins, city engineer of Elizabeth, N. J., read a paper entitled "Napped Trap Block Pavements." These pavements are similar to recent granite-block pavements and are rebuilt from old trap-rock pavements of large-sized stone which are cut through the middle, the new surfaces thus formed serving as the wearing surface. These blocks are laid as are other blocks, except that the author recommended ramming them after instead of before the application of the first grout. This he thought necessary because of the omission of pebbles to fill the lower portions of the joints.

A. T. Rhoads, field engineer, Granite Block Manufacturers' Association, stated that it is feasible to ram block before the first grout is applied, if the blocks are uniform in size, whether pebbles are used or not. He felt that if the ramming is left until after the first grout is applied it is imperative to ram immediately after such application.

Short papers on concrete bases for bituminous and other pavements, and on concrete pavements, were submitted by W. A. Hansell, superintendent of public works, Fulton County (Atlanta), Georgia. A new method of protecting concrete while curing was suggested. It consists of giving the surface a coat of bituminous material as soon as it has set sufficiently to make it safe, and covering this with enough stone to absorb the bituminous material used. This, it was stated, will protect the pavement while setting and also when the traffic is turned upon it. Tar-asphalt has been used successfully for this work, the author stated, and its use is much more satisfactory than the old method of covering the concrete with earth and keeping the earth moist for several days. The writer also recommended a wooden roller with spikes for finishing bases for bituminous tops, thus obtaining a roughened surface. E. C. Conant, Savannah, Ga., favored the use of loam kept thoroughly moist, for protection while curing.

Sewage Disposal Receives Attention

A group of papers on sewage disposal and treatment occupied a large part of a forenoon. One of these, by Capt. F. A. Dallyn, of the Ontario Board of Health, was of unusual interest because it made public the conclusions and recommendations of the International Joint Commission, reached after studying for six years the question of the control of the pollution of the boundary waters between the United States and Canada. These conclusions are printed on p. 660 of this issue. Papers by G. H. Norton and by Carl L. Howell dealt with sewerage and sewage disposal at Buffalo and vicinity. Morris Knowles, Pittsburgh, sent a paper reviewing sewage disposal by various European and American cities, and outlining the scheme adopted by several Canadian towns across the river from Detroit, which are building a joint sewerage system under a district organization called the Essex Utilities Commission. Venturi meters will be used to distribute operation costs among the various towns. Prof. C-E. A. Winslow

(Concluded on page 691)

Engineers Study Flood Dangers in Imperial Valley

The board of directors of Imperial Valley, accompanied by C. K. Clarke. chief engineer; C. E. Grunsky, consulting engineer, and C. R. Rockwood, formerly general manager and chief engineer, recently made a tour of inspection over the levee system. The Colorado River, since the break in the Ockerson levee in 1910, has changed its bed and now flows against the Volcano Lake levee at an angle of about 90 degrees. Under these conditions, during the flood stage of the river, the Volcano Lake levee would be seriously menaced. In a recent report to the district Mr. Clarke stated that "conditions are rapidly approaching a stage where the Colorado will be uncontrollable from an engineering standpoint." The problem now being considered is that

of turning the river back into the old channel, used prior to the 1910 break. The Ockerson levee, which kept the river in this channel, is in good condition in some places and partly destroyed in others, while at the point where the river now flows through it is totally destroyed for a distance of four or five miles. The report of the engineers was to be laid before the board of directors with a recommendation for immediate action.

Pump Ground Water for Combined Irrigation and Drainage

The advisability of pumping subterranean waters on the Salt River irrigation project, in Arizona, for the double purpose of furnishing an increased supply for irrigation and lowering the present ground-water level to prevent water-logging of the land, is being considered by a board of engineers consisting of W. H. Code and D. W. Murphy, consulting engineers, and W. R. Elliott, project manager. This investigation was begun on account of the necessity for obtaining more water for irrigation. The novel plan of combining this with drainage has been included because frequent trouble is caused by water-logging of irrigated lands. Mr. Elliott writes that by assessment of its members the Salt River Valley Water Users' Association has made available a fund of $500,000, which, it is expected, will permit the installation of 60 to 70 wells and pumping plants. These units will be located adjacent o or connected with the main canals.

Ship Launched in 17 Days, Completed in Twenty-Three

A new record for speed in wooden ship construction has been made in the completion of the "Aberdeen," built by the Grays Harbor Motor Corporation, Aberdeen, Wash., in 23 days, after being launched in 17½ days, as stated in *Engineering News-Record* of Oct. 3, p. 644.

$294,845,170 Advanced to Railways by Administration

Since Apr. 1 $294,845,170 has been advanced by the Railroad Administration to the railroad companies, stated Director General McAdoo. This is exclusive of the current earnings of the roads applied directly by the individual roads to their current expenses and corporation needs. The advances went to 85 different railroads or systems.

Of the total sum disbursed, $209,347,910 was taken from the $500,000,000 revolving fund, and $85,497,200 came from the surplus earnings of a limited number of roads whose receipts for the period exceeded their requirements. The total amount so turned over to the Director General by roads reporting surplus earnings was $113,000,000, to which the American Railway Express Co. added $10,419,944.

The disbursements to the railroads for September aggregated $52,993,750.

General Water Meter System Is Proposed in Philadelphia

An ordinance before the city councils of Philadelphia provides that by Dec. 31, 1924, all water supplied to consumers from the city water-works shall be delivered through meters and charged for at meter rates. As nearly as may be, a fifth of the present unmetered services would be equipped with meters each year for the next four years, and all remaining in the fifth year. Consumers would pay the cost of supplying, setting, maintaining and repairing meters, but the work would be done and the meters controlled by the Bureau of Water. The ordinance authorizes the Director of Public Works to let one or more contracts for installing the proposed meters, under the terms stated in the ordinance, including possible payment in five annual installments. C. E. Davis is chief of the Bureau of Water.

Milwaukee Intake Tunnel and Lake Shaft Connected

Workmen working from the lake shaft connected up on Sept. 24 with the bulkhead end of the Linnwood Ave. tunnel of the Milwaukee water-works. The tunnel was completed in the fall of 1917. It extends 6500 ft. into the lake, and there it connects with a lake shaft 12 ft. in diameter, concrete-lined, sunk to a depth of 150 ft., 66 ft. in water and 84 ft. in the lake bottom. It is expected that the bulkhead will be removed, the short addition of tunnel built and connection made with the shaft within the next four or five weeks. The steel crib used for construction purposes will then be removed and a screen placed on the permanent timber crib, thereby making the tunnel ready for operation.

War Program for Public Health Association Meeting

The program for the annual meeting of the American Public Health Association, to be held at the Hotel Morrison, Chicago, Oct. 14-17, will be very largely given over to war subjects and conditions arising out of the war. Consideration of the war program of the Public Health Service will take up a full session of the meeting on Oct. 15. Surgeon General Blue, Assistant Surgeon Generals McLaughlin, Schereschewsky and Warren and Surgeon J. O. Cobb will outline the plans of the Public Health Service in detail, a general discussion following.

The measure before Congress to establish a sanitary reserve corps and to commission in the Public Health Service men of national prominence in the various phases of health administration will be dealt with, as well as the question of full-time health officers for states and municipalities.

Included in the program of the meeting are the following subjects and speakers: "The Health of the Civil Population in War Time," by Col. V. C. Vaughan, Medical Corps; "Some Public Health Problems and Opportunities Created by the War," by Maj. William H. Welch, Medical Corps; "Team-play for Public Health," by Dr. George E. Vincent, president of the Rockefeller Foundation; "Future of the American Public Health Association," by Dr. Lee K. Frankel, treasurer of the association.

General Goethals Now Member of War Industries Board

Maj. Gen. George W. Goethals has become a member of the War Industries Board, as assistant chief of the General Staff and director of the Division of Purchase, Storage and Traffic. As such his work brings him into close and frequent contact with the operations of the War Industries Board; this his membership will intensify.

General Goethals takes the place on the board formerly filled by his recent assistant, Brig. Gen. Hugh A. Johnson, who has been assigned to a field brigade for active service. General Johnson's position in General Goethals' organization as assistant to the director is being filled by Gerard Swope, of New York.

Let New Contract and Start to Rebuild Destroyed Plant

The work of rebuilding the TNT plant at Morgan Station, N. J., which was wrecked Oct. 4 and 5 by a series of explosions, will be begun at once. While the fire was still burning, and before the last great explosion, officers of the Construction Division and Ordnance Department were discussing the details of the reconstruction. Decision was made in a few minutes and the contract was awarded to T. A. Gillespie Sons & Company.

Laborers have been mobilized and work was started just as soon as the fire was extinguished and all danger from further explosions was past. The work will be done under the supervision of the Construction Division.

Drainage Congress To Meet in Chicago and Kansas City

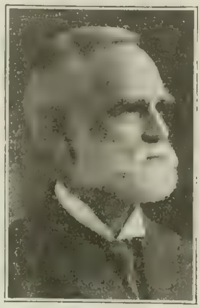
The National Drainage Congress will hold a meeting in Chicago, Oct. 15, at 315 Plymouth Place. The principal officers and those interested in the congress will meet in the morning to discuss the policies and the present action of the drainage interests.

The congress will also hold an informal conference of those interested in drainage and flood protection in Kansas City, Mo., Oct. 17, as an acknowledgment of the invitation of the International Farm Congress and the International Irrigation Congress to attend their joint meeting in Kansas City beginning on that date.

In urging attendance at the Kansas City meeting, an official of the drainage congress says: "We must coöperate with Governmental and other agencies in preparing for the return of our soldiers. Immediate consideration of many grave questions is demanded, and you are urged to attend this meeting not only for your personal interest but in the interest of our country."

Committee on Development, American Society of Civil Engineers

THOMAS LEE WILKINSON, consulting engineer, Denver, appointed by the Colorado Association, has been secretary and general manager of the Intermountain Railway, Light & Power Co. since 1909. 1891-1894, on machinery design for M. C. Bullock Mfg. Co., Chicago and Joliet plant, Illinois Steel Co. Since 1894, in general engineering practice at Denver. Assistant general manager and engineer, Southwest Smelting & Refining Co., Orogrande, N. M., 1905. Past-president Colorado Scientific Society, Denver. Born in 1867.



ONWARD BATES, Chicago, past president, American Society of Civil Engineers (1909-1910), appointed by the president as chairman of the committee, has been engaged in private practice as a consulting engineer since his retirement from the Bates & Rogers Construction Co. in 1908. 1865-1868, apprentice in pattern making. 1868-1871, draftsman and inspector of bridge work, and foreman on construction of caissons, Eads Bridge, St. Louis. Student in Rensselaer Polytechnic Institute, 1871-1873. Engaged in bridge and iron work from 1878 to present time, three years of which were spent in Australia. From 1888 to 1901, engineer and superintendent of bridges and buildings, Chicago, Milwaukee & St. Paul Ry. Past eight years, trustee, Chicago Bureau of Public Efficiency. President Western Society of Engineers, 1899. Born in 1850.

S. EVERETT TINKHAM, appointed by the president, is engineer of construction, bridge and ferry division, Public Works Department, Boston. Continuously in service of engineering department, Boston, since 1874. Secretary of Boston Society of Civil Engineers since 1880, and represented society on board of managers, Association of Engineering Societies, from its formation in 1881 until withdrawal of the society from the association in 1914. For a number of years, chairman of the board of managers of the association. Born in 1852.

EDGAR B. THOMAS, appointed by the Cleveland Association, has been engaged in private practice for the past four years as a consulting engineer with headquarters in Cleveland. With the city engineering department, Cleveland, for 15 years, advancing from transitman to chief engineer. President Cleveland Engineering Society and member special engineering committee on improvement of Cuyahoga River, Civic League Paving Committee, Cleveland Council of Sociology, Cleveland Chamber of Commerce. Born in 1870.

H. L. HAEHL, appointed by the San Francisco Association, has been a member of the firm of Duryea, Haehl & Gilman, consulting engineers, San Francisco, since 1907. 1901-1902, assistant professor of geology, Leland Stanford Jr. University. 1902-1906, with Bay Cities Water Co., San Francisco, as draftsman and assistant engineer. 1906 became first assistant engineer, development of San Francisco water-supply in Sierra Nevadas. President San Francisco Association, 1916. Born in 1876.

CHARLES J. TILDEN, appointed by the Baltimore Association, is professor of civil engineering, School of Technology, Johns Hopkins University. Instructor in engineering department, Harvard University 1897. 1897-1901, structural draftsman and bridge inspector. 1901-1903, assistant engineer, Rapid Transit Commission, New York City. Instructor in civil engineering, Cornell University, 1903. Instructor in civil engineering, University of Michigan, 1905; assistant professor, 1906; junior professor of civil engineering, 1908; professor of engineering mechanics, 1911. Born in 1873.

ARSENE PERRILLIAT, appointed by the Louisiana Association, is a consulting engineer, with headquarters in New Orleans, specializing in canal, levee and land reclamation work. 1885-1888, assistant professor of physics, mathematics and chemistry, Tulane University. Chief of engineers, Louisiana National Guard, 1905; later chief of ordnance, with rank of brigadier-general. Representative United States Government, International Congress of Navigation, Paris, 1900; St. Petersburg, 1908. Sent to Holland by United States Government, 1906, to study dike and levee protection. Member of International Commission for relief of Belgium. Born in 1865.

FRANK T. DARROW, Lincoln, Neb., appointed by the Nebraska Association, is assistant chief engineer, Chicago, Burlington & Quincy R.R. In service of Burlington since 1897 on location, construction, maintenance and bridge work; appointed principal assistant engineer, 1907; engineer, maintenance of way, lines west, 1908; assistant chief engineer, August, 1918. Born in 1875.

GEORGE GRAY ANDERSON, appointed by the Southern California Association, was previously consulting engineer for the Imperial Irrigation District and has specialized in irrigation, water-supply and valuation work for 38 years. Has made studies and reports on Canadian Pacific irrigation projects, Alberta, for Canadian Pacific Ry.; issues in controversy between Canada and United States on diversion of water from St. Mary's River, for Dominion Government; Trinchera Irrigation District, Colorado; and Salton Sink. Made valuations of Beaver Land & Irrigation Co., Colorado; Denver Union Water Co.; and Spring Valley Water Co. Born in Scotland, 1858.

HARRY R. SAFFORD, until recently of Montreal, appointed by the president, was chief engineer of the Grand Trunk Ry. until a short time ago, when he became assistant to the regional director, Central Western Region, United States Railroad Administration, Chicago. In engineering department of Illinois Central R.R., 1895-1910, as rodman, instrumentman, assistant engineer, roadmaster, assistant chief engineer and engineer maintenance of way. Appointed chief engineer of the Grand Trunk Ry. in 1911. Born in 1875.

WILLIAM L. DARLING, appointed by the Northwestern Association, has been engaged in private practice in St. Paul since his return from Russia, where he went in 1917 as a member of the Railway Commission, headed by John F. Stevens. Beginning 1878, was on original construction of Northern Pacific Ry., through North Dakota and Montana, rising through various grades and becoming chief engineer in 1901. Chief engineer Chicago, Rock Island & Pacific Ry., 1903. Chief engineer Chicago, Milwaukee & Puget Sound Ry., 1905, then again chief engineer Northern Pacific Ry.; resigned 1916. Born in 1856.

PAUL G. BROWN, New York City, appointed by the president, has, since 1908, been at the head of the Cuban Engineering and Contracting Co., engaged in sanitary work for the Cuban Government. Is at present also doing Government work for Emergency Fleet Corporation. 1894-1900, assistant engineer and engineer in charge, Bureau of Engineering, Chicago, on tunnel and crib work. 1901-1904, engineer, W. J. Gawne & Co., tunnel work at Cincinnati. Since then has been engaged in tunnel, railway terminal and canal work, Pennsylvania crosstown tunnels, Grand Central Terminal, and New York State Barge Canal. Born in 1870.

J. H. BRILLHART Dallas, appointed by the Texas Association, is president and manager of the Texas Structural Steel Co. and chief engineer of the Mosher Manufacturing Co., Dallas. 1905-1912, with Guerber Engineering Co., Bethlehem, Penn., as tracer, detailer, designer, checker, assistant engineer and chief engineer. Chief engineer Mosher Manufacturing Co., 1912. President and manager Texas Structural Steel Co., 1915. Born in 1880.

CLIFFORD M. HOLLAND, Brooklyn, N. Y., appointed by the president, is division engineer in charge of construction of tunnels, East River, First District, Public Service Commission, State of New York. Continuously in service of Rapid Transit and Public Service Commissions since 1906; first as assistant engineer in subway and tunnel work. Became tunnel engineer, East River tunnels, 1915. Made division engineer 1917. Born in 1883.

W. H. HOYT, Duluth Minn., appointed by the Duluth Association, has been assistant chief engineer of the Duluth, Missabe & Northern Ry. since 1905; in the service of that company since 1905, first as assistant engineer. 1890-1892, in private practice 1892-1896, assistant engineer, Duluth & Iron Range R.R. 1896-1900, U. S. Engineer's Office, Duluth. 1901-1903, principal assistant city engineer, Duluth. Born in 1867.

GEORGE C. MASON, appointed by the Portland (Ore.) Association, is at head of the Hurley Mason Co., building contractors, Portland. 1892-1904, New York University. Organized Hurley Mason Co. in 1904 for contracting and engineering work with offices in Tacoma, Seattle, Spokane and Portland. State chairman Associate Members of United States Naval Consulting Board; member Civil Service Commission, Portland. Born in 1871.

CHARLES HANSEL, New York City, appointed by the President, is a consulting engineering specializing in railroad valuation work. Was chief engineer of Wabash Ry. 1884-1899. Later made appraisals for the states of Illinois and Michigan, and appraisal of all railroads and canals in New Jersey. Now consulting valuation engineer for Pennsylvania, Philadelphia & Reading and Jersey Central systems. Born in 1859.

EDGAR S NETHERCUT, Evanston, Ill appointed by the Illinois Association, is secretary of the Western Society of Engineers. 1889-1893, architectural and structural draftsman. 1893-1907, chief engineer and sales manager, Paige Iron Works and Buda Co., Chicago. 1908-1911, track expert, valuation department, Public Service Commission, First District, New York. 1911-1914 in private practice, headquarters Chicago, engaged in steam and electric railway valuation, sewer and building construction. Made valuation of Washington Ry. & Electric Co., Washington, D. C Born in 1866.

BAXTER L. BROWN, appointed by the St. Louis Association, has been engaged in private practice in St. Louis since 1905, previous to which was chief engineer of the St Louis Valley Ry. for four years. 1882-1901, engaged in railroad location, construction and maintenance work in various capacities from rodman to assistant chief engineer. 1912 and 1913, retained by City Plan Commission, St. Louis, to report on development of river front. 1916, member committee for preparation of plans for St. Louis Chamber of Commerce, relative to general industrial and civic improvement of city. Born in 1864.

ARTHUR PEW, appointed by the Atlanta Association, is a consulting engineer with headquarters in Atlanta, specializing in water-supply, sewerage, railroad and appraisal work. Has made many valuations of public utility properties and reports on improvement of efficiency of industrial plants. Has been in charge of design and construction of a number of municipal and private projects. Elected member American Society of Civil Engineers, 1885.

RICHARD L. HUMPHREY, appointed by the Philadelphia Association, has for the past 10 years been engaged in practice as a consulting engineer, with headquarters in Philadelphia, specializing in cement mill and concrete construction, and is now chief of the Building Materials Section, War Industries Board, Washington, D. C. 1891-1899, with Department of Public Works, Philadelphia, and as engineer in charge, Philadelphia Municipal Testing Laboratory. 1899-1903, engineer and general manager, Buckhorn Portland Cement Co. 1908, in private practice. Born in 1869.

GEORGE BUTLER, appointed by the San Diego Association, is county surveyor, San Diego County. 1887-1888, draftsman, instrumentman and computer, engineering department, Colorado Springs, Colo. 1889-1891, assistant to chief engineer, Hartford Loan & Trust Co., and in general practice vicinity of Denver. 1891-1907, with U. S. Indian Bureau, Interior Dept. as draftsman, special disbursing agent, principal assistant in charge design of structures, superintendent of irrigation, general superintendent in charge of irrigation, water supply, sewerage, and other works for Indian Bureau. Private practice, San Diego, 1907. County surveyor, San Diego County, 1907. Born in 1864.

GARDNER S. WILLIAMS, appointed by the Detroit Association, is a consulting engineer, specializing in hydro-electric development, water-power and water-supply work, with headquarters in Ann Arbor, Mich., and Chicago. 1898-1904, professor of experimental hydraulics, Cornell University. 1904-11, professor of hydraulic and sanitary engineering, University of Michigan. Born in 1866.

GEORGE R. PUTNAM, appointed by the District of Columbia Association, is commissioner, Bureau of Lighthouses, Washington. Engineering department, Chicago, Rock Island & Pacific Ry., 1883. In 1890 entered service United States Coast & Geodetic Survey; on Mexican and Alaskan boundary surveys; on expedition to Greenland as astronomer 1896; on survey Pribilof Islands, Bering Sea 1897, and delta Yukon River, 1898-1899. 1900-1906, director of Coast Survey, Philippine Islands. First commissioner of lighthouses 1910. Author of works on nautical charts and lighthouses. Born in 1865.

FREDERICK C. NOBLE, New York City, appointed by the president, is a consulting engineer having a general practice. In the service of the city of New York from 1900 to 1911 on bridge, subway and tunnel work, during which time he was division engineer for construction of the first rapid transit tunnel under East River. Son of the late Alfred Noble, past president of the American Society of Civil Engineers. Born in 1872.

JOHN L. HALL, appointed by the Seattle Association, is a consulting engineer with headquarters in Seattle. From 1896 to 1916, associated with Purdy & Henderson, from which he resigned as vice-president in charge of the Pacific Coast territory in 1916, remaining, however, as a member of the board of directors. Born in 1860.

ROBERT A. CUMMINGS, appointed by the Pittsburgh Association, is a contractor and consulting engineer specializing in concrete and harbor work. President, Cummings Concrete Construction Engineering Co., now engaged in building concrete barges for New York State Barge Canal. Originator of Cummings System of Reinforced Concrete. Born in 1866.

JOHN C. RALSTON, appointed by the Spokane Association, is a consulting engineer with headquarters in Spokane and was previously city engineer of that city. 1891-93, on railroad survey and construction work in the Northwest; later, erecting contractor, Chicago Elevated Railways. 1896, in private engineering practice, northwest territory. Born in 1867.

$13,000,000 Insurance for Employees Taken by Shipyard

The Skinner & Eddy Shipbuilding Corporation, Seattle, has announced that arrangements have been made for placing $13,000,000 in life insurance, representing a $1000 policy for each of the 13,000 employees of its two shipbuilding plants. This announcement was made on the second anniversary of the launching of the company's first vessel, the 8800-ton steel steamship "Niels Nielsen."

New employees will receive policies after 60 days in the company's service. The premiums are paid by the company, and the insurance in no way affects awards made under the state workmen's compensation act.

Draftsmen Wanted in Air Service

The air service of the United States Army is in need of draftsmen, as well as of men in many other trades and professions, says the headquarters of the air service for the Eastern department. It is stated that men from 18 to 45, registered in the draft, are eligible, and in making application should give full details as to serial number and local board under which they are registered. Applications should be made to Lieutenant Billker, Room 902, 104 Broad Street, New York City.

Imperial All-American Canal

The Imperial All-American Canal Association of Los Angeles has been organized in that city for the purpose of working for the installation of a canal system in the Imperial Valley at a higher altitude than the present system, and wholly in California. The lands to be served by the proposed new canal system are situated in Imperial and Riverside Counties and are not now producing because they lie above the present Imperial Valley canal system.

George F. Kapp is president of the association and Charles F. Price is secretary.

Municipal Improvements Meeting

(Concluded from page 686)

read a paper prepared by himself and F. W. Mohlman on experiments with the Miles acid process of sewage treatment carried out under their direction by the City of New Haven, Conn. The process seems to have much to recommend it under local conditions existing at New Haven, but it presents difficulties which, according to present indications, would bar its use in some other cities.

Rudolph Hering opened the discussion on these papers. Two factors enter into sewage disposal, prevention of nuisance, which is easy, and protection of public health, which includes problems not yet solved. Bacterial standards have been suggested, first according to numbers, later as to kinds. B. coli is now the measure. Before spending millions of the people's money we must go farther than the B. coli standard. It may be that 500 B. coli per c.c. will give us typhoid, but it is not the coli that will do it. As engineers we must see this matter very clearly before spending millions to reduce bacteria to any fixed standard. Engineers must urge bacteriologists to go further in their studies.

Specification Committees' Reports

For the subcommittee on bituminous pavements A. W. Dow, New York, acting chairman, reported that the other members of the committee were all in Government service. He submitted entirely new specifications to take the place of those adopted two years ago at Newark. This report, like the others which included new specifications or amendments to old ones, was ordered sent to letter ballot. Specifications for surface treatment of broken stone and gravel roads with cold bituminous material, designed to conserve fuel, were submitted by Prof. A. H. Blanchard, New York City. Slight changes were recommended in the specifications for brick and wood-block pavements, and no changes in stone block or sewer specifications. There was no report from the committee on concrete pavement specifications. On motion of Mr. Dow, it was decided to request the chairmen of the various paving specification committees to confer and report on the desirability of providing specifications for foundations of materials other than concrete, with power to draft such specifications if deemed advisable.

The convention voted not to copyright the society specifications this year.

Twenty-Fifth Jubilee Addresses

Addresses reviewing the history of the society since its foundation 24 years ago were made by Pres. N. S. Sprague, Sec. C. C. Brown and Past-Sec. George W. Tillson. It was pointed out that the membership and the topics discussed extended more generally over the whole municipal field in the earlier than the later years. The rise, work and final amalgamation with the society, a few years ago, of the Association for Standardizing Paving Specifications, was sketched. This amalgamation gave a new impetus to the society.

The election of officers, in accordance with the report of the nomination committee, resulted in the choice of E. R. Conant, Savannah, Ga., as president; G. H. Norton, Buffalo, first vice president; R. Keith Compton, Baltimore, second vice president; W. J. Hardee, New Orleans, third vice president. C. C. Brown, Bloomington, Ill., was reelected as secretary, and F. J. Cellarius, Dayton, Ohio, as treasurer.

For the next meeting place New Orleans was tentatively chosen, the convention to be held in October or November, the exact date to be chosen by the executive committee. The committee was authorized to postpone the meeting if conditions a year hence made it seem advisable to do so.

War-Time and Reconstruction Resolutions

The convention adopted resolutions expressing (1) its desire to coöperate to the full extent with the Government agencies in all measures which may hasten the winning of the war, and requesting that individual engineers exert their influence toward deferring all public improvements which, although perhaps of considerable local importance, should not be considered as essential under war conditions; (2) expressing the belief that state, county and municipal governments should undertake at once the planning of important works which it may be practicable to construct soon after the declaration of peace; (3) requesting the President of the United States to appoint a commission on reconstruction to coöperate with the British Ministry on Reconstruction; (4) also requesting careful consideration by the United States Highways Council and the various State Highway Departments of the urgent necessity for greater latitude in the release of highway materials, so that the highway systems may be maintained against destructive loss. It was voted to send copies of the resolutions to the United States Highways Council and to the highway department of each state.

Engineering Societies

The Detroit Engineering Society, at its meeting Oct. 4, was addressed by J. F. Rawlinson, Detroit representative of Lloyds' Register of Shipping, on "The Submarine and Its Use." The meeting of Oct. 18 will be addressed by J. E. Freeman, engineer Portland Cement Association, Chicago, who will speak on "Concrete Ships."

The Mechanical Section of the Cleveland Engineering Society has been established by the American Society of Mechanical Engineers as its Cleveland section. The petition for the formation of this section was signed jointly by members of the local society and of the national society resident in Cleveland and adjacent cities and towns.

The Brooklyn Engineers' Club held its regular meeting for October on Oct. 10. A paper on "The Modern Technical High School" was presented by Albert L. Colsten. It dealt with representative technical high schools in the United States, including the earlier manual training school, the four-year technical high school and the two-year trade school. The paper also dealt with the proposed four-year technical high school for Brooklyn. The next informal meeting of the club will be held Oct. 17. A paper will be read by Albert H. Hager, manager for the Atlantic Gulf and Pacific Co., New York, on "The Mill Basin Development."

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Chicago.

CITY MANAGERS' ASSOCIATION; Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

Personal Notes

John W. Twohy of Twohy Brothers, engineers and contractors, Seattle, has become general manager of the Seattle, North Pacific Shipbuilding Company.

Philip P. Farley, formerly president of the Jamaica Bay Improvement Commission and consulting engineer of the New York State Highway Department, who has been engaged in private practice for the past three years, has been named consuiting engineer for the Borough of Brooklyn, New York City.

Otto E. Eckert of the engineering division, Michigan State Board of Health, and formerly assistant city engineer of Saginaw, Mich., has been appointed acting state sanitary engineer.

Col. Herbert Deakyne, Corps of Engineers, U. S. A., who for four years previous to 1915 was in charge of the Missouri River improvement work between the mouth of the river and Sioux City, has been promoted to the rank of brigadier general.

A. O. Peabody, formerly with the Acheson Graphite Co., Niagara

Falls, N. Y., and recently in charge of construction and maintenance for the New Mexico State Highway Commission, has been appointed bridge engineer for the commission, succeeding L. O. Martin, who has resigned to enter war work.

PETER A. DALY, North Bergen, N. J., has been placed in charge of the extensive improvements now being made on the Newark turnpike.

JAMES F. MCINDOS, formerly colonel, Corps of Engineers, U. S. A., is now a brigadier-general.

S. A. SIVERTS, JR., city manager of Morris, Minn., for the past four years, has resigned to enter the Engineer Officers' Reserve Corps, with the rank of first lieutenant.

KENNETH ALLEN, sanitary engineer, Board of Estimate and Apportionment, New York City, has become district engineer, Bureau of Industrial Housing and Transportation, with headquarters at Washington.

A. D. WHIPPLE, chief engineer of the structural bureau of the Portland Cement Association, has become chief engineer of the Lime Association, with headquarters in Washington.

ALBERT E. GHYSENS has been appointed city engineer of Verdun, Quebec.

J. R. LEIGHTY, engineer maintenance of way of the Missouri Pacific Ry. at Kansas City, has been appointed chief engineer of the corporation, with office in St. Louis.

P. J. NEFF, formerly district engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed engineer for the corporation, with office in St. Louis.

N. W. H. SCHAFER, JR., supervisor of the Philadelphia & Reading Ry. at Lebanon, Penn., has been appointed division engineer at Harrisburg. He succeeds John S. Goodman, who is transferred to Tamaqua, Penn. Mr. Goodman succeeds W. D. Kenzie, transferred to Reading and succeeding in turn John C. Wrenshall, Jr., transferred to Philadelphia.

J. Q. BARLOW, formerly assistant chief engineer of the Southern Pacific Co., has resigned.

FRANK J. RADIGAN, assistant engineer, engineering department, Jersey City, N. J., has been appointed assistant county engineer of Hudson County, New Jersey.

COL. SHERWOOD A. CHENEY, Corps of Engineers, U. S. A., has been made a brigadier-general.

JAMES A. JOHNSON, contractor, Seattle, has been appointed superintendent of buildings of that city, succeeding T. Josenhans, resigned.

CAPT. F. A. DALLYN, provincial sanitary engineer of Ontario for some years past, started for Siberia with the Canadian Expeditionary Force on Oct. 3, to serve as a water-supply engineer.

COL. AVERY D. ANDREWS, Corps of Engineers, U. S. A., is one of the new brigadier-generals, recently promoted.

H. F. BLOMQUIST, for the past seven years city engineer of Mankato, Minn., has resigned to become principal assistant engineer, Bureau of Water Supply, St. Paul.

HARVEY S. DARTT, for the past eleven years city engineer of Owatonna, Minn., has resigned to become city engineer of Mankato, Minn., succeeding H. F. Blomquist, who has resigned to become principal assistant engineer, Bureau of Water Supply, St. Paul, as mentioned above.

EDWARD C. SHERMAN, designing engineer and project manager, Bureau of Yards and Docks, U. S. N., has been commissioned as lieutenant commander, Corps of Civil Engineers, U. S. N. R. F., and assigned to duty in the same work, with headquarters in Washington, D. C.

CAPT. JOHN P. WENTWORTH, Sanitary Corps, U. S. A., formerly assistant engineer for Metcalf & Eddy, Boston, has been assigned to duty as camp sanitary engineer at Camp Wheeler, Macon, Ga.

EDWARD WRIGHT, JR., assistant engineer, Massachusetts State Department of Health, has been commissioned as captain in the Sanitary Corps and assigned to duty at Fort Oglethorpe, Georgia.

COL. CHARLES D. DAWES, Corps of Engineers, U. S. A., is now Brigadier-General Dawes.

HORACE J. COOK, resident engineer for Metcalf & Eddy, Boston, and formerly assistant superintendent of the Kennebec Water District, Waterville, Me., has been commissioned as captain in the Quartermaster Corps and assigned to duty at Camp Cody, Deming, N. M., in charge of camp utilities.

HOWARD J. JACKSON, engineer, water resources branch, United States Geological Survey, has resigned to devote his full time to work as special agent of the Northwestern Mutual Life Insurance Co., with headquarters at Washington, D. C.

S. S. STEINBERG, South Carolina State Highway Department, and formerly assistant engineer, New York State Highway Department, has become assistant professor of civil engineering at Maryland State College, College Park, Md.

W. H. FRANKLIN, assistant general superintendent, James Black Masonry & Contracting Co., has been commissioned as first lieutenant in the construction division, Quartermaster Corps, and assigned to duty at Mays Landing, N. J.

OBITUARY

CAPT. JOHN BELLAMY, 103rd Engineers, U. S. A., has been killed in action in France. He was struck by a shell while walking back of the lines. He was formerly employed in the engineering department of the Lackawanna R.R., with headquarters at Scranton, Penn.

CHARLES GUSTAVUS ROEBLING, who with his brother, Washington Augustus Roebling, completed the construction of the Brooklyn Bridge, started under contract by their father, John A. Roebling, died Oct. 5 in Trenton, N. J., in his seventieth year. Mr. Roebling was president of the John A. Roebling Sons Co., Trenton and Roebling, N. J., and of the New Jersey Wire Cloth Co., Trenton, and vice president of the John A. Roebling Sons Co., New York. He was engineer and builder of the Oil City Suspension Bridge at Oil City, Penn.; in 1881 he was engineer of the machinery and contractor for the removal of Cleopatra's Needle from Alexandria, Egypt, to Central Park, New York City, and in 1902 was the contractor and builder of cables for the Williamsburg suspension bridge.

Mr. Roebling was the founder of the model town of Roebling, N. J., on the Delaware, designed originally for the employees in the wire and steel mills. Among Mr. Roebling's achievements in the industrial growth of the John A. Roebling's Sons Co. are the construction and operation of seven large wire mills, the largest rod mill in the country, an open-hearth and steel plant of twelve furnaces, a billet mill, many tempering and tinning furnaces, a large cloth factory and great mills for making flat steel wire.

Mr. Roebling was a member of the legislature of New Jersey in 1903, and presidential elector for New Jersey in 1904. He was a member of the Iron and Steel Institute of Great Britain and of America, of the American Institute of Mining Engineers, and of the Engineers' Club, New York.

JAMES MURRAY AFRICA, city engineer of Huntingdon, Penn., died at his home in that city Sept. 18. Mr. Africa entered engineering work in 1882 on surveys and topographical work in Huntington County, Pennsylvania. He was first elected city engineer of Huntingdon in 1884, serving for four years. Soon after this time he designed the water-works for the city as well as water-works for Palmyra and Riverton, N. J. In 1888 he became assistant engineer of the Chautauqua Lake R.R., and soon afterward became chief engineer and general manager of the road. In 1894 he became chief engineer of the Pennsylvania Midland R.R., at the same time serving as city engineer of Huntingdon.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Metal Trades Leaders Thrash Out Many War Problems

A drive to increase America's production of iron and steel, at the same time releasing man power for military service, by the installation of labor-saving machinery, was launched at one of the largest gatherings of metal working manufacturers ever assembled, held at Milwaukee, Oct. 7, in attendance at the five-day congress of the American Foundrymen's Association and the American Institute of Mining Engineers.

Charles M. Schwab, director general of the Emergency Fleet Corporation, reviewed the progress of the shipbuilding campaign of the past year, pointing out the present need for carrying the program to a successful conclusion. Many problems were considered at the meeting, including labor, proper distribution of coal and coke, closer coöperation with and between the Fuel and Railroad Administrations, and the employment of women in war work. The Auditorium was filled with machinery of all description used in the metal industry.

Improvements Urged In Export Lumber Trade

Suggestions for improvement of the present methods employed in the export lumber trade of the United States are contained in a report just made public by the bureau of foreign and domestic commerce, Department of Commerce. It states that the most serious complaint made against American lumber has been in regard to qualities, and has been due largely to hurried or inefficient grading and lack of adequate grading rules recognized in both foreign and domestic markets. It is pointed out that comparatively few mills in this country have specialized in cutting for export trade or have endeavored to market their product abroad on their own accounts.

The report points out that when the war is over the subject of export trade will become an important one to the lumber industry, and the constructive criticisms in the Government's report are aimed solely at assisting in the necessary preparation for meeting conditions as they will exist when the demand for reconstruction materials makes itself felt. The report contains in detail practical suggestions as to methods of developing and improving the foreign lumber trade. Copies may be obtained for 20c. each from the Superintendent of Documents, Washington.

That lumber manufacturers expect to play a material part in furnishing building materials for rehabilitating devastated Europe is shown in a report recently issued by Dwight Davis, representative of the West Coast Lumbermen's Association, which includes the statement that this project had gone as far as a survey of lumber needs, showing that 7,000,000,000 feet will be required for the work.

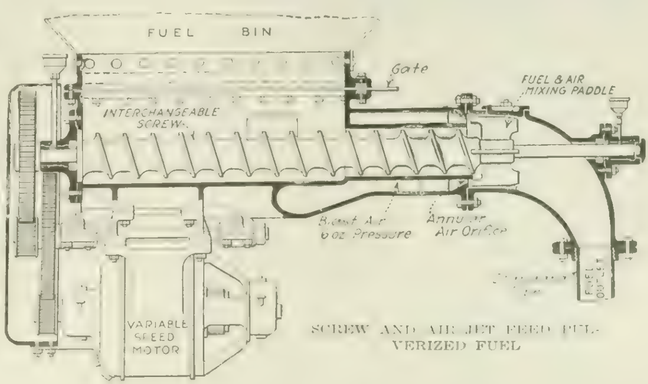
Quotas of Coal Production Pledged By Mines

Reports being received by the Fuel Administration indicate a general acceptance of the weekly production quotas of operators, fixed by Fuel Administrator Garfield as a means of stimulating supply throughout the Eastern part of the country, where the need of increased production is at present the greatest.

In the Pocahontas and Tug River fields in West Virginia the miners and operators joined in a pledge to mine 2,000,000 tons in October, which represents an increase of 300,000 tons over the large August production, in spite of the fact that 5000 mine workers have left this territory since May 1.

Feeding-Mixer, With Screw Conveyor, for Pulverized Coal

A screw conveyor with air jet and mixing paddle constitutes a combination feeder and mixer for delivering pulverized fuel to boilers, kilns or furnaces. Under the bottom of the fuel bin is a horizontal screw of coarse pitch and giving such length of contact as to prevent clogging. On the discharge end of the shaft is a revolving paddle.



SCREW AND AIR JET FEED PULVERIZED FUEL

Around this end of the conveyor is an annular orifice through which air at 6 lb. pressure is blown through the paddle, which thus effects an intimate mixture of the air and fuel. This mixture under pressure is discharged into the nozzle at the combustion chamber.

Noiseless gears of steel and rawhide transmit power from a variable-speed motor to the screw shaft and a blower furnishes air for feeding and mixing. Feed is controlled by varying the speed of the motor. A 5-in. feeder with screw of 3½-in. pitch has minimum and maximum capacities of 850 and 3400 lb. per hour, with 12 intermediate rates. Feeders of different sizes deliver from 60 to 4000 lb. per hour. This device is known as the "Lopulco" feeder and is manufactured by the Locomotive Pulverized Fuel Co., New York.

Industries Reclassified Under Recent Ruling

The priorities division of the War Industries Board has issued circular No. 20, which contains preference list No. 2, superseding preference list No. 1 issued Apr. 6. It contains all amendments and supplements to the previous list.

The first 11 pp. contain the classification of industries as made by the War Industries Board, and those following have an alphabetical list by states of individual plants working on Government contracts, naming the towns in which they are situated and the numbers of their respective classifications. In it is also included a list of fuel supply priorities.

Could Save 110,000 Barrels of Fuel Oil Daily

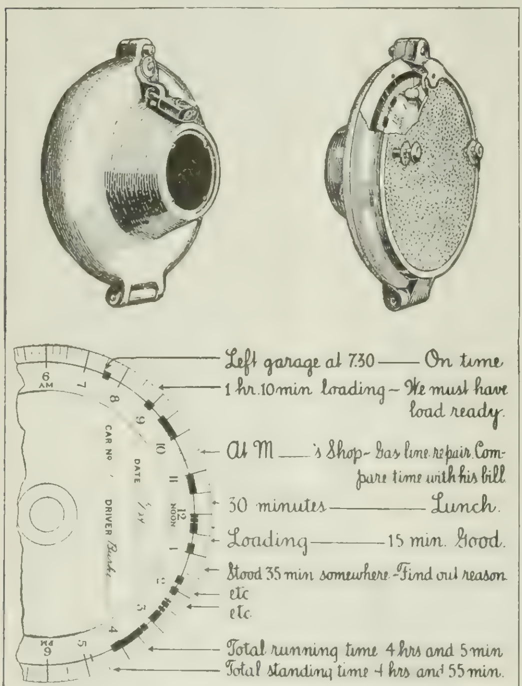
By more intelligent operation of plants and proper firing, 110,000 bbl. of fuel oil per day, or 40,000,000 bbl. per year, might be saved of the present annual consumption of 160,000,000 bbl., according to conclusions just reported which have been drawn by experts of the bureau of mines, Department of the Interior. These experts have been coöperating with the Fuel Administration in a general survey of the use of fuel

oil for power purposes in the United States. Their conclusions indicate that the annual wastage of fuel oil represents a needless expenditure of $140,000,000 per year.

As one result of the investigation a handbook for plant engineers in the efficient use of fuel oil has been issued by the Bureau of Mines. It gives instructions to all who have oil-burning plants.

Elapsed Time Recording Device For Motor Trucks

The efficiency of a motor truck is more or less inversely proportionate to the time in which it is idle. Rapid loading and unloading devices, trailers, etc., are all for the purpose of keeping the trucks moving and reducing such overhead items in the unit cost as driver's salary, etc. Proper supervision to see that trucks return from trips promptly, and inquiries as to the reasons for delay if they do not, are, if properly conducted, efficient means for lowering the unit cost of operating the trucks.



TIME RECORDING DEVICE FOR MOTOR TRUCK

An appliance has been produced by which the actual running time of the trucks may be recorded. The device consists of two essential elements, a pendulum which will swing from side to side in response to the side sway of the moving vehicle and a chart, rotating at clock speed, upon which the pendulum records the side sway which indicates that the truck is in motion. The absence of this record, therefore, shows that the vehicle is not moving. The motion is recorded on the disk by means of the stylus that is set in motion by the pendulum near its point of suspension. The disk records are turned in for the daily inspection of the truck superintendent, dispatcher or higher official, who, being familiar with the duties the truck must perform, identifies the various trips and stops as shown in the chart. Stops or delays for which there is no apparent reason can then be noted, inquiries made and the elimination of unnecessary causes effected. These may be small, but they can accumulate to large proportions in the case of the use of a large number of trucks.

America Has Advantage in Promising African Trade

Starting with an advantage, owing to the already established high reputation of certain goods, the United States has an opportunity for trade with an African country rich in resources, according to a bulletin of the Bureau of Domestic and Foreign Commerce. The bulletin states that "even far-off Abyssinia has trade possibilities that should be studied now and developed as soon as the war is over."

The country is wealthy in natural resources, has a comparatively good climate and is populated by eight or ten millions, intelligent and aggressive, the report states. It expresses the opinion that the possibility of a more economic and industrial development does not obtain in any other portion in the world with equal commercial opportunity, and although the trading population is relatively small the merchants in that class are intelligent and observant.

The advantage now enjoyed by Americans there is on account of the establishment of a nation-wide reputation in cotton goods, so well known that in portions of the country they are used as a medium of exchange.

The railway extensions in other parts of Central Africa, especially the connections along the Congo River with the so-called Cape-to-Cairo route, are opening up other large territories of wide trade possibilities, according to commerce bureau reports.

Business Notes

The Lidgerwood Mfg. Co. announces that it has opened a branch office in the Union National Bank Bldg., Cleveland, Ohio, for the better handling of its mine hoists, contractor's hoists, derricks and cableways. The office will be in charge of Ernest F. Pegg, recently associated with the W. M. Pattison Supply Co.

The American Steel Export Co. announces the opening of its own office at 1203 Smith Building, Seattle, Wash., for the convenience of its customers on the Pacific Coast. M. R. Rosse, Pacific Coast sales manager, will be in charge.

Albert W. Russel, former president of the Russel Motor Axle Co., and later connected with the office of the Secretary of War, has been appointed a member of the War Credits Board, to fill the vacancy caused by the resignation of F. P. Neal.

The R. H. Beaumont Co., Philadelphia, Pa., has issued Catalog No. 38 describing and illustrating the Beaumont Drag Scraper System for the ground storage of coal.

Trade Publications

The Standard Asphalt and Refining Co., 208 So. La Salle St., Chicago, has recently issued a publication, "Sarco Mineral Rubber Asphalts." It contains illustrations of the application of "mineral rubber" for insulation, waterproofing and protection purposes.

The Pittsburgh Water Meter Co., East Pittsburgh, Penn., has issued a 42-p. catalogue entitled "Water Meters." It is illustrated with halftones and line cuts.

"Improvements in Water Wheel Efficiency," is the title of a pamphlet issued by the Pelton Water Wheel Company, San Francisco, Calif. It is illustrated with plant views and diagrams, and is based on studies made by E. C. Hutchinson, Chief Engineer of the Pelton Water Wheel Company.

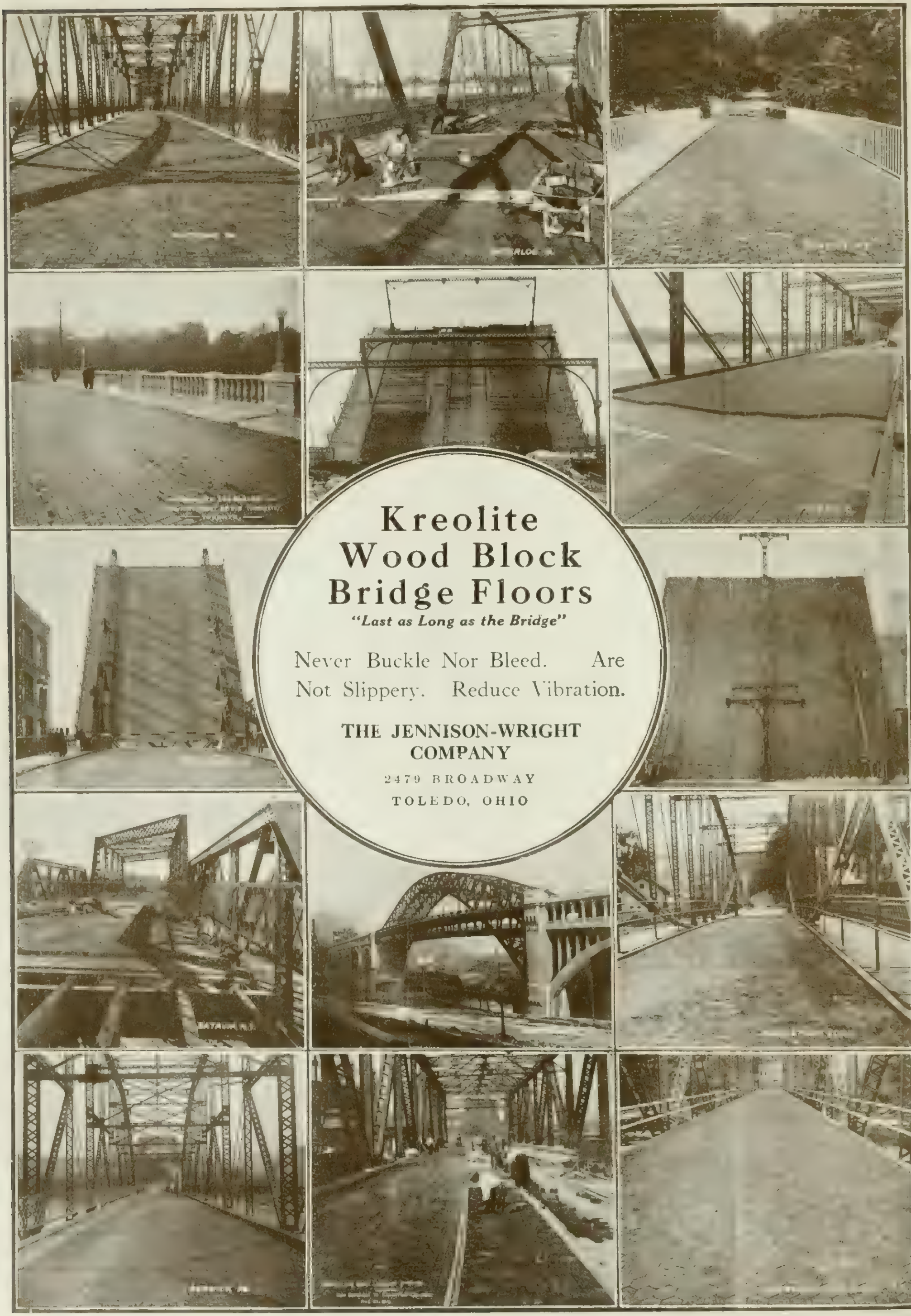
The C. W. Hunt Co., Inc., New York City, has issued bulletin 18-2 containing descriptions and illustrations of its standard storage battery industrial trucks.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

October 17, 1918

Ships Built Indoors by Conveyor-Assembly System Adapted From Automobile Manufacture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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, OCTOBER 17, 1918 — Number 16

No Relaxation

GERMANY admits defeat. It remains for her to accept terms and give necessary guarantees. Until she does both, our war efforts must be increased not relaxed.

Every Engineer

SOON or late peace will come. We are not prepared for it. Every engineer not in the war should address himself to reconstruction, as suggested in a letter on p. 729, lest peace, however long delayed, find us still unprepared.

All Engineering Societies

UNITER action would accomplish infinitely more for reconstruction than isolated individual effort. It can be secured at once if all our engineering societies will make reconstruction problems their chief concern. Which society will be first?

An Example

A RECONSTRUCTION conference has been called by the National Municipal League. Its program goes far beyond the municipal field. The conference at Rochester (see p. 734) should be largely attended by engineers, public officials and representatives of engineering societies.

Every Municipality

HOW many cities are awake to the fact that they should immediately formulate reconstruction programs? Very few. Adjourning politics indefinitely, every city should address itself to what is fast becoming the most pressing question of the hour.

All States

STATE authorities should act. Reconstruction legislation for both states and cities will be needed. Fortunately most of the legislatures will be in session this winter. No time should be lost in drafting legislative bills, framing budgets and planning state engineering work for the reconstruction period.

The Nation

AT LAST reconstruction legislation is before Congress. The Weeks-Madden resolution provides for a joint Congressional Committee on Reconstruction, composed of 12 members chosen by political caucuses. Far better is the Senator Overman bill creating a Commission on Reconstruction, consisting of five full-time paid members appointed by the President. Engineers and engineering societies should back the principle of the commission bill and secure copies of it for study.

The Railways After the War

THERE are plenty of indications that strong opposition will develop to any attempt to return the railroads after the war to the competitive system. Very likely popular sentiment will force the permanent retention of them by the Government. The alternative of unified corporate control proposed by Mr. Dennis on p. 711 is not a new idea. The advantages of such a plan are well set forth by him, however. This plan, or some less comprehensive scheme of regional corporate operation, seems to offer the best solution of a peace problem which needs early attention, judging from the recent news from Europe and Asia Minor.

Recruits for the Construction Ranks

AFTER the war the ranks of the contractor will be materially strengthened by a group of returned soldiers who as young students are now being trained in the vocational schools of the Committee on Training and Instruction. Already Purdue University has turned out a contingent of 100, and the second unit started in early in September. These men, as noted on page 712, are getting in a short course such things as every concrete construction man must get in the school of hard knocks before he makes any material success. Perhaps the state institutions will find after the war that this is one of the things they must add to their list of short courses, of which those in the agricultural field have proved so popular. At any rate, this is one by-product of the war not to be belittled.

Partners All For Increased Efficiency

SUPPORTED last month by the War Labor Board, and recently made general for its plants by the United States Steel Corporation, the eight-hour day is rapidly becoming universal. Of more importance than the shortening of hours, however, is the recognition of the principle that working conditions are not adjusted to maximum production until they are so arranged as to give the worker a chance to keep himself at the top notch of mental and physical efficiency. Long hours which denied the opportunity for recreation and produced cumulative fatigue are among the first of these working conditions to be improved. The benefit in increasing individual production has been so long demonstrated by experience that it is not surprising to find one of the largest corporations accepting the plan for all its plants. A further benefit in the reduction of labor turnover among these plants may well be looked

for. The individual can stand cumulative fatigue for a length of time dependent on his vitality. Then his system demands relief. If he is a European peasant, and can make the opportunity, he moves to America. If he is employed in a mine or factory here he changes his job. The next step after making it possible for the worker to reach his greatest efficiency is to make it profitable for him to do this by sharing with him the benefits of increased production and enabling him to improve his social condition. Shortening long hours accomplishes both objects. The logical carrying out of such policies in the industries of this country will make capital, management and labor partners for an increased efficiency the results of which will surprise some of America's competitors in world trade.

Developing Technic of Concrete Boat Building

CONCRETE barges have been built intermittently for the past decade, but conditions of use and cost in pre-war days did not encourage the practice, nor were records of the methods of building given much publicity. In consequence there is no developed technic of concrete boat construction either for the river and harbor lighter or the more spectacular ocean-going ship. So far the latter in this country has been represented by one vessel only and the bold builders of that have not seen fit to give the results of their experience to the profession. Barges, on the other hand, are under construction in a dozen or more widely scattered yards, in each of which individual theories and practices of construction are given full sway. Standard methods have yet to be developed. Nothing can more quickly bring about the very desirable standardization of such methods than the publication of descriptions similar to that of the Aberthaw yard on page 704 of this issue. Each yard will profit by some advance of its fellow yard and this new and promising industry will so much the sooner achieve the stability it deserves.

Another Step Forward in Ship Production

SHIP deliveries from the new yards of the Atlantic Coast began last week when the 9600-ton steamer "Liberty" was turned over to the U. S. Shipping Board at Kearny. The event marks another epoch in our shipbuilding history, for it was on the mammoth fabricated-ship yards—Kearny, Newark Bay, Bristol and Hog Island—that our hopes for a great emergency fleet had been chiefly founded. Yet without a single contribution from them, American ship production has broken all records in the world's history month after month since early summer. Henceforth even greater performance will be shown, as the productive power of the big yards makes itself felt. Fully four months ago these yards took a place in shipbuilding, for on May 30 Newark Bay launched the "Agawam," the first agency-yard hull, and two weeks later the "Liberty" went down the ways. Bristol and Hog Island launched their first ships, "Watonwan" and "Quistconck," early in August. A great fleet of vessels has been put into the water since then by the four yards, but fitting-out proved to be slow work, and not a single ship had been added to the record of completed ships until the "Liberty" was delivered. The period of delay is now over, and September's figure of 362,635 dead-weight tons delivered by the yards of the United States, itself an increase of ten per cent. over the August record, is sure to be far surpassed by the deliveries of October and the months to come.

Inland Waterway Development Lags

PERFORMANCE has lagged farther behind promise in inland waterway operations than in any other war reform. A year ago there was every reason to hope that at last under pressure of railway freight congestion the inland waterway would be permitted to show what it could do as a freight carrier. Active opposition melted away. Government aid was promised and given. Enthusiastic reports from the waterway advocates seemed to indicate a return to the old days when rivers and canals were crowded with shipping. This promise has not been fulfilled. Government inland waterway control has indeed been established and a program for future work has been evolved though not published, but in the eight months which have elapsed since the Government commenced to take over certain canals the actual increase in waterway traffic has been practically negligible.

The New York State Barge Canal is the most conspicuous example of this peculiar blight on activity in a time when speeding up beyond previous hopes is so common as hardly to be noticed. Some increase in traffic on the New York canals has taken place, but the increase is ridiculously small. Just at present there is unfortunately an effort to throw the canal back into what to it is familiar ground, the political arena, but the difficulties with the New York Barge Canal are far deeper than those which lie in party control. That the canal does not work to its full capacity is the fault of the people of the State of New York who will not use it. Education along these lines is a tedious task. While barges for anything like the capacity of traffic on the canal are not available, they could be found for intercity freight if such freight were available. The shippers along the canal, however, still stick to their rail routes.

The Mississippi has been another disappointment. Only this week did the first regular barge line service start, and there is no assurance that this so-called regularity will be continued. Here, again, it is not the fault so much of the Government, which expects to lose money on the early operation of its New Orleans-St. Louis barge line, as it is the fault of the towns along the river which have not provided proper terminals and of the shippers in those towns who make no effort to use the river.

It is disappointing to those who hoped that the waterways operators would rouse themselves from their familiar rôle of theoretical promoters and reformers to find that when opportunity has been offered no real progress can be readily made. Underground opposition the waterways have undoubtedly had. Favorable reports recommending certain desirable measures have been lost in the interminable maze of Washington offices. Terminals have been slow in building. Barges are difficult to get. But all of these things are opposi-

tions which the waterways men should have overcome just as so many other men in these days of stress have overcome what seemed to be insurmountable obstacles in the path toward some necessary reform. The waterways men—and we use the term to represent that group so vociferous in advocating development of waterways in the past—should take a lesson from the other engineers and builders of this war.

Shipbuilding by Factory System

THERE are inspiration and instruction for all, but particularly for the shipbuilder, in the history of the remarkable River Rouge plant, where the "Eagle" submarine chasers are being manufactured. In bold originality the enterprise has few parallels; it embodies shipbuilding of a wholly new kind. Yet the service required was of utmost urgency, and no chance of failure could be taken. The final success of the "Eagle" work therefore is in a way a dramatic climax which brings the courageousness of the project into sharp relief and increases its inspiring effect. But quite apart from this, each item of plant and process invites scrupulously careful study because it was worked out with ingenuity and highly expert knowledge to meet the special manufacturing requirements of the case.

Shipyard men will therefore be certain to gain from a study of the River Rouge work. The story of the development of the process told on p. 698 of this issue, and the fuller operating details to be given in a later issue, make primary appeal to yard managers, as suggestions of new possibilities in improving shipbuilding methods with a view to increased efficiency. Though the plant is very different from a shipyard, almost startlingly so, yet the product is a ship that any yard might turn out, and most of the mechanical operations are not far from identical with those of ordinary shipbuilding. But the work is organized in a manner fundamentally different.

Existing shipyards could have dealt with the mechanical part of the task of putting in the water a great fleet of submarine chasers. The problem was controlled, however, by the Navy's imperative demand for high-speed quantity production and by the necessity of utilizing non-shipbuilding labor—the only kind available. This brought to the fore a proposal of radical character, based not on shipbuilding knowledge but on thorough experience in mass manufacture. It was that factory system should be substituted for shipyard system and that a manufacturing plant of a new kind should be equipped for the work, in which material would be localized, operations segregated, and labor specialized to deal with single operations, all in a way unknown to shipyards. This remarkable proposal was adopted by the Navy, and it is today a working success.

Henry Ford's entry into ship manufacture by way of his automobile factory thus has demonstrated that shipyard tradition and precedent are not essential to the production of ships. Already shipbuilding has shown itself animated by a spirit of innovation which produced progress; the past eighteen months have seen remarkable advance in efficiency. But the radically new instance of progressivism afforded by the River Rouge enterprise cannot fail to prove an added stimulus toward new thought and disregard of mere tradition.

Keenest interest attaches to the distinguishing characteristic of the "Eagle" manufacture—the rigid systematization and specialization of labor. Each worker carries out a single set of operations constantly repeated, using material placed close to hand. It is this fact that makes the plant a factory and the process a manufacturing process; not the buildings or the plant arrangement or the novel launching elevator, but the specialist-labor system applied to carefully analyzed and segregated operations. This is the feature of the process that invites most searching study by shipbuilders. The specialist-labor system belongs inherently to quantity production, but today all shipbuilding is quantity production.

Whether the factory methods of the River Rouge plant can be used to advantage by the ordinary yard is worth determining without delay. If expert study shall show that a system of subdivided organization in hull building is practicable in the shipyard, that it would reduce the handling of material, increase labor efficiency, and speed up production by holding the entire chain of operations up to schedule, the value of the system in our present extreme demand for ships will need no further proof, and shipyard methods should be modified accordingly. There need be no concern over the unsuitability of the system for the commercial shipbuilding of normal times. Readjustment of methods can be carried out at leisure when emergency shipbuilding draws near its close.

Rapid Construction Meets Army Needs

RAPID construction, high efficiency of organization and relatively low cost characterize the erection of the immense war-supply structures built during the past 12 or 18 months for the quartermaster division of the U. S. Army. Sudden demand for enormous quantities of all sorts of supplies for our armies in the field and the training camps made necessary the establishment of great warehouses and other buildings for storage and shipping facilities. Some of these are of a temporary character, but most are permanent structures, many of them with notable features of design. Capability for rapid progress under high pressure is a characteristic of American engineers and contractors, and many works attest their resourcefulness in expediting progress. These army structures, however, presented a special problem, due to their number and size, the difficulties of obtaining labor and material, and the necessity for simultaneous construction in various parts of the country.

This was not a case of a single building or of rapid work to meet a contract or commercial requirement. It was a vast national emergency which had to be met and overcome at once and at all hazards. The record-breaking construction work for the army cantonments was mainly on one- and two-story frame buildings. This warehouse work, however, involved large and tall buildings of steel and concrete, sometimes with difficult foundations to be provided.

The speed with which this work was successfully done in the face of many and great difficulties attests the skill and energy of the engineers and contractors to whom it was entrusted.

Great Submarine-Chaser Factory Produces "Eagles" By Indoor Shipbuilding System

Problem of Rapid Production Solved by Special Design and by Quantity Manufacture—Ship Brought to Material and Men—Launching Elevator—Plant Built in Three Months

[This article has been passed by the Chief Censor of the Navy Department]

SHIP manufacturing instead of shipbuilding, carried on under the roof of an enormous factory, is used for producing the "Eagle" submarine chasers at the new Ford plant on the River Rouge, near Detroit. Shipyard methods were largely discarded when the problem of immediately creating a great fleet of the large chasers had to be solved. The plant is now in regular operation, and the remarkable system of ship construction is a practical reality.

Most characteristic of the system is the fact that the shipbuilding berths are moved along to the material and the men, instead of being stationary and having the men go to the berths. That this process of taking the work to the men, used in automobile assembly at the Ford shops, could be made to serve the needs of high-speed ship construction, was the original conviction of Henry Ford when he undertook to build the fleet of chasers for the Government.

Every effort was bent toward obtaining the highest efficiency in applying the process. Direct straight-line movement of material was made a governing consideration when the factory was planned. A remarkable straight-line plant layout is the result. The "Eagle" plant lacks all resemblance to a shipyard. What emphasizes the difference further is the absence of launching of the kind seen in shipyards. The completed hulls are lowered into the water by a huge elevator moved vertically by hydraulic jacks.

A remarkable ship design is an essential feature of the "Eagle" production. Pressed-steel shapes, electric welding and electric rivet heating were called into service. From the design of the hull to the final equipment of the vessels, the whole enterprise is a fabric of original thought. The plant, conceived as a means for most rapid construction of the chasers—as a quantity-production ship factory—represents a combination of bridge shop, automobile works and marine fitting-out yard.

By the courtesy of the Navy Department in opening the plant to technical inspection, and in supplying data concerning the work, *Engineering News-Record* is enabled to present a description of the perfected manufacturing process. Though this process is in every sense a special solution of a special problem, yet, being the product of technical genius, expert knowledge and manufacturing resource of a high order, it possesses a character that is likely to exert lasting influence on the entire art of shipbuilding.

Realizing the magnitude of the problem before it, the Navy Department brought together a remarkable combination of men to work out a solution. Washington contributed Admiral D. W. Taylor and Capt. Robert

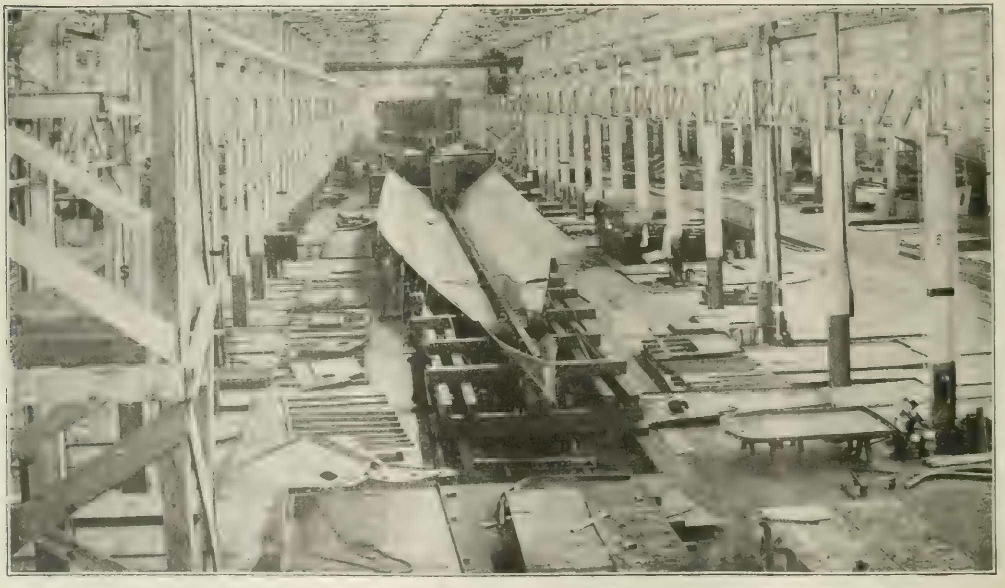


FIG. 1. BUILDING "EAGLES" BEGINS AT THE HEAD OF THE ASSEMBLY SHOP AND CONTINUES AT SEVEN SUCCESSIVE STATIONS; KEEL, BOTTOM PLATING AND BULKHEADS ARE BEING ERECTED AT STATION I

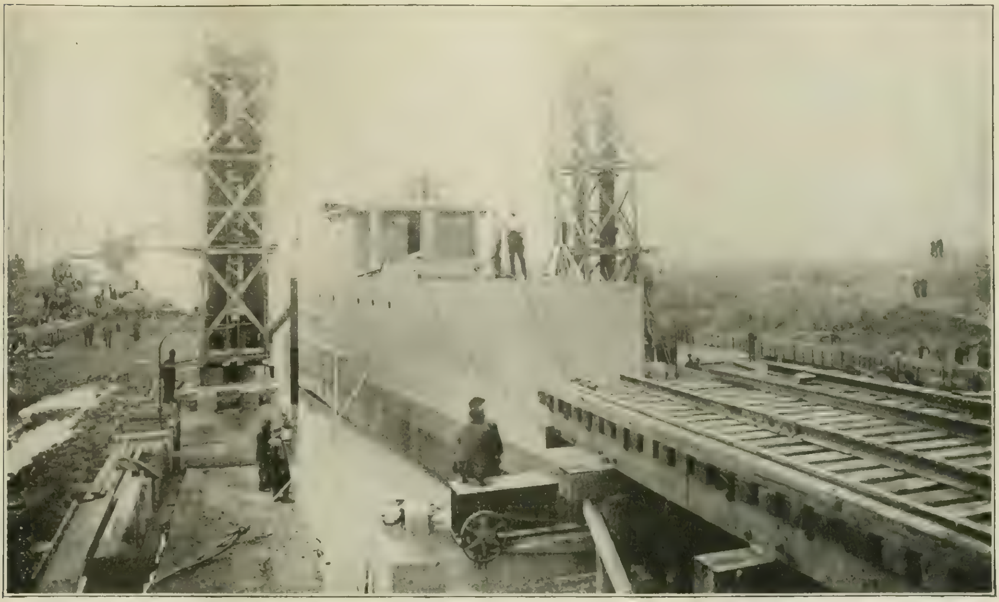


FIG. 2. EARLY IN JULY THE FIRST "EAGLE" WAS PUT INTO THE WATER—A VERTICALLY-MOVING ELEVATOR TAKES THE PLACE OF ORDINARY LAUNCHING WAYS

Stocker, who designed the hull, and Admirals Griffin and Dyson and Commander S. M. Robinson, who designed the power plant. Secretary of the Navy Josephus Daniels contracted with the Ford Motor Co. to build the boats, and thereby brought into the work Henry Ford, systematizer of automobile manufacture, with his strong organization. Shipbuilding experience and craftsmanship were called in by drafting from the Manitowoc Shipbuilding Co. one of the most energetic shipbuilders on the Great Lakes, Charles C. West, to supervise the development of the hull manufacturing system. Commander Carlos Bean, of the Navy, was named to take charge as executive officer and to direct the practical development of the power plant, contributing executive ability and extensive torpedoboat experience.

Through the planning ability and driving power of these men, aided by many others, the results were achieved of converting a paper design into a successful factory-made ship, and a prairie into an operative manufacturing plant, within the short space of three months. Only a little later than this, a working organization was in service, despite the difficulty of obtaining skilled men.

In February the plans for the "Eagle" factory were started; late in May the first hull work was got under way. In July and August the first three "Eagles" were put into the water. Now the plant is in running order, has a working force of nearly three-fourths the ultimate intended strength, and each day is approaching the maximum rate of production.

Ten Elements of the "Eagle" System

In its completed form, as it now exists, the "Eagle" manufacturing system comprises the following elements: (1) A factory design of ship, prepared in its entirety by the Navy Department, a design which has straight lines substituted for curves as far as possible, in longitudinal lines as well as in cross-section (Fig. 3), and with the utmost simplicity and strength of structure; (2) multiple punching applied as extensively as possible; (3) preassembly or subassembly of parts that can be set in place as units; (4) erection of the ships in a long file moving forward to the material and to the workmen; (5) lateral short-distance movement of the hull materials from the storage piles to the ships; (6) step-by-step movement, the file advancing one station (the length of one hull) at fixed intervals (three to six days); (7) arrangement of the work in three parallel competitive working lines; (8) railway-truck mounting of the hulls during erection; (9) transfer of the completed hulls into the water by a hydraulic elevator; (10) installation of interior fittings, machinery and other parts in step-by-step progressive movement of the ships along the fitting-out dock, by a series of stations like those of the hull erection, and with short-distance lateral movement of the material.

The two parts of the system—hull assembly and fitting-out—together constitute a straight-line progressive shipbuilding mechanism, but are physically separated by the launching platform at the center of the plant. A straight-line plant arrangement serves for carrying out the straight-line process.

It does not appear that any one of these elements is vital to the success of the fundamental task of building the ships rapidly. However, taken together they today constitute an integral mechanism—the "Eagle" production system—and they are so interrelated that each one is essential to the successful working of that mechanism. This mechanism grew together gradually during the

evolution of the enterprise; its elements did not come into being as parts of one original conception.

The ship design itself underwent some change during the working out of the manufacturing procedure. Thus, originally the side frames were 6-in. heavy-flanged channels, but when it was recognized that these might give trouble in beveling (required in the stern and bow sections) they were changed to flanged plates, following the design already adopted for the floors and brackets (Fig. 3). Furthermore, the straking was changed so as to make as many as possible of the side and bottom plates parallel-sided and rectangular, to permit of the greatest possible extent of multiple punching (Fig. 4). Some other changes of minor character were made in the design. The important development and change, however, were in the manufacturing system. Essential help in working out both the system and the design was obtained through the construction of a pattern ship in the Ford automobile works (Fig. 5), even before the ship plant had begun to take shape.

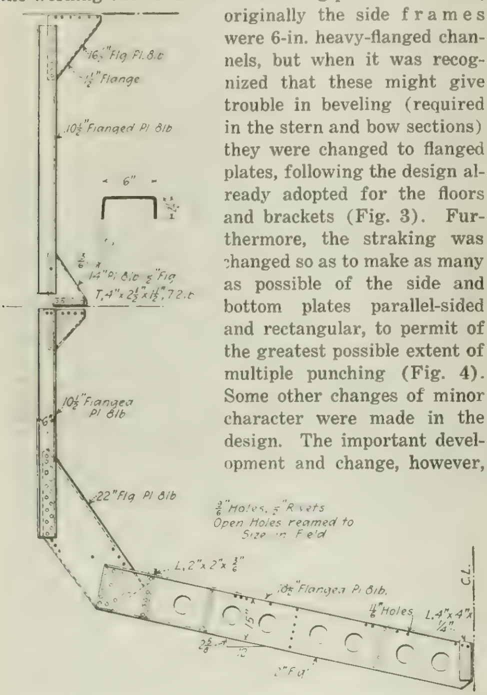


FIG. 3. FRAME OF FLANGED-PLATE MEMBERS IN STRAIGHT SECTIONS

How the System Developed

Taking the work to the material and men, the idea of the Ford automobile assembling system, was at first intended to be applied by a conveyor-like arrangement, the ship moving along continuously at very slow speed. Though the company was not experienced in shipbuilding, its successful development of automobile manufacture produced the conviction that the "Eagles" should be built under a roof and that the conveyor-assembly method was practicable and would result in great gain in time, cost and quality. In view of the novelty of its undertaking, the company did not call upon either naval architects or shipbuilders to plan the factory operations. Getting the new enterprise started was, under these circumstances, like building a machine of a wholly new kind and making it an operating success—which, incidentally, describes accurately the task of developing the turbine power-plant with which the ship is equipped.

Time for leisurely and careful development of plans was lacking, under the urgent rush for earliest possible production. Prompt decisions and quick action were absolutely essential. The development, therefore, was a trying process to all concerned, and some steps were taken that conflicted with later decisions. For example, in order to get construction started the buildings had to be designed before all phases of the manufacturing process were elaborated, and it was found afterward that somewhat different arrangements in this or that detail would have been better. That an efficient ship-producing machine was created under these conditions, and made ready for service in phenomenally short time, testifies to the value of the combination of able men concentrated on the work.

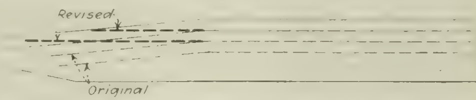


FIG. 4. STRAKING TO INCREASE AMOUNT OF MULTIPLE PUNCHING

In the development of the process, study based on shipbuilding experience early indicated that continuous movement of the file of ships was not practicable, as the individual operations in the hull assembly are necessarily slow and involve large quantities of material. Step-by-step movement took its place, the string of hulls to be shifted forward one ship's length at a time. Seven stations were decided upon; this number was not dictated by inherent requirements of the ship-assembly process, but rather by the anticipated rate of working and the space conditions at the site. The three separate assembly buildings were joined into one, with a material-supply bay between and joining the assembly bays (line bays). Preassembly of parts then came to be recognized

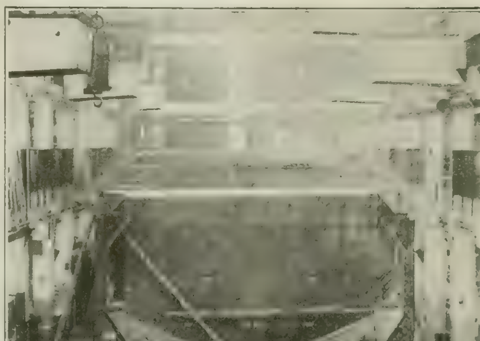


FIG. 5. PATTERN "EAGLE" BUILT IN AUTOMOBILE WORKS TO HELP IN DEVELOPING SHOP DETAILS

as an important agency of rapid working, and a length of about 200 ft. was added at the incoming end of the assembly shop for doing this work. The progressive or step-by-step method was extended to the fitting-out work, since this half of the manufacture involves as much labor as the hull construction and brings into action even a greater number of trades. Finally, after the shop was already in service, the order of assembly operations was fixed with regard to proper balance of time at the stations, as determined by actual experience in the shop. For fabricating the hull material, single punches were depended upon when the pattern ship was built. Later, machines were considered which would punch a group of holes at a time, the plate then to be shifted ahead by the length of a group. The example of bridge-shop practice prevailed, however, and multiple punching was adopted —using presses having a transverse gang of punches capable of being actuated simultaneously or in sets, and a rack for longitudinal spacing. The equipment plan of the punch shop was revised accordingly, after the building was under construction. Further development occurred later in balancing up the number of multiple punches and of single punches (for doing the work to which multiple punches were not adapted).

FIG. 7. AT THE MIDDLE OF THE EAGLE PLANT—GREAT TRANSFER TABLE RECEIVES THE ASSEMBLED HULL, PASSING OUT THROUGH ONE OF THE THREE STEEL ROLLING DOORS, AND DELIVERS IT TO THE LAUNCHING PLATFORM

An important contributory factor in the success of the plant development lay in the large resources of the Ford Motor Co. in machines and factory equipment. Thus, the whole shop-crane installation of the River Rouge factory was brought together from Ford assembling plants all over the country, and the multiple punches which form the backbone of the fabricating end of the plant were fitted up from presses taken out of the sheet-metal department of the Highland Park automobile works.

Straight-Line Plant and Straight-Line Process

Lying along the left bank of the widened and canalized River Rouge, some miles from Detroit, the plant extends in a straight line down stream (See Fig. 6). Starting at the north end, its successive parts are the plate-storage yard, the punch shop and, across a transverse road, the huge assembly shop which constitutes the main feature of the plant; just beyond this shop and a short distance to the right is the launching platform to which the hulls are moved by a transfer table (Fig. 7). A few hundred feet downstream begins the concrete dock and ore storage space of the Ford blast-furnace plant. On this dock has been erected a long, narrow fitting-out shed, in two sections, each about 1000 ft. long, which hold the machinery and equipment for the finished hulls lying alongside the dock and moving forward in successive steps to receive different parts of the equipment. Supply warehouses nearby feed the fitting-out sheds.

Direct forward movement of material, in the least number of separate moves, characterizes the plant. From the storage yard, plates and shapes are moved into the punch shop partly by hand and partly by locomotive crane and cars. After the marking, punching and other fabrication, the material is loaded on short railway trucks moved by hand along one of four longitudinal tracks leading into and along the supply bays of the assembly shop. It goes directly to the place where it is to be assembled in the ship, and is unloaded and piled alongside that point. An exception is made in the case of material for preassembled parts, such as frames, deck sections, bulkheads and the like, which is unloaded at the head of the assembly shop and is bolted up and riveted there. The completed parts are then moved down the shop to the proper station by bridge cranes spanning the assembly bays.

Thus, the material and supplies, having once reached the punch shop or the warehouses, undergo in general but a single move to a point directly adjacent to the place of assembly in the ship. From there a short cross-transfer only is required to put them in final position.

Building up a working mechanism for carrying out this revolutionary process of ship construction was done with equal originality and disregard of precedent. Fully as impressive as the boldness of the designers, however, is the great size of the units of the plant. The punch shop in which material is fabricated ready for erection in the hulls is the largest shipyard punch shop in existence. The assembly shop contains 21 shipbuilding berths under one roof (Fig. 1), and in addition a pre-assembly space that in itself is as large as many bridge shops.

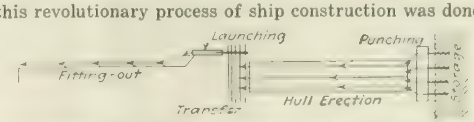


FIG. 6 EAGLE PLANT LAID OUT ALONG A STRAIGHT LINE

The launching platform, conceived by W. B. Mayo, chief engineer of the Ford Motor Co., is the equivalent of a 200-ft. railroad bridge mounted on hydraulic jack supports capable of moving it up and down through a range of 20 ft. Of the same magnitude and difficulty was the task of providing for boiler and turbine manufacture, after the development problems of the power plant had been worked out.

A review of the hull-building operations of the "Eagle" factory, with sketches of some of the special devices employed, will follow in another issue. How the plant was built in so short a time, by concentration of construction resources and by careful organization of methods, will be told by the contractor and the steel erectors.

Discusses Prevention of Cracks in Hard Pavements

William C. Perkins Suggests Hollow-Tile Course to Reduce Heat Conductivity of Slab and Facilitate Drainage

ELIMINATION of longitudinal and other cracks produced by frost heaving in hard-surfaced pavements was discussed in a paper by William C. Perkins, chief engineer of the Dunn Wire-Cut Lug Brick Co., read before the recent meeting of the American Society for Municipal Improvements, at Buffalo, N. Y. Mr. Perkins suggested the use of a hollow-tile bottom course, which he believes would give sufficient insulation between the subgrade and the atmosphere to prevent serious freezing and consequent heaving. The course would also give immediate drainage for all water collecting under the slab, and at the same time give a foundation nearly if not quite equal in strength to the same depth of concrete. The following is an abstract of his paper:

Many brick and concrete pavements, especially in Northern latitudes, develop unsightly cracks along the center line of the pavement, which mar the otherwise satisfactory surface. These cracks may not lessen the durability of the pavement, and they are easily taken care of at small expense; but they are defects which we should endeavor to overcome by improved construction methods.

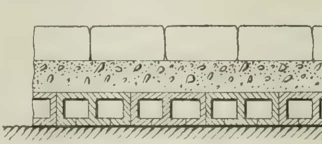
Study of longitudinal cracks in hard-surfaced pavements has evolved several theories of the cause. The generally accepted cause is the pressure exerted against the under side of the artificial foundation by the freezing of water in the underlying subgrade. Undoubtedly other conditions, such as traffic or soft subgrade, may be a contributory cause of cracking; but in the writer's opinion, 90% of longitudinal cracks are the result of frost heaving.

How can this frost action be prevented? We have said in the past, "Drain! Keep the subgrade dry." We have done so, and though many different forms of drainage have been used, we still have longitudinal cracks, many times directly over our elaborate system of drainage. Underdrainage is unquestionably advantageous in lowering the water table, but present methods fail to keep subgrades dry, particularly in clay soils and in soils susceptible to capillarity. While our present drainage system does not prevent cracks due to frost, it does tend to prolong the life of pavements. Nevertheless, in spite of drains, a certain amount of water reaches the earth underlying and supporting the artificial foundation, and successive freezing and thawing, especially in the early spring of the year, cause upheaval of the subgrade. As the pressure cannot go downward on account of the frozen ground, it must extend upward. This upward thrust breaks the pavement.

We do not know exactly how the pressure acts; we have not enough data on the subject to warrant positive conclusions. Undoubtedly, after the war, when engineers will have more time for research work, tests will be made to determine exactly how the resultant forces are distributed through the pavement. All we really know now is the result.

Evidently, the remedy must be found in a foundation design. Can we construct a foundation which will, either entirely or in some measure, overcome the destructive action of frost? As a means for accomplishing this purpose, the foundation design of which a drawing is shown in the illustration is suggested for consideration.

Upon the prepared subgrade lay a course of two-duct tile 4 in. in height, outside measurement. The surface measurements could be any standard size, but the



HOLLOW TILE SUBFOUNDATION INSULATES AND DRAINS SUBGRADE

writer would suggest 8½ in. wide by 12 in. long. The tile may be made of any desired material, such as concrete, vitrified shale or clay, and of any shape or form. Complete this foundation with 2 in. or 4 in. of concrete or other suitable material. We have then prepared a 6- to 8-in. foundation upon which to place our wearing surface of any standard material that is used for paving.

By the use of the tile in the artificial foundation we endeavor to minimize the force of the upward pressure of a frozen subgrade and assert that its use will produce results as follows:

1. The tile will act as a nonconductor of heat between the ground and the surface of the paving. The air within the ducts of the tile, serving as a nonconductor prevents the frost from penetrating through the pavement to the subgrade, or, in more technical language, prevents the escape of heat from the earth. In many sections this type of construction may prevent actual freezing of the subgrade, while in extreme Northern sections it will materially reduce such freezing of the subgrade.

2. When the earth, or subgrade, does freeze, notwithstanding the heat insulation of the tile, we believe that the upward pressure of the frozen subgrade will be dissipated by the eventual breaking of the tile, and that the force or explosion will be compensated for by the air space and not be transmitted to the paving above. Should the tile be too strong to break under pressure

of a frozen subgrade, the bottom of the tile, under the air spaces, could be "scored," thus providing a weak spot to break under this upward pressure. The super foundation and the wearing surface will be sufficiently strong to bridge over any breakage of the bottom of the individual tile under the air-space sections, since the walls and partitions of the tile will remain intact and afford ample support to the super-foundation.

3. The tile, not having the joints cemented, will also act as drains to carry off any ground water or water drawn into them by capillary action, thus lessening the hazard of cracking due to the upward force exerted by frost in the subgrade. They may be laid longitudinally, transversely or diagonally. If they are laid either transversely or diagonally the water will be carried to the curb or edge, where it can be taken care of by means of longitudinal drains or French drains of gravel or stone. If the tile are laid longitudinally the water can be taken care of at regular intervals by cross drains of tile or by French drains of gravel or stone. The grade and cross-section of the improvement will determine these details.

It is difficult to estimate comparative prices in these abnormal times, but, basing estimates on available data, the 4-in. tile should not cost more than 4 in. of concrete in place, and if constructed as suggested the tile and concrete foundation should be able to carry at least the same load as if the foundation were constructed entirely of concrete or of a material of equal load-bearing strength.

The type of foundation suggested as a means of preventing longitudinal cracking of hard-surfaced pavements is the result of study and experience, and while it has not been subjected to the final test of practical service under all kinds of climatic and traffic conditions, the writer has sufficient faith in its utility for the purpose designed to have the type of construction protected by patent.

Interpolation of Contours

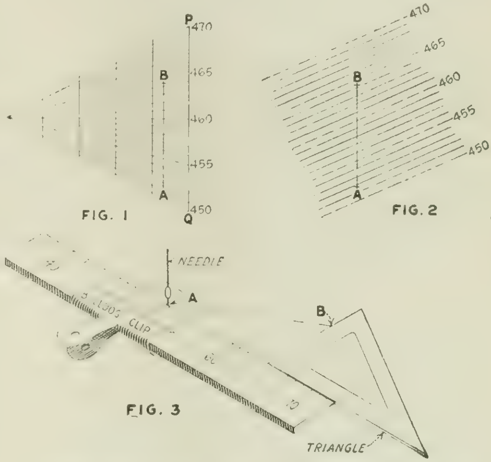
Use of Triangle Sliding Along Scale Found Easier Than Pricking of Points Through Ruled Tracing Cloth

By Ian M. Sutherland
Novar, Dandenong, Victoria, Australia

There are many ways of interpolating contours, and perhaps no new one has been devised in a decade. But time can be wasted by a clumsy method, and textbooks dismiss the subject so briefly that an occasional review of it in this journal seems in order.—Editor.

Contour lines between two points A and B whose elevations are known can be interpolated in so many simple ways that most textbooks of surveying do not mention them, but when many contours have to be plotted the choice of a method is worth consideration. The writer has found the use of a scale and triangle most satisfactory.

In a method described by J. Whitelaw, Jr., in his book on surveying, a diagram similar to Fig. 1 is made on tracing cloth. Suppose, for example, that the elevation of A is 451.65 and that of B is 464.31. Take the lowest dotted line to represent the 450 contour, the next dotted line 455 and so on, and place the tracing on the plan so that the point A is covered by a point on the tracing that represents El. 451.65, and B by a point that represents El. 464.31. The tracing must be so placed that the line PQ on the tracing is parallel to the line AB on the plan.



THREE DEVICES FOR INTERPOLATING CONTOURS

When the tracing is in the right position the contours can be marked where they cut the line AB by pricking through the lines on the tracing.

The writer must admit that he has found the three simultaneous adjustments of the tracing on the plan so difficult that he has never used this method.

A better method was described in some periodical within the past ten years. A diagram similar to Fig. 2 is made on tracing cloth. As before, suppose that the elevations of the points A and B on the plan are 451.65 and 464.31. Take the lowest dotted line as El. 450, the next dotted line 455 and so on, and with a pricker mark a point on the tracing to represent El. 451.65, set this point over A on the plan, and drive the pricker slightly into the plan. Then swing the tracing cloth round on the pricker through A as a pivot until the point B is covered by a point on the tracing to represent El. 464.31, and prick the intersections of the contours with the line AB through the tracing as before.

The advantage of this method over the first is that only two adjustments of the tracing are required instead of three, and that when one has been made it is not disturbed while the other adjustment is being made. Of course, for a small-scale plan consecutive lines on the tracing can be taken to represent 5-ft. instead of 1-ft. contours, and it is a convenience to have one or two tracings with different spacings of lines so that the intersections of the tracing lines with AB will not be too oblique.

The writer used this method for some years and found it satisfactory until the job of plotting contours between a few thousand tacheometer levels written in very small pencil figures on a small-scale plan was given to him. There it was almost impossible to read the

figures through the tracing cloth. After several trials a method requiring the following instruments was adopted: (1) Ordinary draftsman's scales; (2) a strip of thin sheet metal (aluminum does well) cut to convenient shape, bent round a scale so that one edge can be set to any reading on the scale, and clamped in place with a small bulldog spring clip (the metal should project about ½ in. beyond the edge of the scale; a piece of paper pasted inside the strip of metal prevents it from staining the scale); (3) a few fine sewing needles, each with a drop of sealing wax about ½ in. from the point to serve as a handle; (4) a small celluloid triangle.

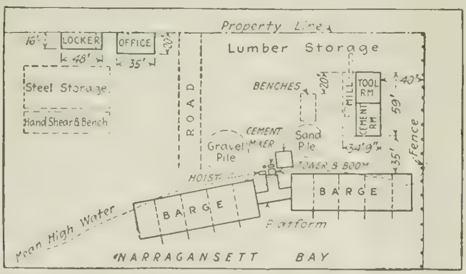
The drawing shows clearly how the interpolating is done. A needle against the scale holds the position of one point, the triangle with the base against the scale passes through the other point and the location of the contour points is found by sliding the triangle along the scale.

This last method is less trying to the eyes than the two preceding ones, because the figures and points on the plan can be seen directly instead of through tracing cloth, which is soon made opaque by handling. There is less chance of large errors, because a properly figured scale is used instead of a tracing that is usually without figures; and, finally, the method is more convenient because the most suitable one out of a number of scales can be used instead of a specially ruled tracing that will sometimes give intersections too oblique for accuracy unless a number of tracings of different scales are available.

Concrete Barges Built True to Design Dimensions

Special Spacers Fix Wall Thickness and Rod Location—Boston Construction Firm Starts New Concrete Shipyard at Providence, Rhode Island

CARE in placing steel and making and placing forms so as to insure the structure exactly following the design dimensions, is a feature of the construction of concrete barges in the yard of the Aberthaw Construction Co., Boston, at Fields Points, Providence, R. I. The accuracy of this work is considerably in advance of previous practice in ordinary concrete operations. At present only lighters designed by the company are being built at the yard, but ship construction is anticipated, and the yard layout is designed for the economical conduct of such work.



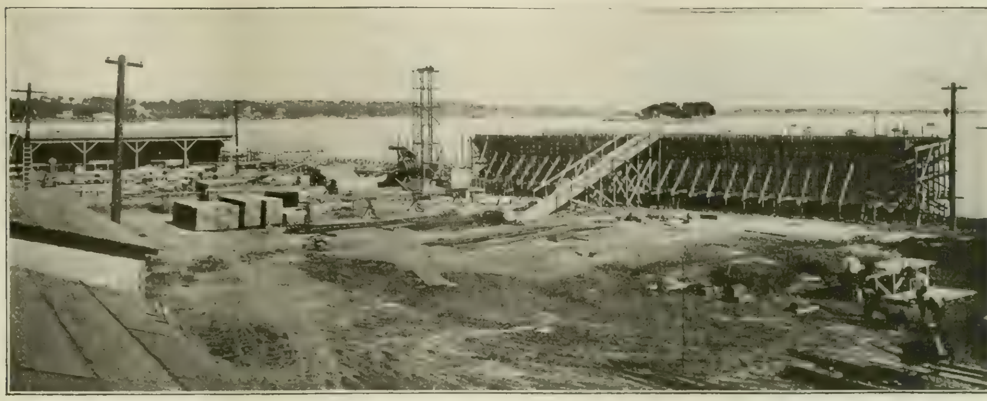
YARD AT PROVIDENCE, R. I., WHERE CONCRETE BARGES ARE BEING BUILT

The barges which are being built are 112 ft. over all, have 34-ft. beam and are 11½ ft. deep. Their details are given in an accompanying drawing. The draft empty is 3 ft. 9 in., and loaded 9 ft. Four transverse and two longitudinal bulkheads extend from the bottom of the boat to the deck, subdividing it into 15 water-tight compartments of approximately equal cubical capacity. The frames are spaced 4 ft. on centers transversely, the junctions of the frames, bulkheads, etc., being made with proper angle fillets or haunches. The deck is without camber, and a timber bulkhead, with sidewalls 2 ft. high and end wall 5 ft. high, incloses an area 90 x 30 ft., provided to assist in holding the deck load. The compartments themselves are adapted for carrying fuel oil. On spacings of 3 ft. 9 in. transversely, stiffeners 5 in. wide and 5½ in. deep extend out from the longitudinal bulkheads. Similar stiffeners spaced in line with the frames, that is, 4 ft. c. to c., brace the transverse bulkhead. The deck is 4 in. thick and the bottom and sides are 3 in. thick, both being reinforced with transverse and longitudinal rods as shown in the drawings. The minimum spacing of the outside of these rods from the surface is 1 in. A similar distribution of steel is in the 3-in. bulkheads.

The new yard is on Narraganset Bay where, by dredging, 4 ft. depth at low water has been provided alongside the two building ways from which the barges will be side launched. Shops for the construction of the forms and fabrication of the steel form the building equipment, and the concreting plant is a mixer and hoist located between each two barges, as shown on the drawing of the yard.

As shown in one of the views, the building ways are, in effect, the framework on which the forms are set. That is, the lagging which is the bottom form of the barge rests on joists and girts spanning the tops of posts which in their turn foot on sills 8 to 12 in. wide by 6 in. thick, laid in trenches of a sufficient depth to provide a bearing value of four tons per square foot. Throughout this framework a variation from level of more than ¼ in. is not allowed.

In the construction of the building ways and the forms the sills, posts and girts are first erected true and level, the sills being firmly tamped into place. Joists are then carefully spaced, and lagging for the floor is laid in place. The outside wall panels are then erected and braced so that they will maintain a position exactly corresponding to the outline intended for the boat, and bolts, wooden washers and cast-iron spacers are located in positions ready to receive the reinforcing steel. After the reinforcement has been placed in the floor and sides, concrete blocks, shown in one view and drawing, for supporting the inside forms, are placed and floor forms are erected. The inside forms for walls and the forms for bulkhead walls and stiffeners are next put up, care being taken that the inside panels on every wall stop at the horizontal construction joint indicated by the end of the first day's concreting, which



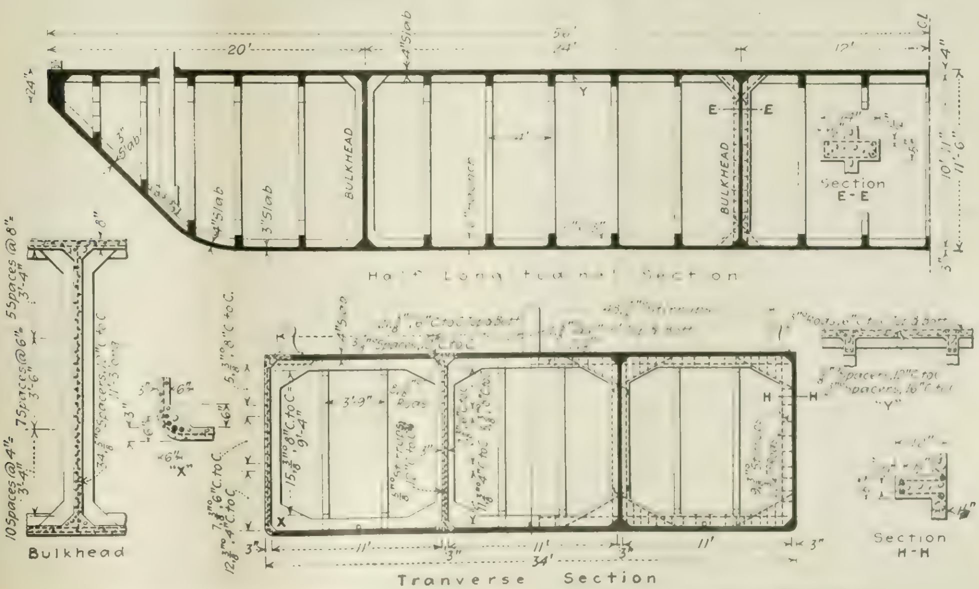
CONCRETE BARGE ON SIDE-LAUNCHING WAYS AT PROVIDENCE SHIPYARD

as a rule is about 3 ft. in lift. Forms for the posts, deck beams and sufficient deck joist to act as deck staging are then erected and braced rigidly in position. The joist are used to support the runway for buggies or wheelbarrows used in distributing the concrete. When concreting has proceeded up to the construction joint and has set properly, the inside forms are completed and the deck panels placed ready to receive reinforcement and concrete.

The forms themselves are in panels and in two types, one for the outside and one for the inside. On the outside every precaution is taken to insure a smooth, impervious surface; on the inside absolute smoothness is not so important. The forms are of sound, good quality spruce, extra cleating being used to prevent warping and twisting as far as possible. Panels are all surfaced with a coating of 26-gage galvanized iron, the sheets being applied butt-jointed and tacked in position, the metal stopping exactly at the edges of the panels. All exposed woodwork on the forms is painted with one cast of boiled linseed oil as soon as the panels are framed, in order to make them as impervious to weather conditions as possible.

The greatest care is taken that the outline of the barge is maintained in the plan, that the outside forms are smooth and as nearly perfect as possible, that all joints on the outside forms are filled with putty before concreting, and that the wall thicknesses, beam and stiffener sizes and floor deck thicknesses conform exactly to the specifications. All wall panels remain in place not less than one week after the concrete is poured; floor and deck panels require two weeks.

Proper thickness of walls and location of steel are insured by special separators designed for this purpose.



500-TON CONCRETE LIGHTERS BEING BUILT BY ABERTHAW CONSTRUCTION COMPANY

In the side walls and bulkheads, which are 3 in. through, the tie-bolts holding the forms are held in position by the cast-iron separator shown in one of the drawings. These separators are threaded, as shown, on either side to a depth of about ½ in., with a solid steel lift between

INTERIOR OF BARGE BEFORE CONCRETING. NOTE CONCRETE FOOT BLOCKS FOR DECK FORM POSTS

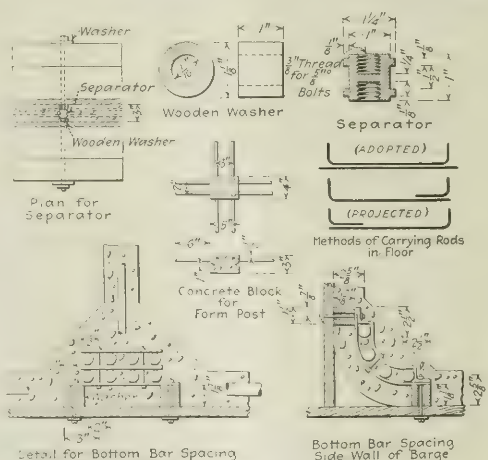
the threaded portions so that there is no possibility of the tie-bolts working through or of the concrete seeping through the separator. On either side of the separator is a round wooden washer. In the erection, the outside tie-bolt is fastened to the outside forms, the wooden washer slipped over the bolt and the cast-iron separator screwed on. The steel is then placed in position and the upright bars are fastened between the flanges of the separator. These upright bars are wired to the separator, the remainder of the steel is placed in position, and the wooden washer on the inside is placed. The outside form is then erected and the inside tie-bolts are screwed home in the separator. When the forms are stripped a slight blow with the chisel removes the wooden washers, which are made with the grain of the wood running lengthwise. The holes are then filled with grout and smoothed off.

In the handling of the larger reinforcing bars a different type of separator is used. This is shown also in the drawing. It consists of a set of stove bolts with plate spacers between the bars. The wooden washers are of the same type as in the small separators and are removed in the same manner. Where the side wall meets the bottom slab a similar scheme is employed. Running through the bottom slab and into the sides are transverse bars shaped as shown in one of the sketches. These bars presented considerable difficulty in bending, and a variation of ¼ in. made them impracticable. To straighten them and to secure accurate bend, they were heated before being bent on the job. An alternative scheme in which there were overlaps which were wired together was found objectionable because it brought so much steel in a narrow space that it was almost impossible to fill the interstices. No difficulty was met elsewhere in bending the steel, and the separators have proved quite acceptable in getting accurate placing.

The concrete is mixed in a four-bag mixer with side loader for charging, and is spouted from a tower hopper, by means of a short section of chute, to a distributing point, or to buggies or wheelbarrows at the end of the boat at deck level. From this point it is wheeled along the staging at deck level, where the placing gang is working, and run through a short chute to a mortar box at the level of the placing gang, where it is shoveled into place in the forms.

Concreting proceeds continuously from the point at which it starts, working constantly around the edges of the material already deposited so that nowhere does any section stand, in wall or floor, for more than one-half hour before new concrete is placed. Where a definite joint is provided, the surface is carefully picked to remove all laitance. It is washed thoroughly clean and painted with a coat of grout, consisting of neat cement and water mixed to the consistency of cream. Concreting proceeds before the grout takes its initial set. While the concreting is being done the forms are constantly tapped with wooden mallets. The outside of the boat is painted with one coat of asphaltic paint.

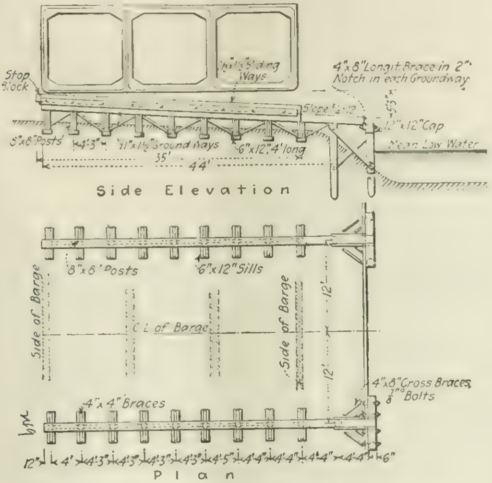
Launching ways for side launching are provided independent of the building ways. Four groundways extend under each of the transverse bulkheads. These are 11½ in. thick by 11 in. deep, of long-leaf yellow pine and are supported on posts on the ground end and on piles over the water. They are set, before the construction of the barge begins, to a slope of ¾ in. to the foot. Sliding ways are made of 11½ x 11½-in. yellow pine, with 4 x 8-in. guides bolted on either side. When



SPECIAL SPACERS HOLD FORMS IN LINE

ready to launch, the form panel, 4 ft. wide, under each transverse bulkhead is removed and the bottom thus exposed painted. The ground ways are thoroughly greased on top and the upper 3 in. of the side. Sliding ways are then placed in position, with stop blocks, as shown, at the upper end.

Building jacks are blocked up on cribs of railway ties on either side of each launching way and longitudinal bulkhead of the barge, making six jacks at each transverse bulkhead. The barge is then jacked up enough to permit the removal of all forms, great care being taken when the jacking is done to obtain as nearly as possible equal distribution of the load on the several



CONCRETE BARGES AT PROVIDENCE YARD ARE LAUNCHED SIDEWISE FROM THESE WAYS

jacks. One man is stationed at each screw and the bars turned a quarter turn at a time in unison, until the barge is clear of the building ways. The remainder of the barge is then painted and when dry lowered by the jacks to the sliding ways which have been placed in the meanwhile. After the barge has been lowered to the sliding ways and is ready to be launched, all four stop blocks are driven out or sawed off.

In the designing of the barges the bottom slab and frames are planned to carry an upward pressure of water equal to a head of 11½ ft., the side walls and frames being designed on the assumption that the water may be flush with the deck. It is intended that the deck frames will take a live load of 500 lb. per square foot uniformly distributed. In the design of bulkheads it is assumed that any compartment may be filled with water. Fiber stresses in the concrete are based on the expectation of using a concrete which will develop 4000 lb. per square inch in 28 days, and the maximum stress of the steel is assumed to be 16,000 lb. per square inch.

The concrete is made up of one part portland cement to one part of sand and two parts of stone. The coarse aggregate is a broken trap rock sizing up to ⅝ in. in diameter, and the resulting concrete weighs about 150 lb. per square inch in 28 days, and the maximum stress of water is avoided. Each batch receives not less than 2 min. of actual mixing after all the materials are in the mixer. The stone and a portion of the water are first placed in the mixer, which is turned over sufficiently to scour the stone clean, the aggregate, cement and water being then added. The amount of water to obtain the best result is approximately 9% by weight of the cement and aggregate. Volumetric and weight tests are made to determine maximum density.

Steel is of round bars of mild structural grade. For the longitudinal girders the rods are in one continuous length, obtained where necessary by butt welding two or more bars. Care is taken that the welds are staggered, no two being within 40 in. of each other. Steel bars in the transverse frames are made continuous in like manner. The crossing of each bar with another is wired with soft, annealed, iron wire wrapped around and twisted tight.

System Controls Openings in City Pavements

City Engineer Does Backfilling and Repair Work With the City Forces—Blank Forms Used with Plan Are Reproduced

By D. B. Davis
City Civil Engineer, Richmond, Ind.

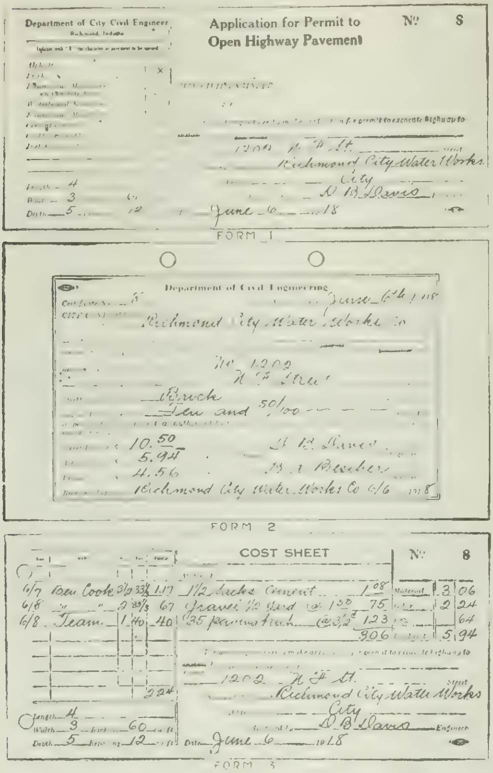
THE proper control of openings in street pavements at Richmond, Ind., is effected by a system of permits deposits and refunds authorized by the city council. The work of backfilling and repaving is taken over by the city and put under control of the city engineer, who does the work by force account, with city employees.

The city council has passed many ordinances, prohibiting the opening of newly paved streets for a period of five years after building. It has also required that gas, water and sewer service pipes be properly laid before permanent pavements are built. Regardless of these precautions, openings are often necessary for one cause or another, and if the erection of a new building depends on obtaining a new service connection, the five-year provision is nullified.

Openings in street pavements being a necessary evil, the engineer should aim to control them so as to guarantee the replacement of the surface in as good condition as it was before opening. Not only must proper care be taken in repaving, but every foot of backfill must be replaced and tamped in such manner that no settlement will occur. A firm foundation is more important in obtaining permanent construction than a smooth surface.

To expect public utility companies and sewer contractors to take proper care in doing this work is useless. It is necessary to eliminate the universal desire on their part to do the least work for the most money. It was our experience that, generally, little heed was paid by service companies to our request for the repair of sunken ditches. While they were getting ready to do so, traffic was bumping its way over the street, and councilmen became eloquent in their criticism of the administration for not compelling those responsible for bad conditions to make the streets at least passable. These considerations induced the writer to draw up an ordinance which was finally passed and which is giving excellent results.

It requires any person, firm or corporation desiring to make any excavation in any paved street first to make application to the city engineer, giving the location, purpose and approximate dimensions of the excava-



FORMS USED FOR REGULATING STREET TRENCH REPAIRS. ACTUAL SIZE OF FORMS 1 AND 2 IS 4¾ x 9 INCHES; FORM 3 IS 5¾ x 8¼ INCHES

tion. This application is made in duplicate upon a form as reproduced, one copy being given to the applicant and the other being filed. After the application has been made a certificate is filled out, stating the engineer's approximate estimate for backfilling and relaying the pavement. To this 12% is added to cover tool expense and maintenance. The table shows the approximate costs used for estimating, which were incorporated in the ordinance. The applicant pays the controller the amount stated on the certificate and is then entitled to receive the permit. The certificate is also reproduced herein. The applicant may now make such excavation and lay such service pipes as are indicated on the application, but must make no backfill.

After the pipes have been laid or repaired the city engineer is notified by the applicant and the city does the remainder of the work with skilled workmen especially selected for the purpose. They make a thorough inspection of the pipes before covering them. Accurate costs are kept on the "cost sheet" shown with this article. It is a triplicate of the application form, the name of the applicant and location of the excavation being a carbon copy.

The total cost of all the work incidental to backfilling and replacing the surface, plus 12%, is entered on the certificate. The difference between this amount and the original deposit is the "refund" to the applicant. The ordinance states that if the indemnity deposit be insufficient the applicant shall be liable for the deficiency. The table of estimates was purposely made high enough to cover any emergency which might arise.

Although objectors to the ordinance asserted that the cost would be doubled if the city's men did the work, this has not proved to be the case, but a material saving to the applicants has been effected. This result was obtained because the writer went outside the list of regular city pensioners to secure men who were efficient; a habit which city officials must acquire if they expect to execute work at low cost.

TABLE FOR ESTIMATING COST OF REPLACING MATERIAL IN TRENCHES

Backfilling open trenches, per cubic foot	$0 03
Backfilling tunnels, per cubic foot	04
Repaving sheet asphalt, per square foot	1 50
Repaving brick, per square foot	.75
Repaving concrete (non-reinforced), per square foot	.60
Repaving concrete (reinforced), per square foot	.75
Repaving macadam, per square foot	.30
Repaving cement sidewalk, per square foot	.25
Repaving brick sidewalk, per square foot	.20
Repaving gravel sidewalk, per square foot	.10
Repaving boulder alley, per square foot	.25

The greatest advantage gained by the ordinance was that it places the responsibility for the maintenance of the streets where it belongs, namely, on the city street department, which can now see that its pavements are safeguarded. Naturally, the success of the system, like the success of any other undertaking, depends upon the persons engaged in its direction. We have found that it fulfills a long felt need, and we can recommend it to places which are experiencing troubles similar to ours.

Pavement Gage Measures Surface Irregularities

Study of Specifications for Smoothness Leads to Invention of New Device—Present Requirements too Severe

By W. M. Kinney
Engineer, Promotion Bureau, Universal Portland Cement Company, Chicago

A PAVEMENT gage which will measure accurately the unevenness of pavement surfaces has been developed by the Universal Portland Cement Co. The belief that present paving specifications are unreasonably severe, if not impracticable, led to an investigation of the smoothness of surfaces of higher class, and a gage was originated to do the measuring. The work, as far as it has progressed, indicates as a desirable specification that no variations greater than ¼ in. in 3 ft. nor ⅜ in. in 6 ft. shall be allowed.

Unevenness in pavements interferes with the smooth riding of vehicles and with satisfactory drainage. To avoid these objectionable results, the amount of variation that will be allowed is often stated, but the specification is usually so worded as to be indefinite. The question then arises as to how much variation from the specified contour should be permitted, and what means should be used in checking up the finished surface. The standard specifications of the American Concrete Institute for concrete pavements require that "the finished surface of the pavement shall not vary more

than ¼ in. from the specified contour." This requirement is very strict and, if interpreted literally, requires careful levelling to determine whether it has been fulfilled. Other specifications contain a clause stating that "the finished surface shall not vary more than ¼ in. in 3 ft. from the specified contour." Usually nothing is said as to how variations shall be measured, and until that is done the requirements are uncertain, because the appearance, size and number of irregularities depend on the method of measurement.

In the "Proceedings" of the American Society of Civil Engineers of December, 1917, a committee on materials for road construction and on standards for their tests and use recommends the following:

"In a newly completed pavement the variations from a straightedge or templet, 8 ft. in length, should not exceed ⅛ of an inch for asphalt block, bituminous concrete, brick, cement-concrete, sheet asphalt and wood-block pavement."

In this specification the amount of allowable variation and the method of measuring are given, but the practicability and necessity of such a requirement are open to question. On a cement-concrete pavement where a templet is used, it may be possible to obtain so even and true a surface, but only with exceptional care. The difficulty of carrying out the above recommendation on pavements where heavy rollers are used to obtain the final surface should be obvious. Even if it were possible to get such results, it would be neither economical nor of special advantage to attain such a degree of refinement.

In order to obtain definite information as to the evenness of surface usually attained in construction, and to determine what variations are consistent with smooth riding and satisfactory drainage, an investigation of pavements in Chicago and its vicinity is being conducted by the engineers of the Universal Portland Cement Co. Thus far much of their attention has been taken up in selecting the best method for measuring the irregularities, and various methods have been tried and found unsatisfactory.

RESULTS OBTAINED BY GAGING TWO EASY RIDING PAVEMENTS EACH ONE YEAR OLD

Kind of Pavement	Gage, Length	Number of Variations per Hundred Feet Equal to or Greater Than ⅛ In.	¼ In	5/16 In	⅜ In
Asphalt,	3		0 33		
Asphalt,	4		0.82		
Asphalt,	5		2 50		
Asphalt,	6	18 00	3 00	1 16	0 33
Total,		18 00	6 65	1 16	0 33
Concrete,	3		0 0		
Concrete,	4		0 16		
Concrete,	5		0 33		
Concrete,	6	16 00	1 00	0 16	0.0
Total,		16 00	1 49	0 16	0 0

The method of measuring irregularities is of great importance. Equipment that may be used with ease is desirable, and at the same time the apparatus must measure accurately both humps and depressions. The former are particularly important, as it is the humps which cause the jolting. In the investigation mentioned above five methods have been tried—level readings, 6-ft. straight-edges, bronze wire, fish line, and a specially constructed pavement gage. While the level readings gave good results, they were too slow and expensive to adopt as a standard procedure. With both the wire and the fish line methods, a wedge gage was used to determine the size of the irregularities. By stretching the line tight and using intermediate weights, any desired gage length could be obtained. The difficulty with either the wire or fish line is that it is supported at the high points and the contour of the surface may be such that over appreciable humps the line is supported for the entire gage length. The profile, which shows actual conditions found in levelling, and which was later tested by means of a fish line, illustrates this difficulty. The use of the straight-edge is open to the same objection, and it has the additional disadvantage that only one gage length can be used.

USING PAVEMENT GAGE TO MEASURE IRREGULARITIES

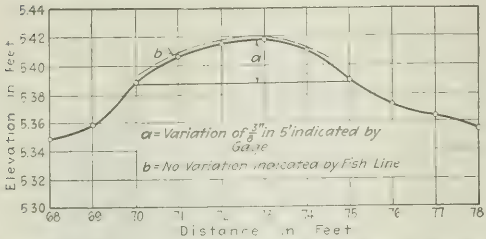
The pavement gage shown in the photograph has been found to measure all irregularities, giving results that check well with the profiles, and with the variations shown by the wire and fish line at depressions. With a 6-ft. gage length the bar deflects approximately 1/32 in. but with the shorter length the deflection is negligible. A graphical record of the total variation is made by a hard compass lead which is held in contact with the indicator diagram paper by a spring. The point is attached to an arm which rests on a roller and which is free to move vertically as it is pushed along the horizontal bar. This gage can be moved continuously along the pavement and will give an accurate and connected profile of the surface.

The table printed with this article records the variations on two pavements, each one year old and considered high class. From these results it will be seen that a variation of ⅛ in. in 6 ft. is very common, and that an irregularity of this size does not cause unpleasant jolting. It should be remembered that all variations were counted, whether humps or hollows, and that if tests had been made with a straight-edge only the hollows could have been measured accurately. Inasmuch as the pavements recorded were considered excellent, it is apparent that a specification limiting variations to ⅛ in. in 8 ft. is unnecessarily strict.

Further tests are now under way and will, it is hoped, establish definite conclusions as to desirable allowances for vertical variations in pavement surfaces. A tentative recommendation that no variations greater than ¼ in. in 3 ft. nor ⅜ in. in 6 ft. be allowed, is indicated. In this connection, it may be stated that the variations in the 2-ft. and 4-ft. lengths may be more important than those in the longer gage length,

for it is thought to be the abrupt changes that cause most of the jolting and vibrations.

No great attention has been given to variations of



HUMPS IN PAVEMENT NOT FOUND BY STRING METHOD

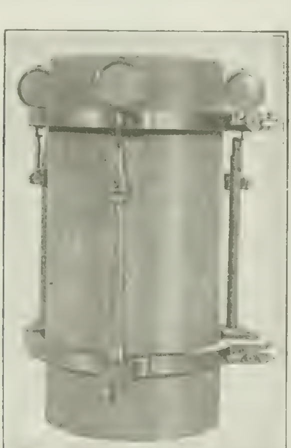
cross-sections. The cross-section is apt to vary more than a longitudinal section, especially if a variable crown is used. However, the irregularities are not so important, since depressions and humps will be found by the test for longitudinal variations. It will probably be found sufficient on the usual low-crown pavement to specify that the section shall be convex upward at every point.

New Compressometer Devised to Measure Elasticity Modulus

By Herbert A. Davis
Assistant Engineer Physicist, Bureau of Standards, Washington, D. C.

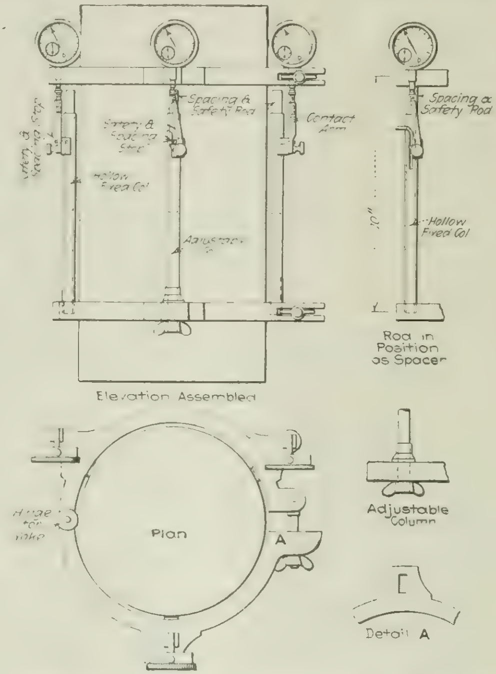
TO DETERMINE the modulus of elasticity of concrete a new compressometer has been developed by the writer at the Bureau of Standards. This instrument is designed for concrete cylinders 8½ in. in diameter by 16 in. high. The deformations are measured over a 10-in. gage length. Three Ames dials reading to 0.0001 in. are used instead of two in order to give a good indication as to the uniformity of travel of the screws of the testing machine in the application of the load.

The instrument is so designed that the yokes can be properly spaced by a part of the instrument itself. To



COMPRESSOMETER IN PLACE ON TEST PIECE

prevent serious damage to the instrument in case of a sudden breakage of the concrete cylinder means were adopted by which the contact arm pressing against the rod of the Ames dial would be removed before the dial



COMPRESSOMETER FOR DETERMINING MODULUS OF ELASTICITY ON CONCRETE SPECIMENS

rod had completed its normal travel. To minimize the damage the pin in the yoke clamp was made sufficiently small so that this part would be the first to give way should a sudden break occur.

Water-Pipe Leak Makes Novel Fountain

Water spouting from the top of a trolley pole in North Ave., Chicago, was a "freak" leak recently dealt with by the Department of Public Works. This pole, in the middle of the street, was set in a concrete base. It was found that it rested on an old lead service pipe which it eventually cut or broke, the water passing up through the pole until it overflowed at the top. This information and the accompanying view were furnished by R. L. Spalding, engineer of water-pipe extension, who states that while leaks of many kinds have been found, this is the first in which the water has been found coming from overhead.

LEAK UNDER TROLLEY POLE MAKES FOUNTAIN

Unified Corporate Control of the Railways After the War

Would Eliminate the Wastes of Competition Without Risking the Dangers of Permanent Government Operation

By A. C. Dennis
Consulting Engineer, Seattle, Wash.

THE popular belief that a railway can only be operated in the public interest when fighting other lines for its existence may no longer be held if the coöperation of the railways under Federal operation demonstrates the advantages inherent in unified control. It seems not to have been realized in the laws to prevent combination and encourage competition that railways, like nations, cannot exist in a state of war except at the expense of one another and the public. It is hoped that the public, perceiving how wasteful and horrible is war between nations will see that the same laws govern industrial relations as govern political, and that industrial war is wasteful and horrible also. As a combination of petty warring states into a strong nation makes for peace and efficiency, so does a combination of warring railways. To make the railways again war on one another for traffic is a retrograde movement, resulting in wasteful expenditure for unnecessary construction, trains and equipment and in other avoidable expense. Rebates, rate wars and other objectionable practices are the direct effect of fights for competitive traffic.

If Federal management were permanently in the hands of men like the present Director General and his staff there would be little cause to worry over the future of the railways by the public, the employees or the security holders. The general record of the Federal Government as a business organization, however, is not such as to inspire confidence that the railway business administration, after the old system railway men are eliminated, will show a sufficiently great improvement over the Canadian and European government administration to be acceptable to the public. This country would never accept the service and costs of the Intercolonial Ry. of Canada or that of the French or German railways, after having been accustomed to so much better service and rates. European rates, notwithstanding very much cheaper railway wages, if in force on American railways, would be so high as to shut down many industries.

Capable Men at the Head

The operation of all railways under a single corporate management will of necessity put large power and responsibility in the hands of a few men, but this is a necessary step in any successful organization, and not more imprudent on a large scale than we are accustomed to on a small scale. These men will be more likely to be fitted by training and experience to exercise their power wisely to the advantage of the railways and the public than the average management of the past, or those whom the political fortunes of the hour might place in temporary power.

The financing of this gigantic corporation will not appear difficult if based on the present Federal plan of payment of rental to railways on the basis of their average net earnings. The proposed corporation can issue securities to each individual railway company for its physical property in the proportion that the average net earnings of that company bear to the total average net earnings of all railways. The value of a railway or other property is independent of original cost, replacement cost or any other factor except future earning capacity. Past earnings in a railway are an approximately true measure of its relative value as compared with other railways for calculating its proportion of future earning capacity. Each railway company can keep its corporate existence as at present under Federal operation, or use the securities issued to it by the absorbing corporation to liquidate its own outstanding securities.

There need be little uneasiness that a unified corporate control of railways will result in oppressive rates and lack of enterprise in providing facilities for business. The unified control, being free from inter-railway competition, will eliminate much construction and operating waste, which, together with items to be discussed later, will reduce operating costs very materially, thus providing the opportunity, if desired, to reduce rates. Every additional ton handled by a railway, up to the economic traffic capacity, is handled at an increased margin of profit. The desire by the railway management for increased business with the increasing margin of profit with each increase will have the effect of reducing rates to the economic minimum. Every saving in railway operation tends to reduce rates, and every addition to operating costs tends to raise rates or impair service. The incentive to increase business by low rates, and encourage new industries by providing facilities, will be just as strong as when the temptation to steal the traffic from a rival existed. It may quite possibly be found that the rates voluntarily made by the skilled traffic department of a railway, not subject to inter-railway competition, will be on a fairer basis than those made by a commission. The rate should be allowed to change when the direction of traffic pressure changes, since the service in the direction opposite to the direction of traffic pressure can be performed more cheaply.

Unnecessary Minor Improvements

Whether unity of railways is under Federal or corporate management, there are many advantages, aside from the elimination of wasteful competition, that may be shared by the railways and public, by such consolidation.

Three high-standard east-and-west transcontinental railways and probably four north-and-south lines could handle with much greater cheapness and dispatch the through business now handled by many lines. These high-standard lines could be made by reconstructing the best existing lines or by a combination of lines to the economic limit corresponding to the estimated traffic, other existing lines being operated as secondary or branch lines, handling only the traffic they originate and can handle best. The expenditure saved by abandoning contemplated line and gradient reductions, and projected lines into the territory served by other railways on many lines, might be sufficient to bring a few lines to the economic standard. Modern tunneling methods

and machinery make reduction of many gradients practicable, which reductions were formerly economically needed.

With traffic largely diverted to one route economies are practicable that cannot be obtained if this traffic is divided among many routes. The lines that give up the through traffic, becoming secondary lines, will still perform a useful and necessary part in the great railway whole, and will be performing a service for which they are probably better adapted than for through-line business. The creation of these suggested high-standard lines will produce a much greater traffic capacity than the same expenditure spread over many lines in minor improvements, some of which lines are perhaps hopelessly long, or have steep gradient lines.

It may not be too optimistic to hope that with the completion of a well-planned system of through routes, and common terminals well planned and adequate, forming part of a united, well balanced railway whole under corporate management, the saving will be such that rates can be reduced to the ante-bellum level without reducing wages, or that independent labor can be brought up to the union labor level; or, perhaps, if reduction is necessary, a percentage of earnings as a bonus may be a wise expenditure. After the war there will probably be for some years a period of surplus labor, at which time railway construction can be done cheaply and in the public interest. Preparation for the time after the war should begin now, at least so far as planning what is to be done with the railways is concerned and withholding expenditures not in harmony with this plan.

The railway system of the United States should be planned as a whole, assuming a common ownership of all railways, by a body of engineers, operating officials and bankers who are experts in railway economics. The working out of the economic railway plan for the nation, to supplant the plan and system developed by each railway for its own interest, is a very important peace preparation, requiring the best brains and training and all the time available, as well as the help and sanction of the Director General of Railroads.

Purdue Trains Concrete Foremen for Army Service

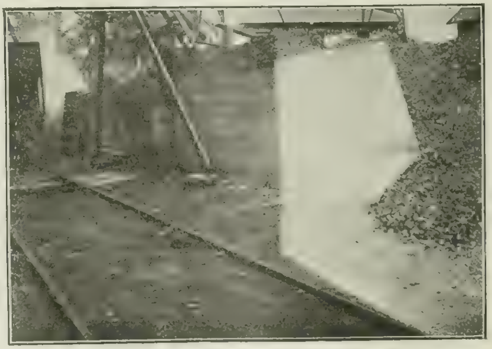
Practical Applications, Teaching To Do by Doing and Thinking, Used To Make Skilled Workmen in Eight Weeks

THE "how" rather than the "why" is the dominating feature of the vocational training in concrete work given to army students at Purdue University. The second contingent of 100 men is taking the eight-weeks' course in concrete work, while drill and military work are being taken by 500 auto mechanics and 150 embryo radio operators. Two main objectives in the concrete foremen's school were kept in mind in designing the course; first, the necessities of the army, and second, the preparation of the men to re-enter civilian life at the close of the war as small contractors or high-class superintendents for large contractors.

To care for 100 men, Purdue needed no additional equipment, for it had good existing facilities. The high-grade concrete laboratories of ten years' use are still ahead of those of most other institutions. Plenty of small concrete jobs about the campus, such as steps, sidewalks, conveyor tunnel and a water tower, were only awaiting forces of men to put them through. Housing facilities for all the men were provided by the erection of a mess hall, and sleeping quarters were amply provided for in the recently completed armory.

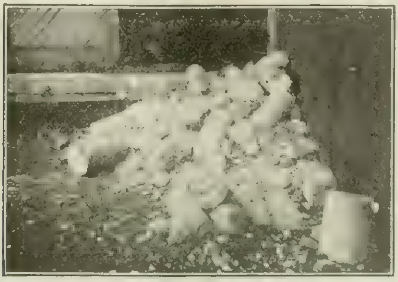
A staff was recruited from college instructors. The field superintendent obtained was a young contractor, a former student of Purdue, with broad engineering and executive experience but incapacitated for military service. The four sections of 25 men each were given six hours' work per day plus their regular drill periods.

As in most of the vocational schools started by the United States War Department's committee on training and instruction, the courses are so arranged that one thing at a time is given intensively, the student "learning to do by doing." Eight days are given indoors on arithmetic (for some of the men had forgotten even this branch of mathematics), blueprint reading, estimates, layouts, specifications, organization and lectures. In the field work 16 days are spent. Of this period six are on placing concrete, and three on form building, with one day each on unloading aggregate, excavating,

EMBRYO FOREMEN PLAN AND MAKE STEPS, AND BUILD COAL STORAGE WALL AND CONVEYOR TUNNEL

proportioning and mixing, organization and management, surface treatment, brick and stucco work, reinforcing and protection. Eight days are spent in the laboratory on tests of cement, aggregate, concrete beams, wood, steel, bond and sampling of a pit. Concrete products come in for four days' drill. Troughs, fence posts,



COMPRESSION TESTING IS LABORATORY EXERCISE

tile and slabs are made, and kinks in their construction are pointed out. A day in the shop is spent in learning the use, care and maintenance of saws, planes, chisels, squares, and other carpenters' tools. Straight edges, floats and darbies are made.

Some of the outdoor work includes the excavation under several full-size, four-panel flat slabs on columns which have recently been tested, inclosing the sides with brick, stucco or plaster on metal lath, and erecting a roomy storage building on top. An old wooden water tower was removed and one of concrete, designed by the engineering staff of the university, is in course of construction. At the time of a visit by a representative of *Engineering News-Record* the foundation had been poured and columns erected, ready for the form work of the tank proper. All work of reading blueprints, getting out forms, bending bars on a frame improvised by the students, handling the mixer and placing concrete, was carried out by them, each step being carefully planned, explained and worked out in advance by the whole class. Such stunts as unloading aggregate from a car, at ordinary speed and then at double speed, give the men accurate knowledge of the amount of material a man is able to handle in a given time.

The best men in the class receive advanced work, by having detailed to them squads for building unaided such small jobs as steps and sidewalk slabs. Only brief oral directions on the ground are given. Sketches must all be made, and estimates of quantities necessary with excavation and tools needed, must all be determined beforehand. This brings in personnel and gang organization ability.

In the pit-sampling tests, the men learn the quartering method, the use of ordinary sieves and Universal sand testers, silt tests, colorimetric tests and meaning, quality of gravel and how to make it acceptable for various purposes.

Talks or explanations precede all laboratory and practical work. For most of it mimeograph instructions are furnished. For inspection there is available a gravel-producing plant, a reinforced-concrete building under erection, monolithic and semi-monolithic brick paving under construction, and a planing mill.

Prof. W. K. Hatt is the supervisor in charge of the concrete school; R. C. Yeoman is assistant supervisor and W. F. Slattery is field superintendent.

Concrete Block River Mattresses Prove Economical

Capitalizing the Cost of Repairs for Japanese Rivers Proves This Type Cheaper Than Any Other

By B. Okasaki

Formerly Chief Engineer, Ishikari River Improvement Work, Japan. Now Civil Engineer, Home Department, Tokyo

CONCRETE block mattresses for river protection have been used for a number of years on the banks of some Japanese rivers, notably the Ishikari. The progressive steps in the application of this flexible mattress were outlined in articles in *Engineering News* of May 16, 1912, p. 922, and Mar. 13, 1913, p. 512. Since its first installation there has been an opportunity to compare its service and its cost with those of other types

FIG. 1. WEAVING CONCRETE BLOCK MATTRESS

FIG. 2. PILE AND FASCINE MATTRESS BROKEN BY RISE

of river-bank protection, and a recent analysis of the observations over a number of years of the various kinds of bank protection show the flexible block system to be most economical in the long run.

In deep rivers the concrete block mattress can be made cheaper in first cost than any other kind of substantial bank protection. However, notwithstanding the merits and advantages which the block mattress generally reveals when placed, one is sometimes forced not to adopt it in other places, particularly in shallow water, because of the slightly higher first cost in such locations. It has been found, though, that the cost of maintenance and repair of the less permanent types increase the final cost to more than that of the block type.

The chief merits of the flexible reinforced-concrete mattress lie in the fact that with this mattress no parts are lost from the attack of drift and scour, as the mattress settles down and fits the newly scoured river bed snugly and prevents further scour, so the only thing necessary is the additional expansion of the width of the mattress to compensate for the settlement. In the other types, parts of the piles, the cribs or the fascines are very liable to be lost *in toto* from the severe scour or

COMPARISON OF FIRST COSTS AND REPAIRS OF DIFFERENT TYPES OF RIVER BANK PROTECTION IN JAPAN

River Locality	Tokachi Obihiro	Tokachi Obihiro	Ishikari Fukagawa	Ishikari Fukagawa	Yubari Yuni	Chubets Asahikawa
Depth of thalweg at low water..	14 ft.	14 ft.	17 ft.	17 ft.	4 ft.	8 ft.
Flood height above low water	10 ft.	10 ft.	12 ft.	12 ft.	10 ft.	10 ft.
Construction ..	Pile and fascine mattress	Concrete mattress	Pile and fascine mattress	Concrete mattress	Concrete mattress	Pile and fascine mattress
Length of work	1,440 ft	960 ft	2,640 ft	600 ft	600 ft	624 ft
First cost of construction per ft	$2.64	$3.97	$2.23	$7.34	$3.70	$2.58
Annual cost of repair per ft. run........	$0.56	$0.12	$0.29	.....	$0.03	$1.97
Allotment of the first cost per ft. run in 20 years	$0.13	$0.20	$0.11	$0.37	$0.19	$0.13
Sum of the allotment and the annual cost of repair per ft. run ..	$0.69	$0.32	$0.40	$0.37	$0.22	$2.10

term of 20 years was adopted as the standard from attacks of drift.

In the examination of costs only those works were examined that are constantly subject to severe attack of the current. The first cost and cost of maintenance and repair are considered since the year 1898. Optionally a

FIG. 3. LOG MATTRESS NEARING DESTRUCTION FROM RIVER RISE

FIG. 4. PILE AND FASCINE MATTRESS IN COURSE OF CONSTRUCTION

which to calculate the annual average of both the first cost and that of maintenance and repair for foot run of the river bank under protection. The interest is not considered, as the works were built with Governmental funds and cared for by the annual local tax. The sum of the annual allotment of the first cost and the cost of maintenance and repair is put in the last line in the accompanying table.

The accompanying views show the block and other mattresses under construction and in operation on Japanese rivers. Fig. 1 shows a concrete block mattress being knitted on the top of the slope of the river bank. A typical work consisting of combined pile and fascine mattress with a sloped pitching of willow hurdles filled by riprap, a part of which is damaged by the drift, is shown in Fig. 2. Fig. 3 shows a log mattress inclined in a critical condition and a part of the framework broken, and Fig. 4 shows a combined pile and fascine mattress with a sloped pitching of willow basket, or a kind of gabion filled with pebbles, in course of construction.

From the table it may be concluded that when a term of 20 years is adopted for a standard of comparison the flexible block concrete mattress is the most economical, provided the annual allotment as the first cost of construction, and the yearly cost of maintenance and repair are considered.

One Out of Three in the Service

Members of the United States Reclamation Service who had entered the military or naval service up to June 15, 1918, according to the *Reclamation Record* of August, 1918, totaled 503, or 30.7% of the employees of the department.

Garbage Collection and Disposal Under War Conditions

United States Food Administration Makes Country-Wide Survey—Kitchen Wastes of 382 Cities With Total Population of 30,000,000 Utilized

DATA SUMMARIZED AND DISCUSSED BY M. N. BAKER
Associate Editor of Engineering News-Record

COMPREHENSIVE data on garbage collection and disposal in cities of the United States having populations of 10,000 and more have been gathered by the garbage utilization division of the United States Food Administration. By means of an easy key system much information concerning the separation of garbage, whether systematic collections are made and by whom, and methods of disposal, has been compressed into small compass by the Food Administration while still bringing out clearly the main point, which is whether and how the garbage of the various cities is utilized.

Access to these valuable data having been kindly given to *Engineering News-Record*, the writer has summarized the primary information by states, groups of states and for the whole country. The summary tables are given below, together with the original or Food Administration tables and some comments designed to be interpretative. The Food Administration is responsible for the basic table only, Table III.

So outstanding is the fact, stimulated by war conditions, that garbage is being utilized and should be used now as never before, that the data on disposal will be considered first. No less than 382 cities with a combined population of nearly 30,000,000 are feeding garbage to hogs or reclaiming from it fats and fertilizer by means of reduction. This is most encouraging.

But it is discouraging to find that the garbage of 316 cities is not all being conserved at a time when the need for every possible ounce of food, fat and fertilizer is many times greater than ever before. Fortunately, the population the garbage from which is not being reclaimed is less than 14,000,000, or less than one-third the total of that of the 698 cities under consideration. Moreover, some portion of the garbage of about 450 cities is fed, although only 345 cities have their populations entered in the feeding column. This makes the case better for utilization, but some of the cities put in the feeding column do not make sure that all the garbage is fed.

REDUCTION PLANTS ARE IN LARGER CITIES

That it is mostly the larger cities which have reduction plants is shown by the fact that the 18,500,000 population totaled under reduction is in 37 cities while 345 cities, with 11,170,000 population, reported their garbage as being fed. Only 13 of the reduction works are in cities of less than 100,000 population, six in less than 50,000, and about half a dozen in places of less than 25,000. Sharpsburg, Penn., with 10,600 population, is the smallest city to report reduction works. Its garbage goes to the Pittsburgh plant. It appears that the number of reduction plants has not increased much during the war, as would be expected in view of their cost and the labor, material and time required to build them. Twenty-one of the 37 reduction works are in three states, New York, Pennsylvania and Ohio.

Indications are that feeding is rapidly increasing, cities turning to it from incineration and from the miscellaneous class of "burn, bury or dump." Feeding often produces some revenue for the city, while incineration is in most cases a dead expense, and in a probable considerable majority of the cities draws upon fuel which is much needed for military and industrial purposes.

On the 316 cities which do not utilize their garbage, 102 incinerate it in furnaces and 214 report miscellaneous means of disposal, lumped under "burn, bury or dump"—"burn" perhaps relating mostly to paper burned

TABLE I. LEADING METHODS OF GARBAGE DISPOSAL IN CITIES OF 10,000 POPULATION AND UPWARD, WITH NUMBER OF CITIES AND POPULATION BY STATES AND GROUPS OF STATES, BASED ON REPORTS TO THE UNITED STATES FOOD ADMINISTRATION

	Total Cities Included	Burn, Bury or Dump* No	Burn, Bury or Dump* Population	Incinerate No	Incinerate Population	Feed No	Feed Population	Reduce No	Reduce Population
Me	11	1	8,400			10	211,300		
N. H	7	1	13,600	1	14,700	5	135,300		
Vt	3					3	41,400		
Mass	69					67	2,187,400	2	895,000
R. I	12	2	65,000			10	469,200		
Conn	22	6	159,200			15	627,500	1	172,000
N. E..	124	10	246,200	1	14,700	110	3,672,200	3	1,067,000
N. Y..	51	22	630,700	5	658,600	19	449,500	5	6,237,000
N. J	31	18	1,353,000	2	268,400	9	171,500	2	76,000
Penn.	57	23	412,200	13	696,400	15	368,900	6	2,499,200
Del..	1				......			1	110,000
Md...	5	3	47,400		..	1	25,700	1	590,000
D. C	1							1	390,000
Mid.	146	66	2,443,300	20	1,623,400	44	1,015,600	16	9,902,200
Va	10	3	88,000	6	427,900	1	17,800		
W. Va.	10	4	88,900	4	101,000	2	35,700		
N. C.	8	2	40,000	5	158,100	1	14,000		
S. C..	5	3	106,900	2	40,600				
Ga	9	2	75,500	5	357,700	2	43,100		
Fla	5	2	119,700	3	102,800				
S. A...	47	16	519,000	25	1,188,100	6	110,600		
Ala	8	4	276,700	2	67,000	2	29,000		
Miss	9	4	82,800	1	9,000	4	84,900		
La	4	1	375,000	2	59,500	1	13,200		
Tenn	6	3	113,900	2	169,300	1	133,100		
Ky	12	6	359,000			6	367,500		
S. C	39	18	1,207,400	7	1,504,800	14	627,700		
Ohio.	46	19	376,200	2	54,100	15	277,800	10	2,209,000
Ind...	34	10	194,100	5	165,800	16	305,000	3	397,600
Mich	32	13	233,400	4	43,700	14	480,600	1	810,000
Ill....	43	16	427,000	7	218,100	18	462,200	2	2,676,800
Wis...	22	8	184,900	3	515,500	11	211,600		
N. C	177	66	1,415,600	21	997,200	74	1,745,200	16	6,093,400
Ia	17	2	68,000	4	163,000	11	303,800		
Minn..	12	3	34,600	3	130,000	6	643,000		
Kan..	16	1	24,000			15	397,800		
Neb.	6	1	55,000	1	11,800	4	205,300		
N. Dak.	2			2	43,800				
S. Dak..	3	2	25,200			1	24,000		
Wyo..	2	1	14,000			1	8,300		
Mont...	6	5	173,000	1	15,000				
N. W.	64	15	393,800	11	363,600	38	1,382,200		
Mo....	15					14	695,000	1	902,000
Ark....	6	5	100,100	1	57,300				
Tex....	23	4	209,800	8	466,200	11	297,800		
Okla...	3	2	33,900			6	254,400		
Colo...	7					7	397,800		
N. M..	1					1	14,000		
S. W..	60	11	343,800	9	523,500	39	1,963,000	1	902,000
Wash.	7	5	493,100	1	150,300	1	25,100		
Ore...	4					4	61,700		
Calif..	22	5	318,800	6	772,100	10	280,[illegible]00	1	590,000
Ariz	3	2	40,000			1	19,200		
Nev..	1					1	15,900		
Utah..	3			1	44,700	2	135,600		
Ida..	1					1	16,000		
Pac.......	41	12	358,900	8	816,800	20	654,300	1	590,000
U. S.......	698	214	6,928,000	102	7,032,100	345	11,170,800	37	18,554,000

*Burn presumably indicates burning paper and rubbish in the open, on dumps

in the open on dumps, and "dump" including both land and water dumping.

A considerable number of fair-sized cities report feeding: Six of 200,000 population or more (Kansas City, Minneapolis, St. Paul, Denver, Providence and Louisville); 20 of 100,000 or more; and 44 of 50,000 and more. Among the cities which report incineration four have populations of 200,000 or more (San Francisco, Milwaukee, part of New York City and Atlanta) while these and eight others, or 14 in all, have more than 100,000 population each. These 14 cities have a total population well toward 3,000,000. All are of sufficient size to support reduction plants, instead of burning wastes that might be reclaimed. However, their incinerators were built in pre-war times. The "burn, bury or dump" class numbers 10 cities of 100,000 population or more, with an aggregate population of about 2,500,000, all again readily in the possible reduction class. The largest of these, New Orleans, has had plans for reduction under way for months, and they are presumably delayed by war conditions. Seattle, next in size to New Orleans, built three high-temperature destructors years ago, which have been closed for some time except for the disposal of combustible refuse. The Seattle garbage goes to "sanitary fills," which the writer was informed several years ago were thoroughly satisfactory to both the local and state boards of health.

Geographically, the modes of disposal and corresponding populations are summarized in Table I. The New

TABLE II SUMMARY OF GARBAGE COLLECTION AND DISPOSAL DATA FOR 785 CITIES OF 10,000 POPULATION AND UPWARDS BASED ON INFORMATION COLLECTED BY THE UNITED STATES FOOD ADMINISTRATION

	Total Cities Listed	Systematic Collection Yes	No	??	Separate or Mixed Collection g	ag	rg	arg	Collection by Municipality, Contract, Private or Combined m	c	p	mc	mp	cp	mcp	Private Collection Permitted or Prohibited pn	ppn	ppyn	ppy	nr	Disposal by Municipality, Contract, Private or Combined m	c	p	mx
Me	11	3	8		3		0	0	0	0			2	1		1	1			1				3
N. H	9	3	3	3	1		1	1	0				2	1		3								3
Vt	5	1	2	2	.	...	1	..		1									1			1		
Mass	70	59	10	1	59	...	...	...	10	20	5	2	5	16	1	15	11	6	19	8	8	17	5	29
R. I	12	6	6		6		...	...		2				4		3	1	1	1		0	2		4
Conn	27	20	2	5	14	1	2	3		5	2	1	6	6		14		2	2	2	1	3	2	14
N. E	134	92	31	11	83	1	4	4	10	28	7	3	15	28	1	36	13	9	23	11	9	23	7	53
N. Y	59	44	5	10	27	.	5	12	4	16	1		15	8		26	4	1	9	4	5	14	1	24
N. J	38	31	1	6	10	1	3	17	8	6		7	9	1		18	3	1	5	4	7	7	2	15
Penn	82	43	17	22	24	.	16	3	4	12	7	9		11		22	1	1	15	4	6	11	6	20
Del	1	1			1	.	.	.	.	1									1			1		
Md	5	5			2	.	2	1	1	3				1		4			1		1	3		1
D. C	1	1	.		1	.		.		1									1			1		
Mid.	186	125	23	38	65	1	26	33	17	39	8	16	24	21		70	8	3	32	12	19	37	9	60
Va	10	9	1		1	1	4	3	3				6			6	1	1		1	4			5
W. Va	10	6	3	1	3		2	1	2	1			1	2		3		1	1	1	1	1		4
N. C	12	6	2	4	2		2	2	3				3			4				2	3			3
S. C	12	6		1	1			4	2				3	4		5					2			3
Ga	11	8	1	2	1		1	6	3		1		4			6				2	2		1	5
Fla	5	5					5		2	1			2			2	1		1	1	2			3
S. A.	60	39	7	8	8	1	14	16	15	2	1		13	6		26	2	2	2	7	14	1	1	23
Ala	8	7	1		1		[illegible]	1			1		6			6				1				7
Miss	9	6	[illegible]		2		3		2			1	3			4			1	1	4			2
La	6	3	1	2			2	.	1				2			2			1					3
Tenn	7	6	1		1		4	1					6			4	2							6
Ky	11	7	4		3	1	1	2	3	1			2	1		4			1	2	3			4
S. C.	41	29	10	2	7	1	15	6	6	1	1	1	19	1		20	2		3	4	7			22
Ohio	52	34	12	6	24	1	4	5	5	7	1		7	14		17	7		4	6	5	7		22
Ind	35	30	4		22		5	5	5	5			12	8		15	4	1	4	6	2	3	1	24
Ill	43	33	10		18		8	7	2	3	1		21	6		28	2		3	0	3	2	1	27
Mich	33	25	8		13		6	6	9	5	3		3	4	1	11	1		7	6	9	3	3	10
Wis	23	16	6	1	9		5	2	1		1		11	3		13		1		2	4	1	2	9
N. C	186	138	40	8	86	1	28	23	22	20	6		54	35	1	84	14	2	18	20	23	16	7	92
Ia	19	10	6	3	4		4	2					6	3	1	8		1		1	1			9
Minn	12	8	4		5		4	1	2	1	1	1	3			3	1		1	3	3	1		4
Kan	16	7	9		5		2			3			1	3		3	1		2	1		2	1	4
Neb	6	4	2		2		2			1				3			2		1	1		2		2
N. D	2	2			1		1		1					1		1				1	.			2
S. D	3	2	1				1	1					1	1		2								2
Wyo	3	1	1	1	1					1					.				1			1		
Mont	6	4	2		1		1	2	3				1			3	1				3			1
N. W.	67	38	25	4	17		15	6	6	6	1	1	12	11	1	20	5	1	5	7	7	6	1	24
Mo	15	4	10	1	4					2			1	1		2	1		1			1	3	
Ark	6	5	1		1		4		1	.	.		2			2			1	2	1		1	3
Tex	27	13	11	3	4		8	1	5		[illegible]		3	3		7	1	1	1	3	5		2	6
Colo	7	5	2		4		1			-	1					1	1		2			3	1	1
N. M	1	1			1															1		1		
Okla	10	5	2	3	3		2			2			2	1		1	2	1		1		2		3
S. W	66	33	26	7	17		15	1	6	10	4		8	5		13	5	3	5	7	6	7	7	13
Wash	10	6	1	3	2			4		1		1	1	3		4		1		1				[illegible]
Ore	5	1	3	1	1									1			1							1
Calif	22	20	2		8		8	4	1	8	9		1	1		8	4		6	2		5	4	11
Ariz	3	3					1	2	1	1			1			2			1		1	1		1
Utah	3	1	2		1									1		1								1
Ida	2	[illegible]	1		1									1		1								1
Pac	45	32	9	4	13		9	10	2	10	9	1	3	7		16	5	1	7	3	1	6	4	21
U. S	785	526	171	82	296	5	126	99	84	116	37	22	148	114	3	285	54	21	95	71	86	96	36	308

Under Systematic Collection the column headed "??" gives number which did not report on this subject. In all but one of the other column groups only those cities which [illegible] included.

Under Separate or Mixed Collection "g" means that garbage is collected separately; "ag" that ashes are mixed with garbage; "rg," rubbish and garbage mixed; [illegible]

Under Collection by Municipality, etc., "m" denotes municipality; "c" contract; "p," private, and the other column heads indicate combinations.

Under Private Collection Permitted, etc., "pn" means private collectors not prohibited; "ppn," prohibited, but not enforced; "ppyn," prohibited by ordinance and not enforced; "ppy," ordnance enforced; "nr," no report.

Under Disposal by, etc., "m," "c.," "p.," indicate municipality, contract, private, respectively and "mx" means various combinations.

England States lead in feeding; the Middle in reduction; the South Atlantic in number and the Middle in population under the same heading. By states, Massachusetts is far in the lead in feeding, with 67 cities and towns in that class, or all reporting except Boston and New Bedford, the garbage of which is reduced. Further geographical contrasts of disposal methods may be drawn from Table I by those interested in groups of states. Table III, the basic table, compiled by the Food Administration, gives disposal data by cities for the whole country, the states being arranged alphabetically and the cities placed in like order under each state.

Systematic Collection Reported in 526 Cities

The disposal data already discussed are simple compared with the combined information on collection and disposal presented in condensed form with the aid of key letters in Table III and summarized by the writer in Table II.

From Table III it appears that of 785 cities and towns having 10,000 population or more 526 reported systematic collection of garbage, 171 no collection and 82 failed to report. Considering the number of small places in the list, this might be regarded as a good showing, even though many cities have no collection. Study of the additional symbols, indicating whether the collection is by the municipality, by contract, by private arrangement with individual householders, or by a combination of two or all three of these methods, indicates that "systematic collection," as reported by many of the cities, may not go very far. This conclusion is strengthened by an examination of the summaries under the columns which show whether private collection is permitted or prohibited, and if the latter, whether the prohibition is enforced.

Of 626 cities which report systematic collection, 285 do not forbid private collection, 75 prohibit it but do not enforce the rule, 71 make no report on the subject and only 95 lay claim to prohibition without enforcement. These figures certainly tend to show that much must yet be done before American cities have anything like thoroughgoing garbage collection—and until that is had the presumption is that large quantities are not properly collected and that a considerable proportion of this total is not available for utilization.

Separate Collection of Garbage in 296 Cities

Garbage is collected separately in 296 of the 526 cities reporting systematic collection; with ashes in five, with refuse in 196 and with both ashes and refuse in 99. Here again lack of thorough collection and full and fair chance for utilization is apparent, for garbage cannot be thoroughly utilized for feeding or reduction unless it is kept and collected free from other wastes. A total of 382 cities, we have already seen, report feeding or reduction of garbage, against only 296 in which garbage is collected separately.

Municipal collection is generally considered by sanitarians to be the best plan, and contract collection the next best. Only 84 of the 526 cities report municipal collection alone, against 116 contract and 37 private and 287 mixed. Some part or all of the garbage is collected by the municipality in 257 cities, some part by contract in 255 and some part privately in 302 of the 526 cities.

Disposal is reported as by the city alone in 86 cases; by contract alone in 96; privately in 36 and mixed in 308 cases. Here also there is opportunity for advance.

Those who desire to pursue the subject can summarize for themselves how the cities, the contractors and the private scavengers each dispose of the garbage they collect.

Altogether, the garbage utilization division of the United States Food Administration has done a large amount of valuable work in collecting and compiling the garbage data presented in Table III. The survey will stimulate better and more complete methods of garbage collection, besides accelerating the utilization of kitchen wastes either by feeding or by reduction, which is the worthy object of the investigation.

Finally, corrections and additions to Table III are desired. These should be sent directly to the United States Food Administration, Washington, D. C.

TABLE III GARBAGE COLLECTION AND DISPOSAL IN CITIES OF 10,000 POPULATION AND UPWARDS INFORMATION COLLECTED BY THE GARBAGE UTILIZATION DIVISION OF THE UNITED STATES FOOD ADMINISTRATION

	Collection*	Disposal†	Population‡
ALABAMA			
Anniston.	sgmp-pn	mgf-pf	17 0F
Bessemer....	srgmp-pn	md-pf	16 5B
Birmingham.	sargmp	md-pf	181 0B
Gadsden.....	srgp-pn	md-pf	15 5I
Mobile.......	srgmp-pn	md-pf	60 0B
Montgomery..	srgmp-pn	mid-pf	51 5I
Selma......	srgmp-pn	md-pf	19 2B
Tuscaloosa	No	pf	12 0F
ARIZONA			
Bisbee.....	sargmp-pn	md-pf	18 0B
Phoenix......	srgc20-ppy	cf	19.2F
Tucson	sargmp-pn	md	22.0B
ARKANSAS			
Argenta.	No	cd	18 1B
Fort Smith	srgm-ppy	md	28 7B
Helena......	sgmp-pn	md-pd	12 0B
Hot Springs	sgc27p	cd-pf	17 2B
Little Rock...	srgmp-pn	mi-pf	57 3I
Pine Bluff..	srgp	pd	24 1B
CALIFORNIA			
Alameda	sargp-pn	pd	32.0B
Bakersfield ..	sgc-21-ppy	cf	20 0F
Berkeley	sargp-pn	pmi-pf	65.0I
Eureka	No	pf	17 2F
Fresno	sargp-pn	pci-pf	48 9I
Long Beach	sgc19-ppy	cf	27.0F
Los Angeles	sc-ppy	mcr	590 0R
Oakland	sgc18-ppn	cd-pf	210 0B
Pasadena....	srgmp-ppn	mct-mcr-pf	42 3F
Pomona	sgc17-ppy	cf	14.3F
Redlands...	sgc20-ppy	cf	21 0F
Riverside..	sgcp-pn	cb-pf	19 8B
Sacramento	srgp	pmi	75 0I
San Bernardino.	No	pf	18 8F
San Diego....	sgc20p-ppn	cf-pf	90 0F
San Francisco	srgp-pn	pmi-pf	[illegible] 2I
San Jose.....	sargcp-ppn	cmi-pf	40.4I
Santa Ana....	srgc19-ppy	cf	15 4I
Santa Barbara	sgp-pn	pf	14 8F
Santa Cruz. .	srgp	pmi-pf	12 6I
Stockton...	srgp-pn	pd	42 0B
Vallejo....	srgp-pn	pd	15 0B
COLORADO			
Boulder	sgc24-ppn	cf-pf	12 [illegible]
Colo. Spgs.	sgc18	cf	36 0F

* Under "Collection" "s" indicates that there is a systematic collection and "no" that there is not; "g" stands for garbage, "a" for ashes and "r" for rubbish, while combinations of these letters mean that ashes or rubbish or both are collected with the garbage. In the same column "m," "c" and "p" denote municipal, contract and private collection respectively, and a combination of these letters indicates that more than one system of collection is in use. When "c" is followed by a figure, as "c 20" it means that the collection contract expires in 1920. Letters in the collection column following a dash show whether private collection is permitted or prohibited, and if prohibited whethr the prohibition is enforced. Thus "pn" means private collection not prohibited; "ppn," prohibited but not enforced; "ppyn," prohibited by ordinance but not enforced; "ppy," prohibited ordinance enforced.

† Under "Disposal" "m," "c" and "p" mean that disposal is by the municipality, by contract or private, while "d" means dumping on land or in water; "b" burning by some unstated method, presumably in the open; "f," feeding; "r," reduction. In the same column, "mgf" means municipality gives the garbage it collects to private parties for feeding; "m s f" means municipality sells to farmers, presumably for feeding; "mscsf," municipality sells to contractor who sells to farmers; "pf," private feeding, etc.

‡ Under "Population," the entries are to the nearest hundred. The letters following indicate what is believed to be the prevailing method of disposal; "B" means burn (probably in the open), bury or dump, the latter on land or in water. "I" indicates incinerate in some form of furnace; "F" denotes feeding. "R" shows that the garbage is reduced for the recovery of grease and fertilizer base.

	Collection*	Disposal†	Population‡
Denver	sgc19-ppy	cf	260 8F
Ft Collins	sgc27-ppy	cf	12 0F
Greeley......	No		11 0F
Pueblo	srgp-ppyn	pf	51 0F
Trinidad.	No argp-pn	pf	15 8F
CONNECTICUT			
Ansonia .			
Bridgeport	sgc25p-ppyn	cr-pf	172 0R
Bristol.	sgmp-ppyn	msf-pf	19 0I
Danbury	No	pd-pf	23 5B
Derby.			
East Hartford	sg-pn	csf	7 0F
Enfield.	sgcp	cf-pf	11 2F
Greenwich			
Hartford	sgmp-pn	msf pf	154 3I
Manchester	sgc	csf	17 0F
Meriden	sagc18p-pn	cd-pf	30 0B
Middletown	sargmp-pn	md-pf	13 5B
Naugatuck	sgc19p-pn	cf-pf	15 3I
New Britain	sgc-ppy	cf	[illegible]
New Haven	sgmc18-ppy	msf-cf	165 0F
New London	sgc18p-pn	cf-pf	24 7I
Norwalk	sargm-pn	md	27 0B
Norwich	srgmp-pn	md-pf	29 4B
Orange....	sgp-pn	pf	15 3F
Stamford	sargmp-pn	md-pd	35.8B
Stonington			
Torrington	srgc-pn	cf-pf	20.5F
Vernon .			
Wallingford	No	pf	10 0F
Waterbury	sgmp-pn	mf-pf	87 0F
Winchester	sgp-pn	pf	9.7F
Willimantic.	sgc18p-pn	cf-pf	13 3F
DELAWARE			
Wilmington	sgc17-ppy	cr	110 0R
DIST. COLUMBIA			
Washington	sgc18-ppy	cr	390 0R
FLORIDA			
Jacksonville	sgrmp-ppn	mb-pf	107 7B
Key West	srgc19	cm	21 7I
Pensacola	srgm-pn	mi	28 9I
Tampa..	srgmp-pn	mi-pf	52.2I
West Tampa..	srgm-ppy	mb	12 0B
GEORGIA			
Albany..			
Americus....	srgmp-pn	mi-pf	10 9I
Athens......	No	pf	22 4I
Atlanta	sargmp-pn	mi-pf	200 0I
Augusta	sargm-pn	md	[illegible] 0B
Brunswick. .			
Columbus....	sargmp-pn	md-pf	26 0I
Macon.	sargmp-pn	mi-pf	45.8
Rome...	sgp-pn	pf	19 7F
Savannah	sargm	mi	75 0I
Waycross	sargmp	mp-pf	20 5B
IDAHO			
Boise	No		
Pocatello.	sgc23p-pn	cf-pf	16 0I
ILLINOIS			
Alton	No	pf	27 0F
Aurora...	sgmp-pn	mi-pf	37 0I
Belleville	sgc-pn	r-cf	24 8R
Bloomington..	srgmp-pn	mf-pf	28 0F
Blue Island..	sargmp-pn	md-pf	11 0B
Cairo.....	sgmp-pn	mscf	16 0
Canton	srgmp-ppn	md-pf	13 3B
Centralia	No	pf	11 5F
Champaign	No	pf	14 5I
Chicago	sgmp-pn	mr-pr-pd	2 652 0R
Chicago Hts.	sgmp-pn	mi-pf	23 6I
Cicero..	sargp-pn	pd	39 4B
Danville .	No	pf	32 0F
Decatur....	No	pf	39 7F
Dekalb.. .	sgmp-pn	mf-pf	8 1F
E. St. Louis	sgc19p-pn	cf-pf	92 0I
Elgin	srgmp-pn	mi-pf	27 8I
Evanston...	sgmp-pn	mspf-pf	28 5F
Freeport....	sgmp-pn	md-pf	17 0B
Galesburg...	sgc18p-pn	csf-pf	24 0F
Granite City..	sgc20-pn	cf	18 0F
Jacksonville	sgcp-pn	cf-pf	15 4F
Joliet..... .	srgmp-pn	mi-pr	47 7I
Kankakee	srgmp-pn	md-mf-pf	19 0F
Kewanee..	sgmp-pn	md-pf	16 8B
LaSalle	sargmp-pn	md-pf	12 5B
Lincoln	No		12 2B
Mattoon..	srgmp-ppn	mi-pf	14 0I
Maywood	srgc18p-pn	cb-pf	11.6B
Moline	sgmp-pn	mcf	30 0F
Monmouth	No	pf	10 2F
Mt Vernon ..	No	pf	10 0B
Oak Park	srgm-ppy	mi	35 0I
Ottawa...	sargm-ppy	md	13 0B
Pekin.....	No	pd	13 0B
Peoria...	sargmp-pn	md-pf	73 0B
Quincy	sgc18p-pn	cf-pf	36 8F
Rock Island..	sgmp-pn	mi-pf	30 0I
Rockford...	sgcp-pn	cd-pr-pf	59 0B
Springfield	sargmp-pn	md-pf	61 2B
Streator	sgc18-ppy	cd	15.0B
Urbana	No	pf	11 5F
Waukegan..	sargmp-pn	md-pf	22 1B
INDIANA			
Anderson	sgm-ppy	mcf	32 5F
Bedford	No	pf	10 3F
Bloomington	srgmp-pn	md-pf	28 0B
Brazil	No		11 8B
Columbus..	sargmp-ppny	md-pf	11 8B
Crawfordsville	No	pf	11.2F
E. Chicago...	srgmp-ppn	mi-pf	36 0I
Elkhart.	sgc	csf-pf	23.0F
Elwood	sgm	md	11.0B
Evansville...			
Ft Wayne	sgmp-pn	mcr-pf	80 0R
Frankfort	sgc19-ppy	cf	9 6F
Gary	sargmp-ppn	mf-pf	16 8F
Goshen	sgc	cf	9 0F
Hammond .	sgm-pn	md	30 0B
Huntington. .	sgmp-pn	mi-pf	16 5I
Indianapolis	sgc18p-ppn	cr-pf	300.0R
Jeffersonville	sgcp-pn	cf-pf	10 4F
Kokomo	sgc	cf	21 0F
Lafayette	srgmp-pn	mi-pf	21 3I
Laporte	No	pd	15 9B
Logansport.	sgc18p-ppn	cd-pf	22 0B
Marion	sgmp-pn	md-pf	22 0B
Michigan City	srgc18p-pn	pf	20 0F
Mishawaka...	sgmp-pn	md-pf	17 0B
Muncie	sgm	mcf	25.5F
New Albany	sargmp-pn	md-pf	27 4B
New Castle	sgc	cf-csf	13 2F
Peru...	sgcp-pn	cf-pf	14.0F
Richmond..	sgmp-pn	mi-pf	26 0I
Shelbyville	sgc19p-pn	cf-pf	10 5F
South Bend..	sgm-ppy	mscf	71.0F
Terre Haute.	sgmp-pn	mi-pf	66.0
Vincennes	sgcp-ppy	cr-pf	17 6R
Wabash .	srgc18p-pn	cgf-pf	10 0F
IOWA			
Boone			
Burlington...	sgm19p-pn	cf and d-pf	25 0F
Cedar Rapids.	srgmp-pn	md-pf	42 0F
Clinton......			
Council Bluffs	sargc19p-pn	cf and d-pf	35 0F
Davenport...	sgmp-pn	md-pf	52 0B
Des Moines	srgmp-pn	mi	100 0I
Dubuque...	sgc28p-pn	ci-pf	43 0I
Ft. Dodge..			
Ft. Madison..	No	pf	9.7F
Iowa City.	sgmcp-pn	mcf-pf	23 1F
Keokuk.....	srgcp	cd-pd	16 0B
Marshalltown	No	pf	16 1F
Mason City	srgmp-ppyn	mbf-pf	20 0I
Muscatine...	No	pf	18 7F
Oskaloosa	No	pf	10 5F
Ottumwa	No	pf	23 0F
Sioux City..	sargmp-pn	mf-pf	65.0F
Waterloo..	No	pf	36 7F
KANSAS			
Atchison..	sgcp-ppi	cf-pf	16 8F
Chanute	No		12 5F
Coffeyville..	No	pf	17 6F
Emporia... .	sgc-pn	cf	10 9F
Ft. Scott.	srgc-ppy	cf	12 0F
Hutchinson...	No	pf	20 8F
Independence.	No	pf	14 5F
Iola	sgcp-pn	cf-pf	11 1F
Kansas City.	No	pf	99 4F
Lawrence	sgcp-pn	cf-pf	13 5F
Leavenworth	srgmp	md-pf	24 0B
Parsons...	No	pf	16 9F
Pittsburgh..	No	pf	19 8F
Salina..	No	pf	12 6F
Topeka	sgc-ppy	pf	48 7F
Wichita	No	pf	70 7F
KENTUCKY			
Ashland... ..	srgm-pn	mb	14 0B
Bowling Green	No	pf	9 8
Covington...	sgm	mscf	56 5F
Frankfort .	No	pf	12.3F
Henderson..	sargc-22	md	15 0B
Hopkinsville	No	pd	10 7B
Lexington	sgc18p-pn	cb-pf	41 1B
Louisville	sargmp-pn	mf	246.3F
Newport..	sagmp-pn	mb-pf	31 9B
Owensboro	sgm-ppy	smf	17 8F
Paducah	No	pf	24 8F
LOUISIANA			
Alexandria..			
Baton Rouge	sargmp-pn	mi-pf	22 9I
Lake Charles			
Monroe...	No	pf	13 2
New Orleans..	srgm-ppy	md-mi	375 0B
Shreveport	srgmp-pn	mi-pf	36 6I
MAINE			
Auburn	No	pf	17.1F
Augusta	No	pf	15.0F
Bangor	No	pf	26.7F
Bath	No	pf	9.3F
Biddeford .	No	pf	17 7F
Lewiston.	sgcp-pn	cf-pf	27 8F
Portland .	sgmp-ppn	mf-pf	64 7F
Rockland..	sgmp	md-pf	8.4B
Sanford...	No	pf	10 9F
Waterville..	No	pf	12.7F
Westbrook	No	pf	9 4F
MARYLAND			
Annapolis	srgc18-pn	cd	10 0B
Baltimore	sgm-ppy	mcr	590.0R
Cumberland.	srgcp-pn	cb-pf	26.6B
Frederick..	sargc19-pn	cd	10 8B
Hagerstown	sgc18-pn	csf	25 7F
MASSACHUSETTS			
Adams ...	sgm	mf	14.2F
Amesbury....	No	pf	10.2F
Arlington	sgm	mscf	12.8F
Athol	No	pf	11.5F
Attleboro.....	sgcp-ppyn	cf-pf	19.3F
Beverly......	sgc20-ppy	cf	23.0F
Boston	sgmc19p-ppn	mcr-pf	775 0R
Braintree.....	sgc19-ppy	cf	10.0F
Brockton	sgm-ppn	mf-pf	63 5F
Brookline	sgc 21 ppy	cf	34.5F
Cambridge.	sgm-ppn	msf-pf	121 8F
Chelsea...	sgc22-ppy	cf	46.2F
Chicopee.	sgmp-pn	msf-pf	30 0F
Clinton	sgc18-pn	cf	13 1F
Danvers	sgc18-ppy	cf	11.0F
Dedham	sgc20-ppy	cf	11.0F
Easthampton	sgc	cf	10 3F
Everett	sgc19	cf	40 0F
Fall River	sgc22-ppy	cf	131 4F
Fitchburg	sgc18-pn	cf-pf	40 5F
Framingham	sgc20-ppy	cf	14.0F
Gardner....	sgcp18-pn	cf-pf	17.1F
Gloucester....	sgc23-ppyn	cf-pf	24.6F
Greenfield	sgc20p-ppn	cf-pf	14.4F
Haverhill.....	sgc20-ppy	cf	55 1F
Holyoke.....	sgc19-ppyn	cf-pr	62.3F
Lawrence .			
Leominster...	sgc18p-ppn	cf-pf	17.6F
Lowell.... .	sgmp-ppyn	msf-pf	108.0F
Lynn.....	sgmc-ppy	msf-csf	96.0F
Malden... .	sgm-ppy	mscsf	50.1F
Marlboro....	No	pf	15.6F
Medford. ..	sgp	pf	33.5F
Melrose.	sgc20-ppn	cf	18.0F
Methuen....	sgmp-pn	mf-pf	13.9F
Middleboro...	sgc-ppy	cf	10.0F
Milford...	sgp-pn	pf	14.1F
Natick	sgc19p-pn	cf-pf	12 4F
New Bedford	sgm-ppy	mcr	120.0R
Newburyport	sgp-pn	pf	15.3F
Newton......	sgc18p-pn	cf-pf	43.7F
North Adams.	sgcp-pn	cf-pf	23.0F
Northampton.	sgc18p-pn	cf-pf	21 7F
N. Attleboro..	No	pf	11.0F
Northbridge..	sgp	pf	9 9F
Norwood	No	pf	12.8F
Palmer .	No	pf	10 0F
Peabody.....	sgp	pf	20 0F
Pittsfield.	sgc19-ppy	cf	38 6F
Plymouth....	No	pf	13.7F
Quincy.......	sgm-ppy	msf	45.0F
Revere	sgc19p-ppn	cf-pf	27 0F
Salem....	sgmp-ppyn	mscsf-pf	42.0F
Saugus.... .	sgc19p-ppyn	cf-pf	10.4F
Somerville....	sgm-ppy	msf	90.2F
Southbridge..	sgc20p-ppn	cf-pf	13 3F
Springfield	sgm-ppy	msf	105 9F
Taunton	sgmp-pn	mf-pf	36.3F
Wakefield....	sgc20p-ppn	cf	12.7F
Waltham...	sgc22p	cf-pf	30.6F
Ware..... .	No	pf	9.4F
Watertown...	sgc19p-ppn	cf-pf	20.5F
Webster.	No	pf	13.2F
W. Springfield	sgcp-pn	cf-pf	12.0F
Westfield... .	sgc18p-ppn	cf-pf	19.5F
Weymouth...	No	pf	14 0I
Winchester...	sgm-ppy	mscf	10 9I
Winthrop. .	sgc18-pn	cf	12 8I
Woburn.	sgc18-ppy	cf	16.0F
Worcester....	sgmp-pn	mf-pf	185 0F
MICHIGAN			
Adrian... . .	sgc19p-pn	cf-pf	10 8I
Alpena.......	No	pf	12.7F
Ann Arbor...	sgc22p-pn	cfd-pf	18.3F
Battle Creek..	sargcp-pn	cf-pf	34 2I
Bay City...	No	pd	47.9B
Benton Harbor.. .	sgm-pn	mi	12.0I
Cadillac... .	No	pf	10.0F
Detroit...	sgm-ppy	mcr	810.0R
Escanaba.. ..	srgc-ppy	cd	15.4B
Flint..	sgc-ppy	cf	54.7F
Grand Rapids	sgm-ppy	mscf	130 0F
Hancock.. .	sargm-pn	md	10 0B
Holland..	sgc		12.3B
Iron Mountain	sgm	mi	9.2I
Ironwood..	sargmp-pn	md-pd	14 7B
Ishpeming.	srgmp-pn	mi-pf	12 5I
Jackson.	sargp-pn	pf	35 4F
Kalamazoo	sargmpc-18	md-pf	51.2B
Lansing.	sgmp-pn	mf-pf	37 5F
Laurium.	sargm	mb	10.3B
Ludington	srgcp-pn	cf-pf	10 4F
Manistee	No	pd	12.3B
Marquette.	srgm-ppy	md	13.0B
Menominee .	srgm-ppy	md	12 8B
Muskegon.	srgp-pn	pf	41.5F
Negaunee.	sgm	md	10 1B
Owosso	sgc-pn	cf-pf-pd	
Pontiac	sgc-18ppy	cf	15.6F
Port Huron	sgp	pd	18.9B
Saginaw...	No	pf-pr	64 5F
Sault Ste. Marie.	No	pd	14.5B
Traverse City	No	pf	13 0F
Wyandotte	No	pf	10 3
MINNESOTA			
Brainard.....	No	cd	9 1B
Duluth.......	srgmp-pn	mi-pi	98 5I
Faribault	No	pf	11 0F

	Collection*	Disposal†	Population‡
Hibbing	sgmp	mi-pf	16 4I
Mankato	sgmc-pn	md-cd-csi	14 4B
Minneapolis	sgm	msf	315 3F
Red Wing	sargcp-ppn	cd-pf	10 1B
St. Cloud	sgc18-ppy	cf	15 5F
St. Paul	sgmp-pn	msef	272.0F
Stillwater	No	pf	10.6F
Virginia	sgm	mi	15 5I
Winona	No	pf	18.6F

MISSISSIPPI

	Collection*	Disposal†	Population‡
Biloxi	sgm-pn	md	9 7B
Columbus	sargmp-pn	mi-pf	9.0I
Greenville	No	pf	12 1F
Hattiesburg	sgm-ppy	mi	16 5B
Jackson	sgmp-pn	pf-mf	31 0F
Laurel	No	pf	11 8F
Meridian	No	pf	30.0F
Natchez	sgmp-pn	md-pf	33 8B
Vicksburg	sgmc	md	22 8B

MISSOURI

	Collection*	Disposal†	Population‡
Cape Girardeau	No	pf	10 8F
Carthage	No	pf	10 8F
Columbia	No	pf-pp	12 5I
Hannibal	No	pf	20 0F
Independence	No	pf	12 5F
Jefferson City	No	pf	15.0F
Joplin	sgc-21-ppn	cf-pf	33 2F
Kansas City	sgc18p-pn	cf-pf	391 0F
Moberly	No	pf	12 8F
St. Charles	No	pf	10 3F
St. Joseph	No	pf	85 2F
St. Louis	sgmp-pn	mer-pr-pf	902 0R
Sedalia	No	pf	27.2F
Springfield	sgc-ppy	cf	39 9F
Webb City			13 8F

MONTANA

	Collection*	Disposal†	Population‡
Anaconda	No		10 6B
Billings	sargm-pn	md	16 1B
Butte	sgm-ppn	mi	100 0B
Great Falls	sargmp-pn	md-pf	29 1B
Helena	sgm-pn	mi	15 0I
Missoula	No		17 2B

NEBRASKA

	Collection*	Disposal†	Population‡
Beatrice	srgc-36-ppy	ci	11 8I
Fremont	No	pf	12.0F
Grand Island	No	pf	15 0F
Hastings	sgc22p-ppn	cf-pb	12 8F
Lincoln	srgc	cd	55 0B
Omaha	sgc18p-ppn	cf-pf	165 5F

NEVADA

	Collection*	Disposal†	Population‡
Reno	No	pf	15 9F

NEW HAMPSHIRE

	Collection*	Disposal†	Population‡
Berlin	srgmp-pn	mi-pf	14 7F
Concord	cf or pcol		22 0F
Dover			
Keene	No	pf	10 6F
Laconia	sargmp-pn	md-pf	13 6B
Manchester	sgpc-pn	cf pf	80 1F
Nashua			
Portsmouth	No	pf	13 5I
Rochester	No	pf	9 1F

NEW JERSEY

	Collection*	Disposal†	Population‡
Asbury Park	sgc18p-ppn	cf-pf	14 0F
Atlantic City	srgc21p-ppn	cr-pf	60 0R
Bayonne	sargm-pn	md	78 6B
Belleville	sargc19-pn	cd	12 4B
Bloomfield	sargmp-pn	md-pd	17 2B
Bridgeton			
Burlington			
Camden	sgm	md	106 2B
East Orange	sargmcp-pn	mdi-pd	42 4B
Elizabeth	sargc-19	cd	88 8B
Englewood	sgcp-pn	cf-pf	11 7F
Garfield	sagm	md	18 0B
Gloucester	sargmp-pn	md-pf	11 5B
Hackensack	sargp	pd	17 0B
Harrison	sgc19-ppy	cd	16 4B
Hoboken	sargc18-pn	cd	72 0B
Irvington	srgm-ppy	mcsf-pf	25 0F
Jersey City	sargc22p-pn	cd	316.9B
Kearny	sargm-pn	md	25 0B
Long Branch	sgc21p-ppn	cr-pf	16 0R
Millburn	sargm-pn	md	
Millville	No	pf	15 5F
Montclair	sgm-ppy	mcf	26 0F
Morristown	sgc19-ppy	cf	13 0F
New Brunswick	sgmp-pn	mgf-pf	25 5F
Newark	sargmp-pn	md-pf	410 5B
Orange	sargc18p-pn	cd-pd	33 0B
Passaic	sargm-pn	md	70 1B
Paterson	sargmp-pn	mi-pd-pr	137 6I
Perth Amboy	srgc19-ppy	cd	45 1B
Phillipsburg			
Plainfield	sgcp-pn	pf	26 0F
Rahway	sargmp-pn	md-pd	10 2B
Trenton	sargmp-pn	mi-pf	120 8I
Union			
West Hoboken			
West New York			
West Orange	sgcp-ppn	cf-pf	14 8F

NEW MEXICO

	Collection*	Disposal†	Population‡
Albuquerque	sgc	csf	14 0F

NEW YORK

	Collection*	Disposal†	Population‡
Albany	sgmcp-pn	mcr-pf	110 0F
Amsterdam	srgm-ppy	cd	37 1I
Auburn	sgmp-pn	md-pf	37 4B
Batavia	srgmp-ppn	mi pf	13 0F
Beacon	sargc 18pn	cd	11 6B
Binghamton	sgmp-pn	mgi-pf	53.7F
Buffalo	sgmp-pn	mr-pf	500 0R
Cohoes	sargc-20 pn	cd	23.4B
Corning	sgc-ppy	cf	15 4F
Cortland	sgc-19p-pn	cf-pf	11 5F
Dunkirk	sgc-19-ppy	cf	20 2F
Elmira			
Fulton	sargp-pn	pd	14 4B
Geneva			
Glens Falls	No	pf	16 9F
Gloversville	srgc18-ppy	cd	22 1B
Hornell	sgc	cf	14 6F
Hudson	sgcp-ppyn	cf-pf	12 0F
Ithaca	sargmp-pn	md-pf	17 5B
Jamestown	sgcp-pn	pf-cf	37 8B
Johnstown	srgc18-pn	cd	10 0B
Kingston	sgmp-ppy	mgf-pf	26 9F
Lackawanna	sargc18-ppy	cd	18 0B
Little Falls	sgcp-pn	cf-pf	13 0F
Lockport	sargmp-pn	mgf-pf	20 5F
Middletown	sgc19-pn	cd	15 8B
Mt. Vernon			
New Rochelle			37 0I
New York City: Manhattan, Bronx, Brooklyn	sgmp-pn	mr-pr-pf	5,270 0R
Queens	sargmp-pn	mi-md	379 7I
Richmond	sargmp-pn	mi	105 0I
Newburgh	sgc	cf	29 6F
Niagara Falls	sargm-pn	md	37 3B
North Tonawanda	sgc18-ppy	cd	14 0B
Ogdensburg	No	pd-pf	16 7B
Olean	sgc20-ppn	cf-pf	20 0F
Oneida			
Oneonta	sgc	cf	10 5F
Ossining			
Oswego	No	pd	24 5B
Peekskill			
Plattsburg	No	pf	11 1F
Port Chester			
Port Jervis	sgmp-pn	md-pf	9 7B
Poughkeepsie			
Rensselaer	sgc19p-pn	cf-pf	11 4F
Rochester	sgm-ppy	mr	275 0R
Rome	sgc21p-pn	cf-pf	25 9F
Saratoga Spgs	No	pf	13 8F
Schenectady	sgmp-ppn	mi-pf	102 0R
Syracuse	sgmp-ppn	md pf	150 0B
Tonawanda	sargc19-pn	cd	9 2B
Troy	sargmp-pn	md-pf	78 1B
Utica	sgc21p-pn	cr-pf	90 0R
Watertown	sgcp-pn	cd-pf	32 7B
Watervliet	srgm	md	15 0B
White Plains	sargc-ppy	cd	22 5B
Yonkers	sgmp-pn	mi-pf	99 8I

NORTH CAROLINA

	Collection*	Disposal†	Population‡
Asheville	sargm-pn	mi	25 0I
Charlotte			
Concord			
Durham	sargmp-pn	mi-pf	26 2I
Elizabeth City			
Greensboro	No	pf	21 9I
High Point	No	pf	14 0F
New Bern	srgm	md	15 0B
Raleigh	sgm	md	25 0B
Rocky Mount			
Wilmington	sgmp-pn	mf-pf	30 0I
Winston-Salem	srgmp-pn	mi-pf	55 0I

NORTH DAKOTA

	Collection*	Disposal†	Population‡
Fargo	sgm	[illegible]	17 3I
Grand Forks	srgcp-pn	ci-pi	26 5I

OHIO

	Collection*	Disposal†	Population‡
Akron	sgc23p-ppn	cr-pf	150 0R
Alliance	sgc21p-ppn	cf-pf	22 0F
Ashtabula	srgc21p-ppn	cd-pf	23 0B
Barberton	sgc18-ppy	cd	18 0B
Bellaire	No	pd	15 0B
Bellefontaine			
Bucyrus	sgmp-pn	mf-pf	11 1F
Cambridge	sgp-pn	pf	15 8F
Canton	sgmp-pn	mcr-pd	70 0R
Chillicothe	sargmp-pn	md-pf	17 0B
Cincinnati	sgc-18-ppn	cr-pf	415.0R
Cleveland	sgm-pn	mr-pr-pf	750 0R
Columbus	sgmp-ppn	mr-pf	220.0R
Conneaut	No	pd	9 0B
Coshocton	sgc-18	cd-pf	11 6B
Dayton	sgmp-ppn	mr-pf	135 0R
Delaware	No		9 8F
East Cleveland	sgc18p-pn	cf	16 0F
East Liverpool			
Elyria	sgc	cr	20 0R
Findlay	No	pf	17 0F
Fostoria	sgc18-pn	cd	12 0B
Fremont	sgc20-ppy	cf	11 8F
Hamilton			
Ironton	sargmp-pn	md-pf	16 0B
Lakewood	sgmp-pn	msf	22 6F
Lancaster	No	pd	15 7B
Lima	sgcp-pn	cd-pf	32 0B
Lorain	sgc-21	ci	54 0
Mansfield	sgc21p-pn	ci-pr	25.0I
Marietta	No	pf	14 8F
Marion	No	pf	27 5F
Martin's Ferry	srgc-ppy	cd	12.1B
Massillon	No	pd	17 0B
Middletown			
Mt. Vernon			
New Philadelphia	No	pf	10 5I
Newark	sargcp-pn	cd-pd	32 9B
Niles	sargcp	cdp	12 0B
Norwood	sgm-pn	md	25 0B
Piqua	No	pf	14 5I
Portsmouth	sargm-pn	md	33.0B
Salem	No	pd	11 0B
Sandusky	srgcp	cd-pd	23.0B
Springfield	sgcp-pn	cf-pf	60 9F
Steubenville	srgc18p-pn	mi	29 1I
Tiffin	sgc18p-pn	cf-pf	13.5F
Toledo	sgm-ppy	mcr	275 0R
Warren			
Xenia	No	pf	10 0I
Youngstown	sgc18p-ppn	cr-pf	120 0R
Zanesville	sgm	mi	30 9B

OKLAHOMA

	Collection*	Disposal†	Population‡
Ardmore			
Chickasha			
Enid	No	pd	18 9B
Guthrie			12 0F
McAlester	No	pd	15.0B
Muskogee	srgc32-ppy	cf	44 0F
Okla. City	sgmp-ppn	msef-pf	100 0F
Sapulpa	sgcp-pn	cf-pf	11 0F
Shawnee	srgmp-ppn	msf-pf	18.2I
Tulsa	sgc	cf	69 2F

OREGON

	Collection*	Disposal†	Population‡
Astoria	sgc-18p-ppn	cf-pf	20 0F
Eugene	No		13 6I
Medford	No	pf	14.1F
Portland			
Salem	No	pf	14 0I

PENNSYLVANIA

	Collection*	Disposal†	Population‡
Allentown	sgc19p-pn	ci-pf	
Altoona	sgm-ppy	mcf	60 1I
Beaver Falls	sgm-ppy	mi	12.8I
Bethlehem	srgp-pn	pd	21 0B
Braddock	sgc18-pn	cr	22 0R
Bradford	sgp	pf	16.0F
Bristol	sgc-ppy	cf	12.0F
Butler	sgcp-pn	cb-pf	28 1B
Carbondale	No	pd pf	20.0B
Carlisle	No	pf	10 8F
Carnegie	srgc19p-pn	cb-pf	11 7B
Chambersburg	sargp-pn	pd-pf	13 0B
Charleroi			
Chester	sgc-ppy	cf	70 0I
Coatesville	sgc-ppy	cd	20 0B
Columbia			
Connellsville	srgc20-ppy	cf-ci	15 5I
Dickson City	No	pf	12 1F
Donora			
Dubois	srgmp-ppyn	mi-pf	15 0I
Dunmore	No	pf	22 6F
Duquesne			
Easton	srgmp-pn	mf	30 9I
Edwardsville			
Erie	sgmp-pn	mi pf	95 0I
Farrell			
Franklin	sgp	pb	10 7B
Greater Punxsutawney	No	pd	12 0B
Greensburg	sargp-pn	pb	16 0B
Harrisburg	sgc-ppy	i	72 0I
Hazleton			
Homestead	srgm-ppy	mi	23 3I
Jeannette	No	pb	10 0B
Johnstown	No	[illegible]	82 0I
Lancaster	sgc18p	cf-pf	50 0I
Lansford			
Larksville			
Latrobe			
Lebanon	No	pd pf	22 0B
Lewistown	No	pd	11 1B
McKees Rocks	sgcp-pn	[illegible] pf	21 0B
McKeesport	srgmp-ppn	mi	55 [illegible]
Mahanoy City	srgc18p-pn	cd pd	18 4B
Meadville	sgc-ppy	mi	15 0I
Monessen	sargmp-pn	md	17 5B
Mount Carmel			
Nanticoke			
New Brighton			
New Castle	sgmp-pn	mi pd	44 3I
Norristown			
North Braddock	sgm-pn	mi	26 8I
Northampton			
Oil City	srgc22p-pn	ci-pi	19 9I
Old Forge	No	pf	13 0I
Olyphant			
Philadelphia	sgc18p-pn	cr-pf	1,800 0R
Phoenixville			
Pittsburgh	sgc-ppy	cr	590 0R
Pittston	No	pd	19 3B
Plymouth	No	pd-pf	19 1B
Pottstown	No	pf	20 0F
Pottsville	sargp-pn	pd	24.0B
Reading	sgmp-pn	mi-pf	117 0I
Scranton	srgmp-pn	mi-pf	154 3I
Shamokin			

	Collection*	Disposal†	Population‡
Sharon	sgc-ppy	cd	35 4B
Sharpsburg	sgc-ppy	cr	10.6R
Shenandoah		....	....
S. Bethlehem	srgmp-pn	md-pf	30 0B
Steelton		....	...
Sunbury			...
Tamaqua	No	pd	10 8B
Taylor	No	pd	12 6B
Titusville	No	pd-pf	8 5B
Uniontown	sgc23-ppy	cf	20 8F
Warren	srgp-pn	pci-pf	14 4I
Washington	srgc19-ppy	ci	21 6I
West Chester	sgc19p-pn	cf-pf	13 1F
Wilkes-Barre		.....	..
Wilkinsburg	sgc18-ppy	cr	25 0R
Williamsport		....	....
Windber		....	...
York	sgc	cr	51.6R
RHODE ISLAND			
Bristol	No	pf	13.3F
Central Falls	sgc-ppy	cf	25.0F
Cranston	No	pf	29 3F
Cumberland	No	pf	10.8F
E. Providence	sgc20p-ppn	cf-pf	18 6F
Lincoln	sgc18p-pn	cf-pf	10 4F
Newport	sgc19-pn	cd	35 0B
Pawtucket	sgc18p-pn	csf-pf	59.4F
Providence	sgc18p-ppyn	cf-pf	259 0F
Warwick	No	pd-pf	30 0B
Westerly	No	pf	9 4F
Woonsocket	No	pf	34 0F
SOUTH CAROLINA			
Anderson	sgm-pn	mi	13 0I
Charleston	sargmp-pn	md-p.	60 7B
Columbia	sargmp-pn	md-pf	37 0B
Greenville	sargmp-pn	mi-pf	27 6I
Spartansburg	....	....	....
Sumter	srgm-pn	md	9.2B
SOUTH DAKOTA			
Aberdeen	srgmp-pn	mb-pr	16.4B
Lead	sargc18p-pn	cd-pf	8.8B
Sioux Falls	No	pf	24.0F
TENNESSEE			
Chattanooga	sargmp-pn	md-pf	65.0B
Clarkesville	No		
Jackson	srgmp-ppn	mi-pf	18.0I
Johnson City	srgmp-pn	md-pf	12 9B
Knoxville	srgmp-pn	md-pf	36.0B
Memphis	srgmp-ppn	mi-pr-pf	151 3I
Nashville	sgmp-pn	mgf-pf	133.1F
TEXAS			
Abilene	sgp-pn	pf	14.0F
Amarillo	...	....	...
Austin	sgp	pf	34.8F
Beaumont	srgm-ppy	md	33.0B
Brownsville	...	....	....
Cleburne	No	pf	12.3F
Corpus Christi	srgmp-pn	mi	20.0I
Corsicana	No	pf	14.0F
Dallas	srgm-pn	md-pf	122.0B
Denison	No	pf	22.9F
El Paso	srgmp-pn	mi-pf	77 0I
Ft. Worth	srgc18p-ppn	cf-pf	109.3F
Galveston	srgmp-pn	mi	53 3I
Greenville	srgm-pn	mi	12 1I
Houston	sargcp-ppyn	ci-cd-pf	147 0I
Laredo	srgc18p-pn	cd-pf	42 0B
Marshall	No	pf	16 0F
Palestine	No	pf	12 5F
Paris	No	pf	14 0F
San Angelo	No	pf	16.3F
San Antonio	srgm	mi-pf	123 8I
Sherman	No	pf	16 7F
Temple	No	pf	17 0I
Texarkana	No		12 8B
Tyler	No	pf	15 0F
Waco			
Wichita Falls	sgm	mi	16 0I
UTAH			
Ogden	No	pci and d	44 7I
Provo	No	pf	10.6F
Salt Lake City	srgcp-pn	cf-pf	125.0F
VERMONT			
Barre			
Bennington	No	pf	9 1F
Burlington	srgc-ppy	cf	23 5F
Rutland	......	......	
St. Johnsbury	No	pf	8 8F
VIRGINIA			
Alexandria	No		17 8F
Danville	sargmp-pn	md-pf	21.5B
Lynchburg	srgm	mi	35 0I
Newport News	sagm-pn	md	55 0B
Norfolk	srgmp-ppn	mi-pf	106 2I
Petersburg	sargm-pn	mi	39 1I
Portsmouth	srgmp-ppny	mi	43 2I
Richmond	sgmp-pn	mi-pf	158 7I
Roanoke	srgmp-pn	mi-pf	45 7I
Staunton	sargmp-pn	md-pf	11 5B
WASHINGTON			
Aberdeen	sgcp-pn	cd-pf	22.0B
Bellingham	...	......	......
Everett	...	......	....
Hoquiam	Yes		11.7B
N. Yakima	sargmc-pn	md-pf	20.0B
Seattle	sargcp-pn	cd-pf	348.6B
Spokane	sargmp-ppyn	mi-pf	150.3I
Tacoma	sargc-pn	cd-pf	112.8B
Vancouver	No	....	......
Walla Walla	sgcp	cf-pf	25.1F
WEST VIRGINIA			
Bluefield	.....	..	15.4B
Charleston	No-m	mi-pf	30.0I
Clarksburg	No	mi	12.8I
Fairmont	srgmp-pn	mi-pf	17.5I
Huntington	srgm	md-pf	50.0B
Martinsburg	sargc18p-pn	cd-pf	13.3B
Morgantown	No	pf	13.7F
Moundsville	sgc-ppyn	cd	10.2B
Parkersburg	sgcp-pn	cf-pf	23.0F
Wheeling	sgm-ppy	mi	43.7I
WISCONSIN			
Appleton	No	pf	18.0F
Ashland	No	pf	13.1F
Beloit	sgmp-pn	cf-pf	20.0F
Chippewa Falls	srgcp-pn	cf-pf	10 0F
Eau Claire	No	pf	20.0F
Fond du Lac	sargmp-pn	md-pf	20.5B
Green Bay	sgmp-pn	mgf-pf	30.1F
Janesville	sgcp-pn	pf	14.5F
Kenosha	sargmp-pn	md	28 4B
LaCrosse	sgmp	msf-pf	31.7F
Madison	sgm	msf	32.8F
Manitowoc	...		
Marinette	srgmp-pn	md-pf	13 0B
Merrill	sgmp-pn	mgf-pf-md	8 7F
Milwaukee	srgmp-pn	mi-pf	436.5I
Oshkosh	No	pd-pf	36.0B
Racine	srgmp-ppny	mi	50 0I
Sheboygan	srgmp-pn	mi	29.0I
Stevens Point	No	pd	11.7B
Superior	sgcp-pn	cd	47 0B
Watertown	sgp-pn	pd	9.1B
Waukesha	sgmp-pn	mf-pf	12 7F
Wausau	No	pd	19 2B
WYOMING			
Cheyenne	sagc18-ppy	cd	14 0B
Laramie	Collected by private parties	pf	8.3F
Sheridan	No	......	

Freight Handling by Tractors Found Economical

Tractor-Trailer System Replaces Hand Trucking and Reduces Costs at Large L. C. L. Freight Station in Chicago

USE of small tractors to handle trucks in the 43rd St. outbound freight station of the Chicago Junction Ry. was begun in 1914 and has been continued since that time. It results in reduction of cost of freight handling, with fewer men and greater facility of work. At this station less-than-carload freight received from wagons, motor trucks and trap cars is sorted and delivered to cars for shipment. The freight house is U-shaped in plan, 700 ft. long, with 12 tracks and two platforms. It is so operated that all hauls are short, and as the average is only 250 ft., it is thought that the tractors do not show so great an advantage as they would if the distance were greater. But the railway officials consider that for any distance greater than 250 ft. the tractor system is more economical than hand trucking.

ELECTRIC TRACTORS HAUL TRAINS OF AS MANY AS TWENTY-FIVE TRUCKS IN LARGE FREIGHT STATION AT CHICAGO

Electric storage-battery tractors are used. They weigh about 2100 lb. and are capable of running 12 hours on one charge. The tractors carry no freight, but haul trains of four-wheel trailer trucks. As many as 25 trucks can be hauled, but the average train consists of seven trucks. Sharp turns and corners are passed without difficulty, the trucks having castors for the front wheels and special couplings which insure every truck following in the path of the tractor. The average speed is three or four miles per hour, with loaded trains.

The tractor is kept continually on the move. It picks up loaded trucks at the team platform or the trap cars, and

delivers them in succession at the outgoing cars. Having dropped all the trucks, the tractor returns for another train, picking up empty cars on its way. With each tractor there are a motorman and a helper. The latter couples and uncouples the trucks, uncoupling being done without stopping the train.

Freight is handled at the team platforms and trap cars by groups of four men, each assigned to a certain number of outbound cars. The checker indicates the car in which each package is to be placed and the caller marks it accordingly. The truckers place it on the truck destined for that car, and as the trucks are loaded they arrange them in the same order as the cars, so that they can be dropped consecutively by the tractor. At the cars there are dispatchers, each assigned to 150 ft. of platform. These take the trucks as they are cut off from the tractor train and push them to or into the car, ready for the stevedore who stows the freight. These dispatchers also remove the empty trucks and push them into position to be picked up by a returning tractor.

CASTOR FRONT WHEELS AND SPECIAL CHAIN COUPLINGS CAUSE TRAILER TRUCKS TO FOLLOW PATH OF TRACTOR

Two-wheel hand trucks are used to some extent, but are fitted with castors and couplings so that they can be handled as trailers if necessary. One four-wheel truck, however, will carry as much as five of the hand trucks. A special condition at this freight house is the necessity of handling about 20 carloads of perishable freight in one hour, at noon. The two-wheel hand trucks are used mainly during this rush hour.

Equipment and costs for the tractor-trailer system are shown by the accompanying table. The increase of about 1c. in cost per ton for 1917 as compared with 1914 is due to the change in wage rates and labor conditions. For 1917 the total labor cost of handling freight, including unloading from the wagon or trap car and stowage in the outgoing freight car, is stated to have been 35.6c. per ton, distributed as follows: Motormen, 1.4c.; supervision, 1.7c.; callers, 6c.; checkers, 7.3c.; truckers, 11c.; stevedores, 4.8c.; dispatchers, 3.4c. The cost of maintenance, repair, battery renewals and charging current averages $344.93 per tractor per year.

FREIGHT HANDLING BY TRACTOR-TRAILER SYSTEM AT CHICAGO STATION

	1914	1917
Number of tractors	2	4
Number of four-wheel trailer trucks	160	350
Number of two-wheel hand trucks	150	150
Tons of freight trucked daily	1,200	1,200 to 1,400
Average number of trucks per train	7	7
Maximum number of trucks per train	20	25
Average trucking haul	250 ft.	250 ft.
Cost of trucking by hand, cents per ton	16.27 to 17.37	15.8
Cost of trucking by tractor, cents per ton	12.57 to 13.30	14.4
Average saving by tractor, per ton	30%	30 to 35%
Wages:		
Checkers, per month	$75	$97
Callers, per hour	23½c	29½c
Truckers, per hour	22c.	28c.
Stevedores, per hour	23c.	29c.
Laborers, per hour	22c.	28c
Motormen, per hour	23½c	29½c
Motormen's helpers, per hour	22c.	28c

When this system was adopted it eliminated about 70 laborers formerly engaged in trucking. No change was made in the methods or men for unloading, sorting and stowing the freight. It is estimated that a return to the old system, assuming that the necessary number of men could be obtained, would cause a 50% increase in the present cost. E. O. Burton is agent in charge of the station. The work is done under the direction of W. J. O'Brien, general superintendent of the Chicago Junction Railway.

Character of Drawings Reflects Company Standards

Uniformity of Practice Is Necessary and Demands Attention to Details That by Themselves Seem Unimportant

By J. H. Melville

Assistant Engineer, Westinghouse Church Kerr & Co., New York City

While a great deal of time and thought has been spent in standardizing drafting-room practice in the matter of design, the matter of the drafting itself, by which the design is to be expressed, has often not received the attention which is due to it. Character in drawings is no more than a standardization of principles for guidance in practice, and the character displayed measures the standards adopted by an engineering concern for the guidance of its drafting force.

An individual draftsman if left to his own devices may turn out an excellent drawing, but its characterization will be that of the individual. If we have a hundred draftsmen working under the same conditions, we may get a hundred excellent drawings, but we shall have such a mixture of characterization that it will not be at all pleasing or desirable as coming from the same company. Therefore, it is highly desirable for every engineering or architectural office that it should evolve in its drafting practice standards suitable to its particular class of work. In this way only can it acquire what we may call "company" character as opposed to "individual" character.

The following notes, while applicable more or less to all drawings, are intended to deal principally with working construction drawings, the chief function of which

is to provide clear and readable blueprints from which the construction forces may work with ease and certainty.

The first requisite of character in drawings would seem to be arrangement: that is, placing the different parts of the design on the sheet so that each will bring out the idea of the designer in a logical way, without the necessity of resorting to mental or optical gymnastics to find out what it is all about. In this connection it should be remembered that an overcrowded sheet cannot be clear, and clearness, next to accuracy, is the prime necessity in a working drawing.

Plans, sections and elevations should be placed as nearly as possible where they would be logically looked for. If a plan lies with its North toward the top of the sheet, it will be logical to look for a North elevation above it, a South elevation below it, an East elevation at its right and a West elevation at its left. For a section looking North the eye would also logically travel up or down and for sections looking East or West to the right or left. Of course it is not always possible to secure so ideal an arrangement, but the principle should be kept in mind. Sections, etc., should be placed somewhere near the place in which they would naturally be expected, or else be grouped together in some logical and easily found arrangement.

Handling of Details

A general plan on a small scale should not be cluttered up with details stuck in here and there. If the work is large enough, all details should be kept off the general plan and placed on a special sheet. With different sized standard sheets this is easily arranged without a waste of cloth; but if the work is unimportant, and it is desired to show details on the same sheet as the general plan, these should be collected on one part of the drawing—perhaps the bottom portion is best—and separated from the rest of the drawing by an inclosure line if it be thought necessary.

Though proper arrangement demands a little preliminary study and thought, this is amply repaid in the clearness of the drawing and the ease with which it may be read. Before a drawing is started the assistant in charge of the draftsmen should decide just what is to go on the sheet, and should have the various parts roughly blocked out to scale on the cloth with soft pencil for his approval. If he has a good sense of proportion and the fitness of things—as he should have—this will insure a good grouping of the various parts.

It will not be amiss at this point to mention two other matters, seemingly unimportant, but which, if neglected, are frequently enough to spoil the effect of a sheet. One occurs when the border lines should be drawn and the other is the common practice of pencil designing directly on the cloth. If the best arrangement is to be secured under all conditions, the border line should be the last thing put on the sheet—excepting only the title and "Notes," unless every part of the design is cut and dried and can be placed to a nicety before tracing. It is often a great advantage to be able to shift the border line an inch or two from the location first intended, to the great benefit of the appearance of the sheet.

One disadvantage in designing on cloth which outweighs its supposed advantages is that, after the design is drawn, it cannot be shifted, and must be inked in where it stands. Even with a carefully considered prearrangement of sheet, it often turns out that unforeseen additions or other modifications of design make it desirable to shift the position of some part from its original location, to secure better grouping of the various parts. Furthermore, it is very doubtful whether inking in a design made on cloth is any more quickly done than tracing from an independent sheet.

Legends and Lettering Deserve Careful Consideration

In arranging a sheet the "Notes," "Key," "Reference List of Drawings," and cardinal or "North" point must not be forgotten. It is well to standardize the location of these—of the first three at any rate. A good place for a "Key" and "Notes" is directly above the title, and for "Reference List of Drawings" directly to the left of same, or vice versa. The "Notes" generally contain essential specifications for the execution of the work, and it is highly desirable that the user of the plan should know where to find them and not have to hunt for them in a different part of each sheet. Ample space should be allowed to take care of extra notes or symbols that may be found necessary before the drawing is complete, and the "Notes," "Key," and "Reference List of Drawings" should not be put on till the drawing is finished. The size of lettering can be made to suit the space available, and it can be properly placed with respect to adjacent matter to avoid unnecessary crowding at one point and unnecessary blank cloth at another.

All drawings that show design in plan should have a "North" point. Especially is this desirable in a sheet of details such as the foundation details for isolated columns, and in such case every detail should bear its true relation to the "North" point.

The simple border consisting of two straight parallel lines—the inner one heavy and the outer or trim line lighter—meeting squarely at the corners, is now almost universal since it looks as well as any other and takes but little time to put on. Simplicity should also be the keynote of the "North" point and the linear scale. The latter is not generally used on any except topographical maps, or when plans are to be photographed. Size of "North" point and length in inches of linear scale should be standardized for different sized sheets, but the style should be kept uniform in all.

Lettering Should Be Standardized

Poor lettering can easily kill the best drawing ever made, and no other detail should be more carefully standardized. It is not the purpose to discuss here the relative merits of vertical or sloping lettering beyond venturing the opinion that vertical lettering, if properly done, is more in keeping with the vertical and horizontal lines that make up an engineering or architectural drawing. It is, however, very difficult to get it well done, and a much higher general standard of efficiency and speed can be obtained with sloping lettering. But whatever style is adopted it should be clear and bold with both capitals and italics of the same style. The attenuated affectations so much in favor with some architectural draftsmen, with elegantly modish Rs trying diffidently to forget their tails, should have no place in any system of lettering in an engineering office.

Standard heights of capital lettering should be fixed for different sized sheets, and no departure therefrom allowed on any regular working drawing turned out of the drafting room. Perspective sketches, or drawings made for illustrative or other special purposes, would of course be exceptions to the above rule, and should be treated as might seem most desirable in each case.

The lettering for the designations of "Plan," "Section," "Elevation," etc., should be in bold capitals, and reference lines to sections on plans should be boldly lettered so that they can be easily picked out. Nothing is more tantalizing than to find a reference line bashfully disguised with diminutive italic letters which cannot be distinguished from others around them. Structural steel draftsmen are frequent offenders in this respect.

The addition of a few words below the title of a section or plan telling its purpose will often save time, as for instance:

SECTION A-A.	**PLAN AT ELEVATION 193'.**
Showing steam and exhaust headers.	*Showing crane runway and mezzanine landings.*

And do not call a plan a section—it leads to a confusion. All plans are understood to be either sections or elevations on the horizontal plane, so it is clearer to apply the word "Section" to the vertical or intermediary planes only.

As a general rule, lettering should be done after all necessary dimensions and dimension lines are on the drawing, otherwise the two will often clash and make erasures of one or the other necessary. If a stamp is used, its design should be such that it will conform in the matter of lettering with the standards adopted. There are some stamps that detract from, rather than add to the character of a sheet.

Execution Is a Matter of Individual Talent

As to the execution of the drawing itself, this is a matter that must be left very largely to the talent of the individual draftsman. In the writer's opinion a very desirable reform in general drafting room practice would be a greater restriction in the use of diluted black ink. Working drawings require definition of line. Dilute ink is, at best, only an expedient which saves the draftsman the trouble of sharpening his pen while adding 100% to the perplexities of the construction forces. After a week or two of handling and erasures, the dilute-ink lines on a tracing become frayed and hazy; or have parts erased and never replaced, or else are replaced with ink a shade or two darker than the original mixture. The result is messy to look at and an invitation to errors. It certainly is not an aid to character in drawings. Whatever individual opinion on this matter may be, the point is that diluted ink should not be used when definition of line is important—such as for the center lines of columns and all others to which dimension lines refer. These at least should be in black.

Another practice, affected by some architects, which should be condemned is the overlapping of lines at angles. On perspective work or on full-sized details which have to be scaled this is perhaps permissible, but it certainly does not add to the character of a sheet of ¾-in. details to show walls and piers as if they were to be built "log-cabin" style.

If one expects to be taken seriously by those responsible for getting plans out to the field, it would not be safe in this busy age to pay more than a passing tribute to the value of shaded lines. They are a most valuable adjunct to the draftsman's art where the extra time can be afforded, and a great aid to clearness and character.

It may be said that the only thing that should not be standardized in the drafting room is the talent of the draftsman, but the method of expressing this talent must be governed by strictly enforced rules and standards if there is to be any uniformity of character in the drawings turned out. The enforcement of standard drafting practice lies largely in the hands of the assistant engineers and with them rests the maintenance of that standard of "company" character which is so desirable. It is a good plan—and also a paying one where the drafting force is more or less transient—to have in each squad a "retainer" or "old hand" who is thoroughly trained in the standards of the company, and paid well enough to make it worth his while to stay. He will be a valuable aid in breaking in new men and will save more than his extra salary in the maintenance of a high standard of excellence in the work of the drafting room.

In looking back upon the aids to character in drawings which have been touched on, it should be remembered that while the ideal and practical cannot always be reconciled, the closer we work to the ideal in practice the higher will be the resulting character attained.

Using Electric Power To Dredge a Relocated River Channel

Washington Counties Build Suction Dredge Operated by 800-Horsepower Motor Which Contractor Buys When Work Is Done

By J. H. Walter
Tacoma, Wash.

PRIOR to 1906 the main volume of the White River emptied into Elliott Bay at Seattle, except for a small portion of the flow, averaging about 500 sec.-ft., which left the main stream on an inland delta 40 miles from the mouth and flowed southward into the Puyallup River and thence into Puget Sound at Tacoma, a distance of 20 miles. This connecting link between the White and the Puyallup was known as the Stuck River. Topographical conditions on the inland delta were such that the shifting of a bar or an accumulation of drift would divert the river north or south over night. This did occur, in fact, in November, 1906, when high water conditions turned all of the White River through the Stuck Valley and thence to Tacoma by the Puyallup River.

King County desired to make this channel permanent by artificial means, but the situation was complicated by the fact that the King-Pierce County line passed near the point of diversion and only a short bend of the original channel was in King County. Pierce County authorities attempted to make King County take the river back and allow it to empty into Elliott Bay as before, but King County disclaimed all responsibility in the matter. Finally in 1913 the state legislature passed the inter-county river improvement act, providing for the establishment of funds to carry out the necessary work. A tax levy of one mill in Pierce County and

0.6 mill in King County provided \$250,000 per year for six years, or a total of \$1,500,000, for construction, with a maintenance fund to be \$50,000 a year for 99 years.

It was decided that the entire flow would be conducted through the Stuck-Puyallup route to an outlet at Tacoma. The work to be done was accordingly classified under three heads: removal of drift, rectification of channels, and bank protection. The contract for channel rectification, which involved the excavation of 3,000,000 cu.yd. of earth, was let to the Puyallup Dredging Company. Under the terms of the contract the county supplied the company with an electrically operated dredge which the company agrees to purchase at 75% of its original cost of about \$70,000 at the termination of the contract. During the work the municipal plant of Tacoma supplies current at the rate of 0.45 cents per kilowatt-hour.

Dredging Machinery

The hull of the dredge, which was built specially for this river work, is 115 ft. long, 40 ft. wide, and has a depth over all of 9½ ft. It is built with 10 x 12 bottom timbers and 10 x 18 bulkhead timbers and is designed so that all the machinery is located on deck and not inside the hull, thus making unnecessary recourse to trussing or framing. The longitudinal timbers are all long, and there are three interior cross bulkheads secured with 1-in. stay-bolts. The stanchions are 10 x 10-in. timbers and 10 x 10-in. deck beams, and 4 x 12-in. cross bracing was used to increase the rigidity. The hull is divided into ten watertight compartments with a separate compartment as water tank for the boiler. The hull involved the use of 170,000 ft.b.m. of lumber and 27,000 lb. of iron and steel.

The dredging equipment proper consists of a rotary cutter suction head and a 20-in. centrifugal pump with direct-connected motor. The digging ladder is built up of 24 in., 100 lb. I-beams, 52 ft. long. The cutter-shaft bearings, which are set on top of the ladder, are of standard pattern with the exception of the one forward and an outboard bearing in the suction head. These have cast-iron glands in place of babbitt, to allow for the excessive wear on account of grit, and to permit of quick and economical renewals. In these two bearings the cutter shaft is provided with cast-steel sleeves.

The cutter was originally of the helmet type, but has been replaced with a straight-blade cutter on account of encountering very hard clay strata. The cutter motor is mounted on a framed base in the port tongue of the ladder well and transmits its power through the port trunnion on a 60 to 1 reduction. The suction pipe, which is of cast iron, 20 in. diameter, passes from the cutter head up the digging ladder and through the starboard trunnion. The clearance provided in the trunnions is such that the weaving of the ladder when snags are encountered does not affect either the suction pipe or the cutter transmission.

The bull wheel on the cutter shaft is 86 in. in diameter and has an 8-in. face. Special thrust collars are provided for the end thrust of the cutter shaft. The suction head carries a back ring for the cutter, 6 ft. in diameter. The swinging plates are located far enough back from the cutter to keep the swinging blocks free from sand and grit. The cutter shaft, 8 in. in diameter, is of three parts connected by standard couplings.

The pump itself is a 20-in. centrifugal, with front and back lining and a renewable nose ring and stuffing-box. The pump-shell and runner are high carbon annealed-steel castings; the front and back heads are medium steel castings and the nose ring of cast iron, while the liners are one piece of plate steel. The runner shaft is hammered steel, 9 in. in diameter, with one oil ring bearing. The pump casing, together with these three bearings, is assembled on a cast steel base, with a structural sub-base between this and the structural bed. This bed is built up of six 12-in. I-beams running the full length of the unit and plated top and bottom with ½ in. steel. The bed sets directly upon and centers the five center bulkheads of the hull to which it is bolted. This construction has been so carefully installed and fitted that there is not the least vibration when the unit is running full capacity.

The suction and discharge pipes, 20 in. in diameter, are of cast iron ⅜ in. thick and have flange connections. Immediately behind the pump in the discharge line is a 20-in. cast steel flap valve to control the back flow when the pump is shut down. This is designed with a renewable valve seat and an unobstructed passage for material, and is fitted with an outside hand lever and counterweight.

The dredge is held in position by two steel-shot stern spuds, 50 ft. long, in cast steel wells 14 ft. apart. The leads to the spuds run direct from the head block on the spud tower to the drums of the winding machinery.

Electrical Equipment

The dredging pump is driven by a direct-connected 800-hp., 3-phase, 2200-volt motor, operated at 360 r.p.m. (synchronous speed). The motor is designed for continuous operation at any speed from 33⅓% reduction to full speed, and for two hours when developing 25% overload, or for 50% momentary overload, without undue strains or overheating. The cutter motor is likewise operated at 2200 volts, is rated at 75 hp. for 600 r.p.m. (synchronous speed), and is similar to the motor which drives the winding machinery. Both of the latter are reversible induction motors and allow continuous operation for two hours at 25% overload.

While the cutter and winding machine motors have standard drum type controls, the pump motor is equipped with contactor panel and master control. The resistance grids for the latter are mounted in a well ventilated house abaft the pilot house and atop the main deck structure. All controls, including the levers operating the various drums of the winding machinery, together with the three motors, are in the pilot house forward. The switchboards are made up as follows:

Panel No 1—Incoming Line
Panel No. 2—800 Hp. Induction Motor
Panel No 3—75 Hp. Induction Motor
Panel No 4—75 Hp. Induction Motor
Panel No 5—Lighting and Small Power

The pilot house also contains the digging gages and graduated dummy gage connected to the ladder to indicate the depth of cutter and vacuum, pressure and steam gages.

The winding machinery has an auxiliary double 10 x 12 steam engine, with movable coupling to line shaft. This arrangement permits of the use of the winding machinery irrespective of electrical power.

The boiler is kept constantly under a full head of

steam and the engine is limbered up every day. Steam is supplied at 120 lb. by a Clyde type boiler located on the main deck at the stern and jacketed with 2-in. asbestos blocks. Steam is also supplied to a 4-in. ejector for priming the main dredging pump and to a 12 x 7 x 12 in. pump which is used for handling the bilge and can be used for fire service. This pump is so connected that water can be drawn through a 6-in. line from any of the ten water-tight compartments or from outboard. There are four 2-in. fire hydrants on the dredge which are fed through a throttling valve so that any desired pressure can be secured. A 2-in. relief valve on this line affords safety against overpressure.

With the dredge there were furnished 12 pontoons, 500 ft. of 7-gage riveted pipe with dredging sleeves, 3000 ft. of 10-gage riveted levee pipe and the necessary couplings. The pontoons are 12 x 24 ft. in plan, 2½ ft. in depth, and four of them are equipped with turntables so that the obstruction to cross currents can be reduced to a minimum. It was found advisable to build a derrick scow as a dredge tender. This scow is 26 x 48 ft. in plan and is equipped with a 9 x 10-in. 3-drum hoisting engine and a stiffleg derrick with a 40-ft. boom. This scow is used in removing drift and snags from the channel and for general repair work around the dredge.

In a test run made to determine the efficiency of the pump unit, a 3000-ft. length of discharge line was laid so as to obtain 25 ft. difference in elevation between the end of the discharge and the surface of the water at the dredge. Owing to the fact that a uniform formation was seldom encountered while digging, only a clear water test was made, and thus a more even result was obtained. The velocities were obtained by placing 6-in. wooden balls in the suction pipe and measuring the time of transit to the end of the discharge. Also, 1-gal. jugs of potassium permanganate were used, the jug breaking in the pump and coloring the water. Fairly uniform results were secured in eighteen trials.

The vacuum pressure and power consumption ratings were taken at intervals of one hour or less over a period of 19 hours steady running. The only difficulty encountered was in holding the land pipe together, and this arose from the fact that the line was put together hurriedly. As only clear water was pumped there was no silt to close up the joints. The results were:

Average pressure	= 43 lb =	98.9 ft. head
Average vacuum	= 19 in =	21.5 ft. head
Total		120.4

Velocity as measured = 15.3 ft. per second.
Therefore

$$\frac{15.3 \times 2.18 \times 62.5 \times 120.4}{550} = 456.3\text{-hp. output}$$

Power consumed = 505.8 kw.-hr. = 678 hp. input.

$$\frac{456.3}{678.0} = 67.3\% \text{ efficiency of unit}$$

Taking motor efficiency to be 90%

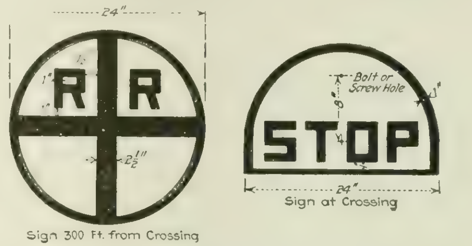
$$\frac{67.3}{90} = 75\% \text{ efficiency of pump}$$

W. J. Roberts, M. Am. Soc. C. E., is chief engineer of the Inter-County River Improvement. The writer, as principal engineer, designed the dredge and equipment, supervised its construction, and operated the outfit for sixty days, at which time it was turned over to the Puyallup Dredging Company.

New Grade Crossing Signs Required on Illinois Highways

PROTECTION of highway traffic at dangerous railroad crossings by special road signs is ordered by the Public Utilities Commission of Illinois. Local highway commissioners must place approach or distance warning signs 300 ft. from the crossings, in addition to the signs placed on the right-of-way by the railways.

Signs placed directly at the crossings are often inadequate, it is pointed out, as warnings for fast motor vehicles or even for ordinary traffic, where the view is obstructed by grades, curves, cuts or trees. Distant signs have been advocated, but the railways had no authority to place them outside their own property, and local highway authorities have given the matter little attention. Under the new order grade crossings designated as "extra hazardous" by the commission must be provided with two signs on each approach.



ILLINOIS ORDERS SPECIAL ROAD SIGNS FOR DANGEROUS GRADE CROSSINGS

At 300 ft. from the crossing the highway commissioners must place a 24-in. circular sign, while the railway must place at the crossing a semicircular "stop" sign. These are to be of the style and dimensions shown in the illustration. They are of No. 16 sheet iron, porcelain-enameled in black and white, having the edge crimped and having holes for attachment to a post. The letters are 5 x 3¾ in., made with 1-in. lines, while the cross lines are 2½ in. wide and the border is 1 in. wide. The reverse side is black. These signs are fastened to iron posts by bolts or to wood posts by brass screws, the posts being so designed as to permit the attachment of a bracket for a light at night, when this is considered necessary by the commission.

Dump Refuse to Form Chicago Park

Use of street sweepings, ashes, factory waste, refuse and wreckage from old buildings, as filling for park land on a submerged site, is advocated by the Chicago Association of Commerce as a means of forming the new lake-front park that is to connect Grant and Jackson Parks. In this distance of nearly five miles about 1280 acres are to be reclaimed. It is estimated that the city produces about 3,000,000 cu.yd. of waste annually, and that by systematic and universal disposal on the lake front this will effect the reclamation of about 100 acres per year. A charge for dumping privileges is proposed to help pay the cost of the necessary retaining walls and bulkheads on the boundaries of the site. The present Grant Park is located on land reclaimed in the same way some years ago.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Worthy Addition to Engineers' Handbook

MINING ENGINEERS' HANDBOOK: Written by a Staff of Specialists Under the Editorship of Robert Peele, Professor of Mining Engineering in the School of Mines, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Leather; 4 x 7 in.; pp. 2307; illustrated. $5.

President Eliot's five-foot book shelf would scarcely hold the best of the handbooks for engineers and allied technical men which have been published in original or revised editions in the past dozen years. The latest addition to the list is designed to serve the needs of the mining engineer. The amount of material which it contains on civil, mechanical and electrical engineering subjects illustrates how the various engineering fields overlap one another. Although the volume extends to almost 2400 pages, metallurgical engineering is treated rather sketchily, and but small space is given to coal mining. The preface explains that a companion handbook on metallurgy is in contemplation, and that there is a coal-mining pocketbook already in existence. The preface, speaking of the fact that there are already two mining engineers' handbooks, remarks that these "either omit, or treat too briefly, many subjects which constitute important parts of the professional equipment of the present-day mining engineer."

The breadth of treatment in the handbook before us may be indicated by stating that, aside from what one might expect to find, it contains sections on mine organization and accounts, wages and welfare, and mining laws, besides one dealing with mine air, hygiene, explosions and other accidents, this last being by George S. Rice, chief mining engineer of the United States Bureau of Mines.

As a rule, each of the 44 sections of the handbook has been contributed by a different specialist. Sections of the greatest interest to the readers of this journal, with their authors, taken in the order of their appearance in the volume, are as follows: Earth excavation and also rock excavation, H. P. Gillette; tunneling, D. W. Brunton and John A. Davis; shaft sinking in rock, Homer L. Carr, and in soft water-bearing soils, Francis Donaldson; boring, Prof. Arthur F. Taggart; underground transport, Edward C. Holden; hoisting plants, etc., Prof. William M. Weigel; drainage, Robert Van Arsdale Norris; mine ventilation, S. E. Brackett; compressed-air plants, Richard T. Dana; electric power for mine service, George R. Woods; surveying, Prof. Charles B. Breed, and underground surveying, Prof. Edward K. Judd; mine geologic maps and models, R. A. Sales; cost of mining, J. R. Finlay; preparation and storage of anthracite coal, Paul Sterling; hydraulics, Prof. J. K. Finch. There are also sections on thermodynamics, steam engines and related subjects, mechanical and electrical engineering, and structural design.

A valuable feature of the handbook is the bibliographies given in connection with each section, some of which run to hundreds of entries.

Two misleading statements in the section on wages and welfare may be mentioned. It is said that for purposes of water coagulation one grain of alum per gallon is used. From this it might be inferred that no more and no less was ever employed. Under sewage disposal it is stated that "Septic Treatment" involves two steps: (a) Putrefaction and (b) nitrification—which is a scientific contradiction. The context, however, makes it clear to those who pay sufficiently close attention that the author is really discussing not septic treatment alone, but that process followed by some method of oxidation. These examples merely illustrate the difficulties of obtaining accuracy and completeness in a handbook of such broad scope as this one. To insure accuracy in all the numerous details presented would require the services of hundreds instead of two-score specialists. Whether it is wise to attempt to go into so many details in various branches of engineering in a handbook designed to cover one branch, is a question regarding which much might be written on both sides. But whatever might be said either way, the fact remains that the present volume is a worthy addition to engineering handbooks and deserves a place in the reference libraries of many civil, electrical and mechanical engineers. That every mining engineer will desire a copy seems beyond question.

Contractors' Business Methods

ETHICS OF CONTRACTING AND THE STABILIZING OF PROFITS—By F. W. Lord. Garden City, N. Y.: The Country Life Press. Cloth; 5 x 7 in.; pp 184 $1.25.

MODERN MANAGEMENT APPLIED TO CONSTRUCTION—By Daniel J. Hauer, Construction Economist; Consulting Engineer. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 187; illustrated. $2.50.

Two new books which are well worth, to every contractor, the time required to study them are listed above. Both treat of the business and management side of contracting, but Mr. Lord's work concerns the relations of the contractor with the world outside his own organization, while Mr. Hauer's deals with modern management as applied to the organization of the contracting business itself. Both books are written from the new, progressive point of view which is rapidly gaining favor under modern conditions. Both outline methods which were openly scouted when first proposed not many years ago.

Mr. Lord is an ardent advocate of the open price association. His book is addressed largely to the subcontractor, who is naturally the one in a position to benefit most quickly by the adoption of open price methods. He presents a strong argument for the local association of contractors and analyzes the manner in which various common evils can be eliminated under the open-price plan.

Mr. Hauer studies scientific management, as applied to construction work, from a very broad viewpoint. He gives the human engineering factor the place to which it is entitled, and which it is coming to occupy in the minds of some of the best administrators in contract-

ing. The entire work endeavors to set before the contractor the ways in which an intelligent, efficient and loyal organization can be built up. The skilled and unskilled workmen are by no means eliminated from consideration in this organization. Only a part of this scheme is represented by scientific management, as popularly understood when time and motion studies and the advance planning of manufacturing or construction operations are discussed. The larger part of it lies in the matter of inducing the human organization to put its best efforts continuously into the work according to well-directed plans, by making sure, through a large number of available means, that this element has cause to set a high value on its position in the business and to consider itself a part of the enterprise.

Both books will give contractors who have not considered these problems a profitable viewpoint. Both outline questions which have a fundamental bearing on the efficiency and therefore on the success of contracting as a business. The time is coming when no contracting business can realize large success without applying these principles, and every contractor who wishes to insure the future of his own enterprise will begin to study them and apply them in his own relations.

Textbook on Heating and Ventilation

HEATING AND VENTILATION—By John R. Allen, Dean of the Department of Engineering and Architecture, University of Minnesota, M. Am. Soc. M. E., and J. H. Walker, Superintendent of Central Heating, The Detroit Edison Company. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 265. Illustrated. $3.

REVIEWED BY D. D. KIMBALL
New York City

Primarily designed "as a textbook upon the subject of heating and ventilation for use in the engineering and architectural schools," as the author states in his preface, this volume, including as it does working methods of design and various tables and charts, will be "of some value as a handbook for the practicing engineer and architect," it is believed. In the first of these aims the author appears to have succeeded. In fact, it seems to the reviewer that the book is better suited for use as a college text than any other which has yet appeared on the subject.

The author seems to appreciate the difficulty of thoroughly presenting the subject of heating and ventilation within the time usually assigned to the subject in a college course. The ground is covered in a most practical and condensed manner. The problems presented for solution at the end of most of the chapters are an admirable feature of the book, but the present writer would suggest that answers should be provided in future editions. The data tables and illustrations are good, although limited. Certain subjects, such as "Dust and Fume Removal," are too briefly treated, but this may be due to the insufficient consideration which has been given to them by ventilating engineers.

As regards the second object, the book appears to be too condensed and incomplete to serve the needs of architects and engineers in practice. The fundamentals of heating and ventilation are well rounded out, but the student who has mastered these would require more information in practice than the book contains. Some of the standards presented were established by recognized authorities of past years, but have been materially modified by engineers in more recent practice; for instance, the percentage by which radiation is increased for buildings intermittently heated. A limited number of modifications of the text would largely improve it for the use of practicing engineers. On the whole, the authors and publishers are to be congratulated on the production of so good a book.

Dr. Houston on Rural Water-Supplies

RURAL WATER SUPPLIES AND THEIR PURIFICATION—By Alexander Cruikshank Houston, M. B., D Sc., F. R. S Ed., Director of Water Examination, Metropolitan Water Board. London: John Bale, Sons & Danielsson, Ltd. Cloth; 6 x 9 in.; pp. 128; illustrated. 7 shillings 6 pence net.

Anything from Dr. Houston on the potability or treatment of water-supplies is sure to be welcomed by water engineers and sanitarians who know of his long and valuable researches on the water-supply of London. His annual reports on those studies are veritable classics. Besides these he has written two books, "Studies in Water-Supply" and "Rivers as Sources of Water-Supply," noticed in these columns Apr. 16, 1914, and Jan. 17, 1918.

In the present volume the author has aimed to "fulfill a want which has long been felt by rural dwellers" for a safe guide in solving the water-supply problems which confront them. The first three chapters deal with rain water, and also describe briefly "the chief methods for sterilizing and purifying water," including the author's excess-lime method. Underground and surface waters are next considered, after which three chapters are devoted to the results of experiments and to the description of apparatus designed to treat household supplies. The volume closes with miscellaneous data on water treatment.

The volume seems better suited to scientists, professional and amateur, and country gentlemen with abundant leisure, than to laymen, but it contains enough of plain instruction to put any intelligent layman on the right track. Moreover, the author generously volunteers to assist perplexed readers of his book in the solution of their problems.

How to Save Fuel in Power Plants

FUEL ECONOMY IN BOILER ROOMS: A Development of Fuel Economy and CO_2 Recorders; Published in the Engineers' Study Course from "Power." In Two Parts Part I: Fuel Economy and CO_2 Recorders—By A. R. Maujer and Charles H. Bromley of the Editorial Staff of "Power". Part II: Fuel Economy in Boiler Rooms—By Charles H. Bromley, Associate Editor of "Power." Second Edition. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 302; illustrated. $2.50.

Timeliness marks this new and much enlarged edition of a volume designed to save fuel in power plants. If such a volume was needed in 1914, as unquestionably it was, it is needed many times more in 1918, and particularly so just now, as winter power-plant problems are upon the country in war time.

Published first under the title of "Fuel Economy and CO_2 Recorders," the junior author has added to the present edition a section on "Fuel Economy in Boiler Rooms," and this section title has been adopted as the title for the whole book. The old and new matter taken together ranges over the whole field of power-plant operation in relation to fuel economy, including coal and oil as fuels and their combustion fuel and flue-gas analyses, draft and its management, chimney design,

evaporation, boiler-setting efficiency and ratings, heat balance, the CO_2 recorder and its use, burning fuel oil, and the operation of mechanical stokers.

The volume is said to be intended "primarily for the student, the fireman and power-plant operating engineer," but it is designed to be useful to the consulting engineer as well. Engineers of water-works pumping stations and superintendents of water-works should find the volume of material service.

Non-Bituminous Road Materials Bulletin

Typical specifications for non-bituminous road materials have been compiled and issued by the United States Department of Agriculture. The bulletin covers all kinds of road material which cannot be classified as bituminous, and is a companion bulletin to "Typical Specifications for Bituminous Road Materials." These bulletins cover practically every kind of road material, and, as their names imply, do not go into details of construction but merely give the proper specifications and tests for the materials themselves. However, footnotes mention to some extent the proper thickness and the construction conditions which will give the most satisfactory results.

Rural Sanitation and Housing

A report on "Sanitation of Rural Workmen's Areas, with Special Reference to Housing," fills 30 pages of *Public Health Reports* (Washington, D. C.) for Sept. 6. It was prepared by a committee of the National Council of Defence, having Prof. George M. Kober, Georgetown University, Washington, D. C., as chairman. Water-supply, sewage and garbage disposal were among the topics discussed.

Instructions for Highway Engineers

A new publication of the Wisconsin Highway Commission (Madison, Wis.) entitled "Instructions to Engineers," and compiled by Gordon S. Daggett, engineer of surveys and plans for the commission, contains instructions in regard to surveys, forms of records, form of reports, preparation of plans and many other things incident to a state highway system.

Wisconsin Highway System Map

Wisconsin main and secondary highways, various points of industrial, scenic and historic interest, including Indian mounds and village sites, are shown in a booklet and folding map compiled by A. R. Hirst, state highway engineer. (Superintendent Public Property, Madison, Wis.; 10c.)

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN CITIES: THEIR METHODS OF BUSINESS—By Arthur Benson Gilbert, M.A., Formerly with the Extension Division, State University of Iowa. New York: Macmillan Co. Cloth; 5 x 8 in.; pp. 234. $1.50.

ANNUAL CHEMICAL DIRECTORY OF THE UNITED STATES. 1918—Consulting Editor, F. B. Lovelace, Johns Hopkins University; Managing Editor, Charles G. Thomas. Second Edition. Baltimore, Md.: Williams & Wilkins Co. Cloth; 6 x 9 in.; pp. 534. $5.

ASSOCIATION OF ONTARIO LAND SURVEYORS: Proceedings, 1918—Ontario, Can.: The Association. Paper; 6 x 9 in.; pp. 228. Illustrated.

CONCRETE STONE MANUFACTURE—By Harvey Whipple, Managing Editor of "Concrete." Second Edition, Revised and Enlarged. Detroit, Mich.: Concrete-Cement Age Pub. Co. Cloth; 5 x 7 in.; pp. 320. Illustrated. $1.50.

DAILY RIVER STAGES AT RIVER GAGE STATIONS ON THE PRINCIPAL RIVERS OF THE UNITED STATES: Vol. XV, 1917—By Alfred J. Henry, Meteorologist. Washington, D. C.: U. S. Department of Agriculture. Paper; 9 x 12 in.; pp. 282.

THE DIESEL ENGINE: Its Fuels and Its Uses—By Herbert Haas. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 130. Illustrated. 25c.

Types, details, kinds made by various manufacturers in the United States, fuels, oils, cost data, examples of successful use and a bibliography are presented. The illustrations include views, details and diagrams.

THE ENGINEER'S YEAR-BOOK FOR 1918—Compiled and Edited by H. R. Kempe, M. Inst. C. E., M. I. Mech. E., M. I. E. E. With the Collaboration of Eminent Specialists. London: Crosby Lockwood and Son. Leather; 5 x 7 in.; pp. 2098. Illustrated. $12.50.

Since its original issue, a quarter century ago, this work has been expanded from 1528 to 2098 pages. The list of associate editors and contributors contains about fifty names, from all branches of engineering. In the present issue there are new sections on fuels, mine valuation, metallurgy and explosives.

GEORGE WESTINGHOUSE: His Life and Achievements—By Francis E. Leupp. Boston, Mass.: Little, Brown & Co. Cloth; 6 x 9 in.; pp. 300. Illustrated. $3.

HANDBOOK OF MECHANICAL AND ELECTRICAL COST DATA: Giving Shipping Weights, Capacities, Outputs, and Net Prices of Machines and Apparatus, and Detailed Costs of Installation, Maintenance, Depreciation and Operation. Together with Many Principles and Data Relating to Engineering Economics—By Halbert P. Gillette, Consulting Engineer, M. Am. Soc. C. E., and Richard T. Dana, Consulting Engineer, M. Am. Soc. C. E. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Leather; 5 x 7 in.; pp. 1716. Illustrated. $6.

THE HISTORY OF STATISTICS: Their Development and Progress in Many Countries; In Memoirs to Commemorate the Seventy-fifth Anniversary of the American Statistical Association. Collected and Edited by John Koren. New York: Macmillan Co. Cloth; 6 x 9 in.; pp. 739. $7.50.

LOUISIANA BOARD OF STATE ENGINEERS: Report for 1916-18—New Orleans, La.: Board of State Engineers. Paper; 6 x 9 in.; pp. 133.

MINE TRACKS, THEIR LOCATION AND CONSTRUCTION: Treating Briefly on the Materials Used and the Principles Involved in the Design and Installation, With a Set of Rules for a Standard Practice—By J. McCrystle, E. M. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Leather; 5 x 8 in.; pp. 102. Illustrated. $1.50.

THE MOTOR TRUCK AS AN AID TO BUSINESS PROFITS—By S. V. Norton. Chicago, Ill.: A. W. Shaw Co. Cloth; 7 x 10 in.; pp. 498. Illustrated. $7.50.

PETROLEUM: A Resource Interpretation—By Chester G. Gilbert and Joseph E. Pogue, of the Division of Mineral Technology, United States National Museum. Washington, D. C.: Smithsonian Institution. Paper; 6 x 9 in.; pp. 76. Illustrated.

THE PRACTICABILITY OF ADOPTING STANDARDS OF QUALITY FOR WATER SUPPLIES—By Robert B. Morse and Abel Wolman. Reprinted from the "Journal" of the American Water-Works Association, Vol. V, No. 3, September, 1918. Address the Authors, Maryland State Board of Health, Baltimore, Md. Paper; 6 x 9 in.; pp. 30.

A PRELIMINARY ANALYSIS OF THE DEGREE AND NATURE OF BACTERIAL REMOVAL IN FILTRATION PLANTS—By Abel Wolman. Reprinted from the "Journal" of the American Water-Works Association, Vol. V, No. 3, September, 1918. Author, Maryland State Board of Health, Baltimore, Md. Paper; 6 x 9 in.; pp. 7. Illustrated.

REPORT ON THE BUILDING AND ORNAMENTAL STONES OF CANADA. Vol. V, Province of British Columbia—By William A. Parks, B.A., Ph.D. Ottawa, Can.: Department of Mines. Paper; 7 x 10 in.; pp. 224; illustrated.

RULE RELATING TO AUTOMATIC SPRINKLER SYSTEMS—(Not Applicable to the City of New York) Bulletin No. 20, Industrial Code; State of New York, Department of Labor, State Industrial Commission. New York: Bureau of Industrial Code. Paper; 6 x 9 in.; pp. 17.

STANDARDIZATION OF THE SAYBOLT UNIVERSAL VISCOSIMETER—By Winslow H. Herschel, Associate Physicist, Bureau of Standards. Washington, D. C.: Superintendent of Documents. Paper; 7 x 10 in.; pp. 25; illustrated. 10c.

WORKMEN'S COMPENSATION LAW, NEW YORK STATE: With Amendments, Additions and Annotations to July 1, 1918—Issued under the Direction of The Industrial Commission, John Mitchell, Chairman, Edward P. Lyon, Louis Wiard, James M. Lynch, Henry D. Sayer. Albany, N. Y.: Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 66.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Licensing Engineers in Iowa

The Waterloo Technical Society, Waterloo, Iowa, which held its first meeting of the season Sept. 20, is considering two lines of activity. One is following up the campaign in favor of state legislation for the licensing of engineers, which was begun in 1917; the other is the conservation of fuel, in line with the work of the United States Fuel Administration. S. J. Fairbanks is secretary of the society.

Columbus Engineers' Club to Learn of Local Industries

Visits to the plants and industries in Columbus, Ohio, to acquaint the membership of the Engineers' Club of the city with the city's activities are to be undertaken intensively by the club. The organization is coöperating with the local War Industries Board and has named Prof. W. T. Magruder as chairman of the engineering section. A committee has under consideration the indorsement of the proposal of the Cleveland Engineering Society, that membership in a local society shall be regarded by the national societies as a prerequisite to membership in the latter.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineering Profession Should Have Leading Part in Reconstruction

Sir—What should the engineer and the engineering society do to help solve reconstruction problems?

Engineers, individually and collectively, have done and are doing much to win the war. In fact, the great world war is largely a matter of engineering. The engineers have an equal or even greater duty in securing to mankind the benefits which flow from victory. They, as men of vision, educated largely at the public expense, have a responsibility and an opportunity surpassing that of other classes of citizens.

They may be excused for their lack of preparedness for war, because war was uncertain. But there is no excuse for failure to prepare for peace. Even though the United States may be merely entering the great war, and while we should devote every possible energy to winning it quickly, yet we know that peace must come some time, whether next year or the year after. We also know that the longer the war continues the greater will be the changes and the more the necessity for thorough preparedness for the resumption of peace activities.

Someone must have the foresight and vision to get ready for the rapid shift which will take place when peace is declared. There is no way of evading the changes. Shall we have any plans ready, or shall we simply leave matters to "muddle along" and take the consequences in internal upheaval and prolonged suffering?

If plans are to be made, shall the task be left to the commercial interests, to the bankers, to the lawyers or to the politicians? Does the engineer intend simply to keep hands off and as a passive spectator or disinterested citizen let matters take their own course? Or will he use his training and experience to conduct researches into the present conditions and rapidly to prepare plans consistent with his broad knowledge of existing conditions? These are momentous questions and should be seriously considered by each engineer and especially by the engineering societies.

It may be urged that consideration of after-the-war problems is premature, but our allies are not of this opinion. They have already begun careful study into the conditions which may prevail. Great Britain has a highly developed Ministry of Reconstruction, with many engineering committees or branches. Canada and other parts of the British Empire are following the example of the mother country. France also is making far-reaching plans, and throughout the world it may be said that every advanced country except the United States is considering the matter from the scientific and practical standpoint. Already bills have been introduced in our own Congress, but the great body of engineers has not yet been heard from.

It may be urged in reply that reconstruction is not the business of the engineer. A little consideration, however, will show that there are relatively few fundamentals with which he is not concerned. Of course, much depends upon what we mean by the engineer. If we limit our definition simply to the mechanician or to the man who is studying the materials of construction, then the excuse may be offered that his range of duties is somewhat limited. But if we adopt a more modern definition, one within which the engineer is acting more and more, then it appears that his responsibilities are large indeed.

Perhaps the best definition yet offered is that by C. C. Williams, of Kansas University, who has elaborated upon Tredgold's well-known saying as follows: "Engineering is the science, art, and business of utilizing the forces and materials of nature and the *abilities of men* to promote the welfare and prosperity of mankind."

If this definition is adopted and we compare it with the list of things which form the subjects of research and study in any reconstruction project, it is surprising to note how many of these fundamentals fall within the domain of the engineer. Primarily, under our new conception of things, the engineer is concerned with the greatest of all the forces used in engineering, that of man himself. Labor, which has before been considered merely as incidental, now occupies the front place in all engineering plans. Fully one-half, if not more, of the expenditures in engineering go directly for labor, and the efficiency and economy of all engineering operations are dependent directly upon the wise direction and control of the labor factors.

It thus appears that the first and foremost consideration in the modern engineer's mind is that of labor questions, and while any solution of these must be partial and temporary, yet even this cannot be workable unless the engineer has a large hand in it.

Next in importance is research and investigation into natural resources and laws. This is particularly the work of the scientific man and engineer, and without his intelligent direction little progress can be made. The great war has awakened American engineers to the fact that in their somewhat complacent attitude of mind they had permitted European nations, especially Germany, to outstrip them by far, with the result that when the war came suddenly upon us we were compelled to lose time, and directly or indirectly sacrifice thousands of lives and millions of dollars in accumulated wealth, because of our short-sighted policy with reference to scientific research along engineering lines.

The whole subject of raw materials is also one which can be attacked successfully only by the engineer, including among these materials not only iron, copper, clay, petroleums and other substances from the earth, but also the fuels and other sources of power, such as the flowing waters.

The engineer's problems also include those pertaining to transportation, not merely the building and operating of railroads, waterways and highways, and the cars or vessels moving on these, but also the navigation of the air and all of the matters which lead up to successful performance.

Next in importance come the means of communication—the telephone, the telegraph, the wireless—and closely connected with these are the rapidly increasing number of public utilities, founded primarily on engineering plans and methods. It has been the fashion to leave the larger control of these to business men and lawyers, but the time is arriving when the engineer is appreciated as the chief factor in their success.

Into agriculture also the engineer has entered, and with the increasing demand for food, his skill is being more and more called upon, not only in developing agricultural machinery, but in building irrigation and drainage systems, in clearing lands and in directing operations in a large way. In housing problems the engineer, as well as the architect, must direct affairs. Even in education and the diffusion of intelligence the operations are becoming more and more closely connected with the principles of engineering.

In all of these matters, which pertain to the conservation and use of the resources of the country, both material and human, and the development of ideals, the engineer should be the leader. Although his profession may not include the direct control of capital and credit, of foreign and domestic trade, of agricultural distribution, and of many purely business questions, yet he is, or should be, such a factor in the fundamentals of these that his knowledge and skill cannot safely be neglected.

Assuming that the above statements of the range of the engineer's activities are approximately correct, then comes the question as to what he and his organizations should do in the present crisis of world affairs. The reply seems obvious that of all mankind he should be most active in these world problems. Every engineering society should have its committee on reconstruction, charged with the duty of arranging for effective presentation of one or another of these great subjects—employment of labor, research, study of raw materials, of fuels, power, transportation, public utilities and other matters, all of which are undergoing radical changes. The trend of these should be studied and the influence of the engineer as an individual should be wisely used.

The engineering society under this conception has a great duty and responsibility to its members and through them to the public. The standing of the engineering profession in the near future must be determined largely by the wisdom of the action taken now in approaching these great problems of reconstruction.

ENGINEER.

Is the Old Academic Educational Program Passing?

Sir—A personal letter from a Middle West professor of engineering indicates that the academic educational shell of past days spoken of by Prof. Frederic Bass in *Engineering News-Record* of Sept. 26, p. 582, is cracking. The letter indicates that the teachers in the Middle West school only needed the magical touch of necessity and practicability to start them on the way toward new methods. The letter follows:

"The new Government orders in regard to technical and college education have come, and I have been appointed chairman of the committee to devise a new curriculum to meet the new conditions. There will be a grand rush by all the colleges to get competent instructors and there will be mighty few to get.

"The head of the department of mathematics has been working out an entirely new method of teaching that subject. He is going to present the concrete side, rather than the abstract. Physics, including statics and dynamics, simple phenomena of heat and electricity, will be presented immediately to the freshmen with everyday illustrations; the students will absorb mathematical processes before they realize what is happening. Mathematics will be regarded as the means of interpretation. Mechanics will be finished by the end of the second year and a vast amount of time will be saved, leaving the fourth year for special courses in economics, political science and similar work designed to broaden the student's mind.

"Of course we will not do much more than begin until the war is over, but it is encouraging to be able to make a beginning. The shell is cracked off many minds here; it is going to be a fairly clean sweep and we can confidently look forward to a new kind of teaching after this.

"Studying under the S. A. T. C. arrangement will all be under supervision. Students will have no time to loaf, except on Saturday afternoon. I do not think college professors will, either. I presume there will be inspectors of the work being done.

"All of this will leave an impression on future technical education, and the graduates of engineering colleges hereafter will be better prepared to meet the world than they ever have been before. It is a pleasing prospect."

INTER NOS.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Keep Broomed Heads of Bull Points Trimmed

BROOMED heads of bull points and hand drills are almost as dangerous as shrapnel shells. Conversing recently with an engineer employed by one of the large contracting firms of the United States, he picked up a pill box which was standing on the desk, and lifted from it three jagged little fragments of steel. "Each of these steel pellets," said he, "was once a part of a broomed head of a bull point. That piece one day, under the blow of a sledge, flew off and, striking a man in the abdomen, pierced his intestines. The man died. This other piece, under the same conditions, struck a man in the cheek, went through and knocked out three teeth. That third piece cut a gash, along a man's brow and temple, which took a dozen stitches to close. Since these occurrences there has been in our work a rigid rule that every job blacksmith, as he puts an edge on a cold chisel or sharpens a bull point or hand drill, must at the same time carefully trim and square the head. We have had no further accidents from the cause mentioned." How many contractors make sure that their workmen never have to use a drill or chisel with a broomed head? C. S. H.

Other Articles of Interest to Contractors In This Issue:

Compacting Concrete by Tamping Plums With Pneumatic Hammers

IN BUILDING the Copco dam on the Klamath River in northern California, concrete was placed in the foundations through shafts, some of which were 125 ft. deep. Because of the limited space in the smaller shaft sections, hand tamping was slow and ineffective, interfered with the other work, and cost about 10c. per cubic yard. The specifications were exacting in regard to well-compacted concrete, and endeavor was made to improve on tamping by hand. Pneumatic tampers were tried out, and after some attention to details the tamping cost was reduced to 5c. per cubic yard.

The smaller shafts were in sections about 16 x 50 ft. in plan, and this space was divided by the cross-bracing into 8 x 16-ft. sections. In these small sections the men shoveling concrete, placing plums and tamping were frequently in the way of one another, and when the concrete was coming at normal speed it was often extremely difficult to tamp it properly.

When tamping by hand, about 100 to 150 cu.yd. of concrete were placed per day, and six to eight men were engaged in tamping. It was found that the hand tamping accomplished very little in the way of compacting the concrete where the layers were more than 3 in. in thickness, and in no case could the concrete be compacted uniformly. When a pneumatic tamper was adapted to the work, however, it was possible for four men to tamp effectively a day's run of 300 cu.yd. or more of concrete. The pneumatic tamper could not be applied directly on the concrete itself without burying the tamping head, but by tamping the plums it was found possible to compact the concrete for a depth of 2 ft. in all directions under the plum. The principal problem connected with adapting the jackhamer used to the work of tamping the plums was to find a suitable tamper head. The first attempts were with a hemispherical piece of steel about 5 in. in diameter and $\frac{1}{2}$ in. thick, whose concave side was riveted or welded to an 18-in. shank of $\frac{5}{8}$-in. hexagonal drill

HAND TAMPING COSTS CUT IN HALF BY JACKHAMERS

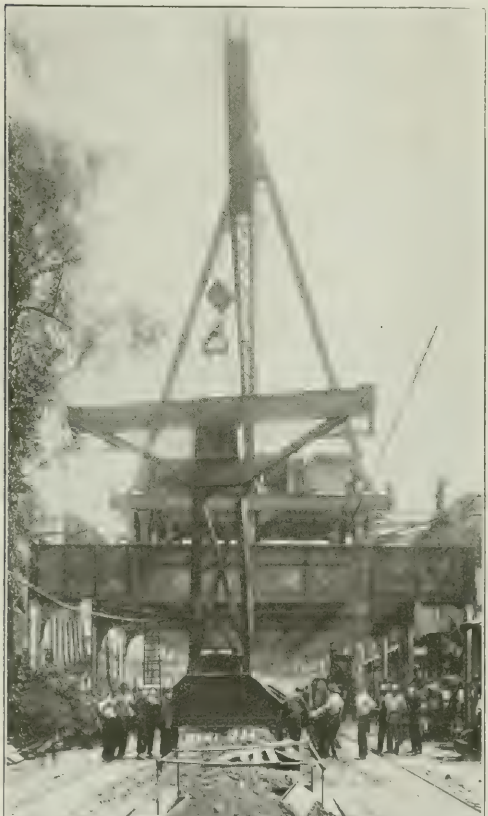
steel. These tamper heads would last long enough to tamp 250 to 300 cu.yd. of concrete, after which the rivets or the weld would loosen so that the head would come off. A more successful type of tamper was built by up-setting the head of a longer piece of drill steel and working it into the shape of a cone with a base about 3 in. in diameter. This type eliminated the difficulty of the tamper head coming loose, and gave good service for 400 to 500 yd. of concrete. It has a weakness, however, in that the shank would finally

crystallize and break off just where it enters the jackhamer. But with such heavy service long life for the steel was not expected, and the economies over the hand method much more than offset the maintenance costs.

The work was carried out by the California-Oregon Power Co. forces, P. O. Crawford being resident superintendent in charge of construction and installation.

Split Hose Protects Erection Men on Elevated from Trolley Wires

HOISTING steel for an elevated structure on a street occupied by trolley tracks and overhead wires has its dangers, as may be appreciated from the photograph, which shows one of McClintic-Marshall's crews setting center columns for the Frankford elevated railroad in Philadelphia. These heavy bents were raised



PROTECTION AGAINST HEAVY CURRENT BY SPLIT HOSE

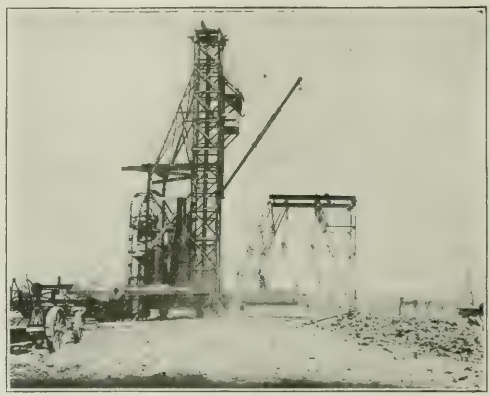
all in one piece, lowered till the base was below the car tracks, turned at right angles—bringing the base underneath the rails on either side—and lowered to place.

During these operations the trolley wires were guarded by lengths of nonconducting tubing, slit so as to be easily slipped on and moved along as the traveler progressed. The tubing can be readily seen in the photograph.

The street cars did not have to lower their trolley poles, but had to get up headway and drift the whole length of the insulation of the wire.

Boom on Traveling Tower Mixing Plant Handles Forms

WHEN not supporting chutes, the tower boom on the traveling mixer plant for the St. Paul, Minn., new high-service reservoir gave excellent service in handling forms. The view shows the mixer plant shifting the steel form carriage employed on the buttressed



WALL FORM CARRIAGE HANDLED BY TOWER BOOM ON TRAVELING MIXER PLANT

outside walls of the reservoir. The legs of this carriage straddled the wall and supported the various forms while a section was being concreted. Ordinarily the boom was occupied in supporting the swinging chute by which the concrete was delivered to the forms. Its handling of forms and its occasional use for hoisting were incidental. The contractors for the reservoir were the George J. Grant Construction Company, St. Paul, Minn.

Separating Concrete Aggregate Into Four Sizes

Concrete aggregate for use in the Lower Otay dam, now being rebuilt for the San Diego water-supply system, is being separated into four sizes, 2½, 1½, ¾ and ¼ in. This is being done so that the ideal proportioning, determined by careful tests, may be secured. The sizing is obtained without increase in cost, trials having shown that with a crusher properly set and the proper length of each mesh in the screen, the run of crusher gives the proper amount of each size. In other words, there is no wastage of material. The bins are on the side of the cañon, and the four chutes, one from each bin, are so located that they are manipulated by one man. Construction work is being carried on under the direction of H. N. Savage, consulting engineer for the city of San Diego.

NEWS OF THE WEEK

New York, October 17, 1918

Educators Organizing To Support Engineering Research Bill

A national committee of educators is being organized to support the Smith-Howard bill, now in Congress, for the establishment, in connection with state-supported universities or engineering schools, of engineering experiment stations for the promotion of engineering and industrial research. More than 35 educators, representing as many institutions, have already become members. A meeting will be held Nov. 12 in Washington for the selection of a chairman.

P. V. Stephens, consulting engineer, New York City, is the author of the bill. The bill has had one hearing before the committee on education of the House of Representatives. A second hearing is expected to be called before Nov. 1.

Canadian Contractors and Building Trades To Organize

As the result of a conference at Ottawa, Ont., in which prominent builders and contractors of Montreal, Toronto, Ottawa and London participated, it was decided to hold a convention in Ottawa Oct. 22-24, for the purpose of organizing all builders, contractors and building supply men in Canada from coast to coast, into what would be known as "The Canadian Association of Building Industries." It is understood that this move of the building interests in Canada to organize is the direct result of the changed status of the building industry, due to war conditions.

It is noted that this movement is entirely independent of any similar movement in the United States, and that it has spontaneously grown out of the pressure of abnormal conditions.

Street Flushing More Important Than Garbage Collection

Street flushing as an aid to putting down influenza in Philadelphia has been urged by physicians and others in that city. Requested to address street cleaning contractors, Dr. William Pepper, of the faculty of the University of Pennsylvania, said in part:

"Elimination of street dirt and dust is imperative, and the only way it can be done is by washing the germ-laden dust away. The more streets that are flushed, therefore, and the oftener it is done, the better conditions will become. Personally, I regard the flushing of the streets as of far more importance than the collection of garbage, for while I cannot see any great disease menace in garbage, though, of course, it is offensive, there is a very distinct menace in the dust that now blows around our streets with every wind.

"I haven't the least doubt that dust was the original disseminator of epidemic influenza in the camps and that it started in crowded barracks through the inhaling of dust carrying the contagious bacteria."

Make Nominations for Officers of American Society

The nominating committee of the American Society of Civil Engineers has presented its report to the Board of Direction, naming the following candidates for offices to be filled at the annual election Jan. 15, 1919: For president, Fayette Samuel Curtis, Boston; for vice-presidents, to serve two years, Herbert Samuel Crocker, Denver, and Leonard Metcalf, Boston; for treasurer, to serve one year, Arthur Smith Tuttle, New York City; for directors, to serve three years, George Hallett Clark, New York City; Jacob Stinman Langthorn, New York City; Charles Clement Elwell, New Haven, Conn.; Willard Beahan, Cleveland; John Watson Alvord, Chicago, and Carl Ewald Grunsky, San Francisco.

Public Health Meeting Postponed

The annual meeting of the American Public Health Association scheduled for Chicago, Oct. 14-17, has been postponed to open in Chicago Dec. 9, according to notification received from an officer of the association by *Engineering News-Record* after the issue of Oct. 10 had gone to press. This action was taken on account of the epidemic of Spanish influenza.

American Shipyards Make New Record in September

September shipbuilding figures show that the United States broke another world's record, having previously established a record in August. The completed tonnages are 369,330 dead-weight tons for September, against 339,313 tons in August. Deducting one steel ship delivered by Japan with a tonnage of 6695, the net United States tonnage is 362,635 tons. Forty-five steel ships and 29 wooden ships are included. During September the deliveries from British shipyards were 231,635 dead-weight tons, so that American shipbuilding exceeded that of Great Britain by more than 50 per cent.

All-American Canal Project Has Setback

The all-American canal project, under which the Imperial Irrigation District would build a canal wholly on American soil to connect with the La-

(Concluded on p. 734)

Another St. Lawrence River Power Addition

Canadian Government Also Protests South Sault Weir Award of Joint Commission

Following the permission to construct a weir across the South Sault channel of the St. Lawrence, the International Joint Waterways Commission has been hearing the application of the New York & Ontario Power Co. for the right to develop additional power by the construction of a dam across the Little River on the South branch of the St. Lawrence at Ogden Island. The company has now the right to develop 100,000 hp. and seeks to increase the flow of water through the power canal by 30,000 cu.ft. per sec., enabling the development of approximately 30,000 hp. additional.

The Canadian Government is opposing the company's application on the ground that (1) it will interfere with the full and economic development of the St. Lawrence system as regards navigation and power potentialities; (2) it will interfere with the complete regulation by a dam at Canada Island of the level and outflow of Lake Ontario; (3) the future development of the river will necessitate the acquisition of any rights the applicant may have in the river, and it is inadvisable to create more; (4) the St. Lawrence River has enormous potentialities, that should be developed in the most efficient and economical manner for future generations.

The Canadian Government has also made a formal diplomatic protest to the United States against the judgment of the International Joint Waterways Commission granting to the St. Lawrence Power Co. authority to dam the South Channel of the St. Lawrence River. An order-in-council has been passed outlining the contention of the Government that the commission has no power to authorize works in contravention of the Ashburton treaty and the treaty of 1909, which guarantee against interference with navigation in the boundary waters. The Canadian Government considers that if the dam that has been authorized were really needed to increase the war output of the Aluminum Co. of America, the two governments should have built it jointly, and the Dominion Government would have had no objection to a lease of the privilege of using the power thus temporarily developed. There are fears that the dam once constructed will be removed with great difficulty, if at all, and will interfere with the broad scheme of national development of the St. Lawrence as proposed.

All-American Canal Has Setback

(Concluded from p. 733)

guna dam of the Yuma project, has received a setback. The district mentioned signed a contract between itself and the Government authorizing the connection, but forwarded the contract to Washington with a protest that it was virtually acting under coercion. The district asserts that the contract would cause it to yield its priority water rights in the Colorado River to the beneficiaries of the Yuma project of the United States Reclamation Service, and that the contract would also cause surrender of certain water-power rights. Secretary of the Interior Lane has returned the contract to the district unsigned, rather than give rise to any question of coercion. The Laguna dam connection would make possible the abandonment of the Hanlon heading, and thus obviate various difficulties and dangers.

Court Confirms Commission-Manager Government for Roanoke

The commission-manager form of government for Roanoke, Va., of five commissioners and a city manager, has been confirmed by the State supreme court of appeals, which upholds the validity of the election affecting the form of city government, thereby replacing the bicameral aldermanic form of government which previously had been officially in effect.

William P. Hunter, of Doswell, Va., formerly resident engineer for the Chesapeake R.R., has been selected as city manager.

Jersey City Water-Supply Suit Passed to Highest Court

The application for a retrial of the suit in which it was decided that chlorination of the water-supply of Jersey City fulfilled the contract requirements for purity has been dismissed without prejudice by the vice-chancellor in order that it may go directly to the Court of Errors and Appeals. The basis for the application was the alleged development by experience of new evidence showing that chlorination alone does not afford the full safeguard against typhoid that was claimed for it by expert witnesses when the use of the process on a large scale was new.

Atlantic Coast Delivers First Steel Contract Ship

Delivery of the 9650-ton cargo steamship "Liberty" to the Shipping Board on Oct. 5 signalized the completion of the first Fleet Corporation contract steel ship built by any Atlantic Coast yard, and also the completion of the first fabricated ship. The keel of the vessel was laid Nov. 15, 1917.

The "Liberty" is 410 ft. long, and has a beam of 55 ft. and a molded depth of 34 ft. 11 in. The power equipment includes three Scotch boilers and geared turbines of 2500 hp. The contract speed is 11 knots, but speed of 12.8 knots was made on the trial trip.

Municipal League Will Discuss Reconstruction Problems

The National Municipal League will meet in conference at Rochester, N. Y., Nov. 20-22, to discuss American reconstruction problems. The Chamber of Commerce and the Bureau of Municipal Research of Rochester will be the hosts. The conference will open with addresses by representatives of Great Britain, France and Belgium, describing in turn what those countries are doing in the way of solving reconstruction problems.

The speakers who will treat of construction efforts among our allies are Professor Van den Ven, formerly of Louvain University, for Belgium; Thomas Adams of Ottawa and London for Great Britain, and Lieut. Maurice Boyer for France.

Notes From the Field

Observations of an Itinerant Engineer

He told me I could not leave San Diego until I had visited the Sweetwater dam and the work at the Lower Otay site. I went. But I saw more than the dams. I saw a man's man at work. I saw an organization in the forming that will render a strong account of itself.

The man began to show after we struck camp at Lower Otay the first night. Holmes was on the wire. He wanted a place as blacksmith on a job that he could stick to till it was finished—and this in a country where roving is the popular pastime. Surely, Holmes was wanted, was the reply, and for the right man there would be a bungalow for himself, the wife and children. "The more children, the better," the chief added, as he closed the deal hiring the best drill sharpener in the county. And so Holmes followed the leader to a new job.

After the "boys" had gone to their respective shacks, there was a word from the chief about each. Paddock, a born leader, he had watched carefully for some ten years, and it was he who would have charge of the masonry. Gates, under observation for as many years on different jobs, would see to the tunnel and the outlet tower, while Stebbins, who had worked for him as far back as 12 years ago, had been *commandeered* (that's exactly what was done) to save the situation—to get 30,000 yards of sand out of the reservoir bed before the rains, and bring in the cement before the roads softened. Willcomb, tried out under severe tests on other jobs, would handle designs. "A picked crew," he remarked, though even the poorest observer would have so read the competent group that a few minutes before had in brief sentences made clear the big points in the day's business.

The next morning I joined the chief at the north abutment and climbed the cañyon with him. "More good news," he beamed. "Cody, one of the best steam shovel men I know, wants to come. We surely need him to get out that sand."

At the camp we saw the showers, the excellent toilet facilities, the recreation hall, and chatted a moment with Woodman, a cook (the men assured me) who "can't be beat." "Nothing too good for men who will give good service," commented my host as I complimented his thoughtful care for his workers.

That morning, as we drove over the Sweetwater dam, I overheard his philosophy, crystallized in answering one of his men regarding an applicant, "We owe the same loyalty to a man as we expect him to give loyalty to the job."

And that's why some of the mainstays of his crew at Lower Otay have followed him half across the country. That's why mechanics and even laborers who have been on his jobs before are giving up other places to work under H. N. Savage.

* * * * * *

When Sir William Willcocks visited the Roosevelt dam he asked for a room facing and nearest the structure, that it might be first to greet his sight in the morning and be near him during the night. And when he inspected the structure he patted it caressingly, as if it might have been a thing alive. And those who saw attributed it to his warm Eastern nature, to the influence on him of the mystical atmosphere in which he had so long lived.

I was reminded of Sir William's feeling, at Sweetwater. I have had some hundreds of men show me over their work in the past dozen years, but never in the way H. N. Savage showed me over the Sweetwater dam. He had first been connected with the structure in the early nineties.

We climbed everywhere that the structure was accessible—over both abutments, into the inspection gallery, over the south spillways and then into the giant 6 x 12-ft. siphonic spillways, which are sure to stand for many a day as record hydraulic structures. At every step was detailed explanation of what was done and why. Throughout was a pride in the work that was not expressed in words, nor even in effusiveness of technical description. One felt the enthusiasm and the pride of the creator; words were unnecessary.

Curiously that attitude was reversed when we came to the south dike, an earth embankment some 45 ft. in height, concrete-faced. "This," said he, "is one of the most eminently satisfactory jobs I have ever done. It is simple, and the average man would likely pass it by. But at low cost it completely fills the purpose for which it is intended. It has won the confidence even of the farmers who lost a lot of money through the failure of this dike's predecessor."

"At low cost it completely fills the purpose for which it is intended"—there spoke the master workman. Pride unconcealed in the small job that showed forth his ideal of an engineering structure.

And as we left it, he remarked, simply, "The big structures speak for themselves." E. J. M.

Necessity, Not Convenience, Must Govern in Utility Extensions

"Only absolute necessity must be considered, and not convenience." This, says Bernard M. Baruch, chairman of the War Industries Board, in a letter to C. S. Hamlin, chairman of the Capital Issues Committee, is what should govern in the matter of capital expenditures on public utilities—for water and gas mains, electrical trunk lines and electric railway service. The letter is the outcome of a request by Mr. Hamlin for a general rule for the guidance of utilities and utility commissions, in making applications for capital issues, and the Capital Issues Committee in passing upon such applications.

Curtail Manufacture of Road-Making Machinery

The War Industries Board announced that beginning Oct. 1 no road-making machinery should be manufactured for six months. Repair parts are expected, as are also machines to be used on various kinds of public works. The text of the order follows:

"Six months from Oct. 1 no road-making machinery or any part thereof shall be manufactured except: (1) Repair parts; (2) for work on railroads and other public utilities; (3) for roads repaired by the United States Government, the several states, counties and municipalities; (4) for new construction by the United States Government, either directly or indirectly."

$1000,000 More for Engineering Research

Ambrose Swasey, of Cleveland, Ohio, has just given Engineering Foundation an additional $100,000 for endowment of engineering research. In 1915 he gave $200,000 for this purpose, so that his total gifts are now $300,000. Mr. Swasey is a past-president of the American Society of Mechanical Engineers.

Calendar

Annual Meetings

CITY MANAGERS' ASSOCIATION: Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS: A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Dec. 9, Chicago.

The Western Society of Engineers was addressed Oct. 7 by E. T. Howson, who spoke on "The First Nine Months of Government Operation of the Railways," commenting upon the changes in railroad organization and the results of operation. While advocating Government control of the railways during the period of the war, the speaker strongly opposed Government ownership and operation as a permanent policy in this country. Phases of the contract between the railways and the Government were also discussed.

The San Francisco Sections of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the American Chemical Society held a joint meeting Sept. 26 under the auspices of the mechanical engineers' section. The subject of the meeting was "Fuel Conservation," the program including 11 speakers. This was the first meeting of the Associated Engineering Societies of San Francisco, and was attended by 325 members.

The Indiana County Commissioners held a convention in Logansport, Oct. 15-17. Road maintenance rather than new construction was emphasized in the discussion. A paper on "Seal Coats or Surface-Treated Macadam" was presented by H. M. Sharp, former state highway engineer of Ohio.

The Associated Building Contractors of Indiana is the name adopted by the organization formed at a recent meeting of building contractors at Fort Wayne, Ind., at which the following officers were elected: President, C. C. Pierson, Indianapolis; secretary-treasurer, A. H. Witte, Fort Wayne. It is planned to hold the first convention of the new organization in Indianapolis in January.

The Oregon Society of Engineers was addressed Oct. 7, by E. J. Mehren, editor of *Engineering News-Record*, on "How War Making at Washington Impresses an Engineer."

The Engineers' Club of Baltimore held a meeting Oct. 3 which was addressed by George A. Riker, district engineer, Portland Cement Association, on "Concrete Ships, Their Construction and Performance."

Personal Notes

WALTER GOODENOUGH, vice-president of the American International Shipbuilding Corporation, in charge of ship construction at Hog Island, has resigned to reënter the organization of Stone & Webster. Mr. Goodenough is succeeded by William W. Locke, formerly his assistant.

ARTHUR CRUMPTON, assistant valuation engineer of the Grand Trunk Ry., has been made valuation engineer, succeeding William McNab, who has been appointed chairman of the valuation committee. Mr. Crumpton was made assistant valuation engineer in 1916. He has been with the Grand Trunk since 1889.

LORD SHAUGHNESSY, president of the Canadian Pacific Ry., has resigned, but will remain chairman of the board of directors. E. W. Beatty, vice-president and general counsel, succeeds him.

H. L. CUNLIFF, contractor, Seattle, has closed his offices to become disbursing officer for the United States Housing Corporation at Bremerton, the Puget Sound naval station. Mr. Cunliff will reënter the building contracting field when the Bremerton housing project is completed.

CAPT. JOHN F. BLAIN, who has been in charge of steel ship construction for Emergency Fleet Corporation yards in the State of Washington, has been appointed district manager, with jurisdiction over both wood and steel construction, following the resignation of William Piggott, formerly in charge of wood construction.

JOHN L. HALL, consulting engineer, Seattle, has been appointed corporation representative for the United States Housing Corporation, Bremerton Navy Yard housing project.

W. S. SHAW, JR., has been appointed division engineer of the Michigan Central R.R., in charge of the lines in Canada, with office at St. Thomas, Ontario.

CHARLES S. CHURCHILL, assistant to the president of the Norfolk & Western Ry. under private control, has been made vice-president of the corporation. Mr. Churchill was formerly chief engineer, and has been in the service of the Norfolk & Western since 1888.

EARL MAULDIN, who for the past few years has been constructing engineer for the R. J. Reynolds Tobacco Co., Winston-Salem, N. C., has resigned to become construction engineer at Camp Bragg, the work for which is under contract by J. E. Sirrine.

CAPT. FRED E. HANSON, formerly in the valuation department of the New York, New Haven & Hartford R.R., now of the Engineer Officers' Reserve Corps, has been promoted to major and is now stationed at Camp Forrest, Georgia, as camp adjutant.

GAVIN N. HOUSTON, consulting engineer, Denver, Colo., who was in charge of the construction of the waterworks at Nitro, W. Va., has become assistant chief engineer to the commissioner of irrigation, Department of the

Interior, Canada, with headquarters at Calgary, Alberta, in work similar to that in which he was engaged between 1913 and 1916.

C. E. HAYGOOD, manager of the railway department of the Manila Electric R.R. and Light Co., Manila, P. I., is visiting the United States for the purpose of consulting with the managers of the company, the J. G. White Management Corporation, New York City. Mr. Haygood expects to return to the Philippines before the first of the year.

JULIUS L. MEIER, Portland, Ore., has been appointed regional chairman, region No. 10, highway transport committee, National Council of Defense, in charge of highway matters in Oregon, Washington and Idaho.

E. L. COLLETTE, assistant engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed district engineer at the same point. He succeeds P. J. Neff, whose appointment as engineer for the corporation was noted in these columns last week.

C. LOOMIS ALLEN has retired from the firm of Allen & Peck, Inc., engineers and managers of public utilities, Syracuse, N. Y. and Baltimore. The name of the firm has been changed to Peck-Shannahan-Cherry, Incorporated.

H. RETTINGHOUSE, chief engineer of the Chicago, St. Paul, Minneapolis & Omaha Ry., has received jurisdiction over the St. Paul Union Depot.

GEORGE HUTCHINSON, superintendent of construction of the Chickasaw Shipbuilding Co., Mobile, Ala., has been promoted to assistant general superintendent.

A. D. BUTLER, city engineer of Spokane, Wash., has been granted leave of absence to enter the service of the War Department at Washington as a civilian engineer. It is expected that Mr. Butler will be commissioned later, probably for duty overseas.

CHARLES F. LOSH has been appointed valuation engineer of the Norfolk & Western Railway.

N. W. DOWNS, assistant chief engineer, Board of Education, Kansas City, Mo., has received leave of absence to enter Government service in construction work, with headquarters in Washington, D. C.

W. J. BERGEN, first assistant to the chief engineer of the New York, Chicago & St. Louis R.R., has been appointed chief engineer of the corporation, with headquarters at Cleveland. Mr. Bergen was born in 1872 and was graduated from Rensselaer Polytechnic Institute in 1897. From 1899 to 1901 he was with the Burlington & Missouri River Ry., most of the time as division engineer on construction. In 1901 he went to the New York, Chicago & St. Louis R.R., as assistant engineer. In 1907 he was made chief supervisor of track, and later in the same year he was promoted to first assistant to the chief engineer.

J. W. REID, bridge engineer of the Chicago & Alton R.R., has resigned to enter the service of the Robins Conveying Belt Co., Chicago.

VIRGIL LEE, formerly of the county surveyor's office, Madison County, Indiana, has been appointed city engineer of Anderson, Ind.

HARRY C. LEA, formerly director of public works, Aspinwall, Penn., is now connected with the United States Ordnance Department, Pittsburgh district.

J. E. JOHNSON, division engineer of the Michigan Central R.R., at St. Thomas, Ontario, has resigned in order to enter private business.

G. W. SMITH, assistant chief engineer, Nash Motors Co., Kenosha, Wis., is now chief inspector of the motors division, Quartermaster Corps, U. S. A., with headquarters at Detroit.

J. R. CASWELL has been appointed division engineer of the Canadian Pacific Ry. at London, Ont.

OBITUARY

CAPT. KIRBY BALDWIN SLEPPY, Corps of Engineers, formerly an engineer on the Los Angeles aqueduct, has been killed in action in France. Captain Sleppy entered the officers' training camp at the Presidio, San Francisco, a month after the United States declared war. He joined the Engineer Corps of California, a volunteer organization, in 1917, and was a member of the Military Engineers' Association of Los Angeles. He went to the training camp at the Presidio as a first lieutenant and was graduated as a captain. He had been in France about seven months. Before going to Los Angeles, he was engineer for the Southern Sierras Power Co. Captain Sleppy was a graduate of the University of Pennsylvania.

LIEUT. ARTHUR K. ATKIN, who was an engineer with offices at 87 Wall St., New York City, at the time war was declared, has died of wounds. Lieutenant Atkin was a graduate of the Plattsburg officers' training camp, and for several months afterward was stationed on Governors Island. He went overseas in Company L, 165th Infantry, "Rainbow" Division. On his arrival in France he was transferred to the 126th Infantry. He was a graduate of the Massachusetts Institute of Technology.

LIEUT. FRANK DICKIE, of Indianapolis, Ind., who was with the engineers at Chateau Thierry and was afterward ordered home for instruction duty, died of pneumonia on Oct. 3 at Camp A. A. Humphreys, Virginia. He was 26 years old and became an officer after attendance at the officers' training camp at Fort Sheridan, Illinois. He had been in France for five months.

RAYMOND R. HILL, construction engineer, Arnold Co., Chicago, died Oct. 5 while engaged on war work at Schenectady, N. Y. He was 41 years old. From 1905 to 1910 he was superintendent of bridges and buildings for the Metropolitan Street Railway Co., Kansas City, Mo., leaving this position to superintend the construction of the Dallas-Oak Cliff Viaduct. In 1912 he rebuilt the Kaw River Bridge at Kansas City, for the Missouri Pacific R.R., and the following year had charge of construction of deep river piers for a bridge over the St. Francis River at Riversville, Que. Later he installed a water-works intake for Hamilton, Ont., and also an intake pipe for the National Steel Car Co., into Hamilton Bay. Mr. Hill's most recent work was in the reconstruction of the Pullman shops at Pullman, Ill., for the Arnc Company.

CAPT. N. SIMONSON, president, and Perry A. Clapper, secretary and treasurer of the American Construction Co., lost their lives as the result of an automobile accident, while returning from a business trip Sept. 26. Mr. Clapper's death occurred the day after the accident and Captain Simonson died Oct. 3.

CHARLES A. MILLER, city engineer of Oregon City, Ore., died recently at his home in that city. Mr. Miller became city engineer of Oregon City in 1915; before that time he was connected with the Portland-Eugene & Eastern Ry. He had been associated with railroad engineering work in the Northwest for a number of years, and was engaged in the construction of the Tacoma street railways and the Willamette Falls Ry., being superintendent of the latter for 22 years.

H. W. BELNAP, chief of the bureau of safety of the Interstate Commerce Commission, died Oct. 12 in Washington.

WALLACE B. LINDSAY, head of the electrical engineering department of Ingersoll-Rand & Co., died of pneumonia at his home in New York City Oct. 10.

News of Engineering Industries

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

American Potash Challenges German Competition

Recovery as Byproduct from Cement and Iron Plants Will Give Large Tonnage and Revenue

That the cement industry of the United States alone is capable of producing from 80,000 to 100,000 tons of potash annually is indicated by data and estimates furnished in a report by the bureau of soils, Department of Agriculture. It is also possible for a 3,000-bbl. cement plant to realize a profit of almost $500,000 annually in the recovery of potash from waste gases. Similar indications come from investigations made in blast furnaces.

German Resources

Germany's immense deposits, the potash content of some of which run as high as 16%, the predatory actions by its government and industrial financiers, together with subsidies and other efforts to control the industry in the years preceding the war, reduced the whole world to almost an economic dependency on Germany for this important product. Basing her belief on the immense supply she has, and her ability to produce it at less cost than others, and on the idea that the other countries of the world will not be able to produce potash in sufficient quantities for their home demand so that of necessity she will be able to enter those markets, she hopes to be able to regain her place in commerce after the war. The Stassfurt mines in Germany are easily able to produce sufficient potash to supply the needs of the whole world, and the extent to which she dominated the world's markets prior to the war is illustrated by the British supply in 1913. The total imports were valued at approximately $6,500,000, of which almost $4,500,000, or 66%, was imported from Germany. The nearest competitor was France, with somewhat more than $900,000, or about 14%.

The chief demand for the material arises in the need for potash fertilizer in agriculture and in the manufacture of explosives. The lead held by Germany in the manufacture of optical goods is also due to the highly developed potash industry of that country. These industries, as well as the dye industries, have been developed in this country and Great Britain since the outbreak of the war, and the strides made in these respects will in themselves be the source of a considerable demand, to which the cement industries and the blast furnaces will look for the consumption of their byproducts.

The acute shortage experienced in Great Britain at the outbreak of the war led that country to study the problem immediately, and it was found that by the addition of small proportions of common salt, involving but a slight increase in cost, into the blast furnace workings made the potash present in the ore obtainable from the emerging gases as potassium chloride without injury to the pig iron product. It was found that the British furnaces were capable of producing 50,000 tons of potash salt per annum, or enough to supply practically the entire needs of the country.

The recovery of potash as a byproduct from cement mills in the United States was studied and developed first at the Riverside Portland Cement Co.'s plant in California. A process was installed to abate the dust nuisance, the varying fineness of the precipitates of which led to the study of the composition of the dust and to the discovery of the high alkaline content. The first study and development of the process of recovering the potash from blast furnace gases was made in eastern Pennsylvania, particularly at the South Bethlehem plant of the Bethlehem Steel Company.

An Economic Weapon

Interest in the various processes will increase, it is believed, as the country realizes the economic weapon available against Germany and her highly organized industry. England and France are alive to the situation and are developing their resources to the utmost. The prospects for the byproduct industry are largest in the South, where the iron ore and other raw materials lend themselves to the possibility of a large output, and the demand for potash fertilizer in the cotton fields in the neighborhood makes a market close at hand. The high development of byproducts in other industries, and the advantages those industries have reaped from them, the value of this byproduct in stabilizing the industry from which it is derived, as by enabling iron furnaces to stay in blast at a time when the main demand is low, give the new industry a large economic value, according to authorities who are studying the problem.

Texas Company Rearranges Its Organization

Announcement was made, effective Oct. 1, that that part of the Texas Co.'s asphalt and road-oil business heretofore conducted in the name of its special agent, John Baker, Jr., will in the future be conducted in the name of the Texas Co. asphalt department. Present offices and organization of the John Baker, Jr. Co., will be retained.

Alien Property Custodian Urges Closer Coöperation

Coöperation in the work of uncovering money and property of enemy character, by readers of *Engineering News-Record*, is urged by A. Mitchell Palmer, United States alien property custodian. He requests that any information regarding the enemy interests in any activity be forwarded immediately to Francis P. Garvan, director of the bureau of investigation, Alien Property Custodian Office, Washington, D. C. Mr. Palmer asks that even if the information is only rumor it should be reported. Clews to many important enemy interests have been obtained in this way. The money realized from the sale of enemy property is invested in Liberty Bonds, and is made to fight for our country, instead of against it. The trading with the enemy act requires the reporting of property rights and claims of every kind, tangible and intangible, bonds, notes, money, securities, lands, indebtedness, and accounts receivable.

Manufacturers as Special Assistants to Chief of Ordnance

The War Department has appointed two prominent manufacturers as special assistants to the Chief of Ordnance. They are W. W. Coleman, president of the, Bucyrus Co., South Milwaukee, Wis., one of the largest producers of steam shovels and dredges, and T. H. Symington, a member of the firm of Symington-Anderson Co., Rochester, N. Y., iron and steel manufacturers.

Mr. Coleman will have charge of all matters connected with the production of cannon carriages, their appurtenances and accessories, and will follow the production of these munitions through the stages of design, production and supply. Mr. Symington will have similar charge of artillery ammunition metal parts, etc.

Epidemic Causes Postponement of War Conference

Notice has been received from the American Supply and Machinery Manufacturers' Association that its proposed war service conference, which was to have been held at Atlantic City Oct. 22 must be indefinitely postponed on account of the prevalence of influenza in New Jersey and at Atlantic City. Owing to the gravity of the situation, the health authorities of the state and city felt that it was impossible to grant permission to hold the conference, and the association announces that the various members will be advised later as to plans to prevent the slowing up of war activities by this decision.

Recover Army Supplies Worth $10,000,000

Searches by Division of Military Aeronautics Disclose Large Stores Apparently Lost

The Division of Military Aëronautics has turned up since Aug. 6 a surplus of supplies worth $10,000,000 which was apparently lost, and its examiners have not yet finished their task. The supplies already listed include typewriters, motor cars, motor trucks, oil, lumber, wood, iron and steel-working machines, motorcycles, building materials, airplanes, and about everything in the accessory line, from screw eyes to stove bolts.

The division of the General Staff which is carrying on this investigation and has accomplished this task is known as the surplus inactive supply service, purchase and storage branch, purchase, storage and traffic division of the General Staff. It has branches in most of the bureaus of the War Department, and the object of their work is to utilize duplicate supplies purchased through the unavoidable lack of organization in the emergency and rush at the beginning of the war. These surplus supplies, as fast as they are found, are listed, and through a system of trade, transfer and sale, either put to use in the department or sold in the public market. The Division of Military Aëronautics has already turned over to the Surplus Inactive Supply Service property amounting to more than $2,000,000, which none of its own branches could use.

Construction Material Found

Among the material found and immediately put to use was 4,500,000 feet of ⅜-in. rope. The present demand for rope is exceedingly great, and specifications were changed in order to take advantage of this "find." Another consignment that was found and immediately put to use was 500 pairs of field glasses, worth $37,500. These were found in a supply depot at Omaha, and other emergency supplies to the value of $75,000 were discovered in this same station and immediately shipped overseas. Other surplus supplies found included seven carloads of iron, steel and woodworking machinery found in a supply depot at Hampton, Va. In one of these cars was a wire-testing machine badly needed in France. Five thousand steel drums also wanted for oil containers were discovered in a private storage; although they were not the property of the Government they were put into immediate use and the owner was paid for them.

Pulverized Fuel Mixer Operates Under 6-Ounce Pressure

The feeding mixer for pulverized coal illustrated and described on p. 693 of the last issue of *Engineering News-Record* operates under 6-oz. pressure and not under 6-lb. pressure as noted.

Auto Manufacturers Approaching 100% War Basis

That the automobile manufacturers of the United States are rapidly reaching a 100% war basis, as suggested by the War Industries Board recently, is indicated in reports made to the National Automobile Chamber of Commerce at a recent meeting. The report also showed that contracts for Government war work aggregating $800,000,000 have been taken by the motor-car factories.

C. C. Hanch, chief of the automotive products section of the War Industries Board, explained the new priority ruling that will govern the production of automobiles and automobile trucks. The production of trucks has been limited to one-third of the average for the 18 months which ended July 1 last, with the understanding that no trucks are to be sold except to absolutely essential industries.

The general war condition of the industry, the need for good roads to expedite transportation, and the growth of the rural motor express, were also discussed.

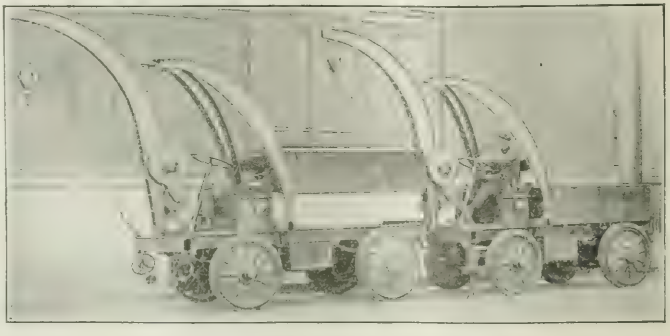
Mobile Crane on Electric Tractor Operated by Same Battery

A tractor equipped with a two-ton capacity crane, also operated by electric motors, and supplied with current from the storage battery used to propel the electric vehicle, has recently appeared in response to a demand from terminal and manufacturing plants. War conditions in such plants created the necessity for a more flexible plant of this nature, although to gain this flexibility a certain amount of lifting capacity had to be sacrificed.

Recently, however, one of these electric crane tractors unloaded a freight of large crates of army kitchen equipment weighing approximately 3700 lb. After lifting the cases off the freight car it backed away, and, running across the pier under its own power, deposited the load.

The boom of the crane swings 180 deg. so that after material is lifted it can be deposited easily on the ground or on a trailer for transportation elsewhere. The tractor also being equipped with a spring draw-bar coupler at the rear of the frame, it is therefore possible to load trailers by means of the electric crane and then haul these trailers electrically to another point and unload them.

Locomotive or overhead cranes are not always available at just the place where it is necessary to handle material at a given time, and, even if available, they cannot always be transported quickly from one point to another as can a crane tractor of this type. It is manufactured by the Walker Vehicle Co., New York City.



ELECTRIC TRACTOR AND CRANE IN OPERATION

Business Notes

The Electro Bleaching Gas Co., 18 East 41st St., New York, has discontinued its Chicago office on account of war demands on its force. G. R. Ellis, in charge of the Chicago office, has been transferred to the plant at Niagara Falls, and placed in charge of the office.

The pipe order from the United States to the Continental Pipe and Mfg. Co. involving 230,000 ft. of wood-stave pipe, varies from 6 in. to 18 in. instead of from 6 in. to 8 in., as noted in *Engineering News-Record* of Sept. 26, p. 606.

Trade Publications

The United Iron Works, Kansas City, Mo., has published catalog P-18 illustrated with line cuts and halftones of different models of pumping machines, and a short description of the application and uses of each model.

The Austin Co., industrial engineers and builders, Cleveland, Ohio, has issued a 63-p. book entitled "Austin Standard Factory Buildings." It explains the Austin method of factory construction, and includes engineering data, illustrations and descriptions of the 10 types of Austin standard factory building.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

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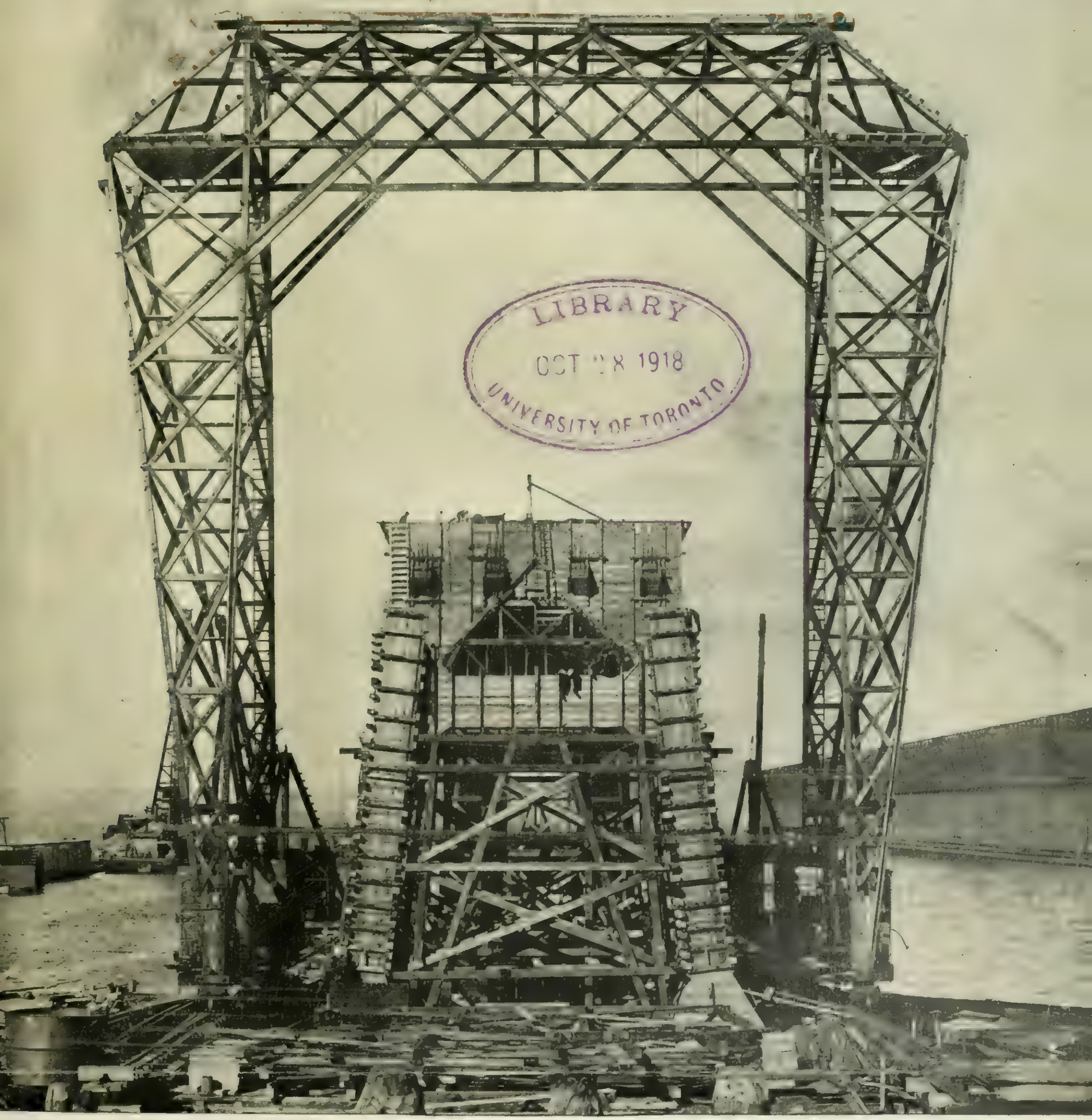

Timber Traveler on Construction of "Soo Line" Ore Dock at Ashland, Wis.

"Delco" Drafting Room
The Dayton Engineering Laboratories Co., and The National Cash Register Co. use over 150 Drafting Machines.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Full Energy in War Work

BUILDING the River Rouge submarine chaser plant in two months, as told on p. 755, was a typical war-time achievement. All hands worked faster than ever before, with a result almost miraculous as compared with normal construction performance. Such drive is a manifestation of the spirit that on the battlefield makes the army resistless. And the successful accomplishment has the same value as a victorious battle; beyond its immediate fruits, it bears an inspiration of power and success for the next task to be encountered.

Raising Sunken Ships Not a Simple Matter

THE mystery of the sinking of the steamer "St. Paul" at her dock last spring is in no way solved by the detailed description of her raising that this journal is now permitted to publish on p. 764. In ordinary times ocean liners of long-established safe design do not capsize in calm rivers under normal loads, but these are not ordinary times, nor does a possibly wise censor permit any information as to abnormal loading or on rumored changes in the vessel's design which may have affected her stability. It appears that the real causes of this accident and of the similar, though still more inexplicable, sinking of the "America" last week in New York Harbor must wait until after the war. The available facts of the raising, however, testify to the magnitude of the operations involved. Lifting this enormous mud-filled and opened hull first to an even keel and then to buoyancy from its resting place in 40 ft. of water in a congested slip required an ingenuity of supervision and a skill of individual execution far beyond the ordinary. The difficulties of the job do not promise well for the fantastic schemes proposed to reclaim the many equally large victims of the submarine from the ocean bottom around Great Britain and in the Mediterranean.

Provide Repair Materials for Accidents in War Time

AMONG hazards of war comes inability to secure materials for emergency reconstruction necessitated by accident. Destruction by flood and reconstruction of the irrigation aqueduct described on p. 761 exemplify this hazard. Twelve thousand acres of grain, alfalfa, sugar beets and minor crops in this instance depended for rescue solely upon the speed of reconstruction of the aqueduct. There were a score of things, including scarcity of labor, to handicap speed, but above all other obstacles towered scarcity of vital materials. Because wire rope had been commandeered by the Government for the supreme purpose of war, makeshift suspension cables had to be pieced together of such rope as could be obtained from dealers in second-hand materials. To this fact indirectly was due the second collapse of the aqueduct, which further postponed for 16 days restoration of water to the thirsty land. Presumably, in a case of this character, where vital war interests depend upon speedy restoration, priority will be granted for obtaining the materials needed, but the process is a slow one, and ordinarily the constructor must depend upon his own resourcefulness in finding what he needs if he expects to rescue his endangered property. Precautions cannot easily be specified, but now is a time when works managers can least afford to risk accidents to producing plant or equipment.

Unharnessed Water-Power Expensive and Dangerous

INTERFERENCE with the régime of a river is likely to have disastrous results unless undertaken with the utmost caution and with a knowledge of all of the facts and conditions. After straightening a channel one must expect increased velocities, which will pile up water in the lower reaches and cause flooding of additional areas of bottom lands, and which may have sufficient power to cause serious erosion or destruction. Failure to recognize these conditions has resulted in costly troubles at Oklahoma City, as detailed on page 752. Drainage commissioners in the county straightened a channel above the city limits. To carry off the added volume through the city the latter permitted a cutoff to be made across a loop. Unfortunately, the city water-works plant was located on the loop and was left without supply when the diversion works were washed away and the cutoff channel scoured to such depth as to take the dry weather flow. To date about $100,000 has been expended on lawsuits and in the numerous attempts to build a permanent spillway in the diverting or cutoff channel in order to maintain a flow at the water-works station. Most of this expenditure might have been avoided had the work been preceded by study of the hydraulic project as a whole. As many drainage reclamation projects will soon receive serious attention in a hurried attempt to provide after-the-war work, it is none too early to warn well-intentioned promoters of the necessity of engineering investigation and advice to guard against such possibilities as the destructive power induced by tampering with the régime of a stream.

After-the-War Road Work in Illinois

AS THE state-wide campaign for the $60,000,000 good roads bond issue in Illinois draws to a close before the election on Nov. 5, it is highly important that the project be actively and enthusiastically supported. The project is sound from the financial, economical and engineering standpoints.

Serial 20-year 4% bonds, to be retired by the automobile license fees, with maintenance provided for, is the financial scheme. The license fees, which already have practically doubled, will be collected anyway, and would build the same mileage or more in the 20-year period. In the piecemeal, patchwork plan a continuation of the present isolated section scheme would be inevitable. By the proposed plan the credit of the state would be used, bonds issued and sold as construction proceeds, and the 4800 miles built within a five-year period. Since no bonds are to be issued until peace comes the project answers the requirements of after-the-war work most admirably.

From the engineering standpoint the routes as laid out (see map, p. 777) will give Illinois in intercity system. It will connect with four national highways and serve nearly every county seat on the route and every town of 2000. Sixty-five per cent. of the people live on the roads in towns touched by the system, and 85 per cent. live within five miles of the road on 65 per cent. of the area of the state. The rational system of choosing routes and types of surface, according to traffic, population and property valuation, whereby the obvious engineering method of equal unit costs per user is a desideratum, was used in making the plans and estimates. In fact, the late W. W. Marr, state highway engineer, developed this method for comprehensive county systems with the state problem in mind. (See *Engineering Record* of Apr. 22, 1916, p. 536.)

To engineers as a class, one scarcely needs to note the very obvious necessities and economics of improved highways. Hoover says half the perishable food products of the United States are now wasted because of the lack of *convenient* transporation, and a quarter of that waste would feed Europe. Without the roads that Caesar and Napoleon built and France maintained, Paris would have fallen and the Verdun warriors could never have held out. Army transport trains crossing the State of Illinois from the Mississippi River east are not uncommon sights in Illinois. Fourteen rural motor express lines already radiate from Chicago a maximum of 70 miles. A brand new economy argument, with definite engineering data on which to base assumptions, was provided in August by the gasoline consumption tests on various types of improved roads and with earth roads near Cleveland by five two-ton army trucks. In the earth-surface test the consumption, 0.173 gal. per mile, was twice that on hard-surfaced types. Assuming that an average traffic of 500 motor vehicles per day for 300 days in the year is developed by the system proposed in Illinois, the whole $60,000,000 would be saved in four years, if gasoline remains at 25c. per gallon. This takes no account of the added commercial values developed, labor, tires or upkeep saved. From every angle, the engineer cannot engage in promoting to the limit a more meritorious public enterprise. By a peculiar law in Illinois a failure to vote on this particular proposition is equivalent to a negative vote. Illinois engineers have indulged in their share of academic debate on the civic duty of the engineer. Nov. 5 will be a good day to put it to the test.

Ship Launchings in the Lead

NOTABLE progress in shipbuilding is revealed by the large excess of ship launchings over completions month after month. Deliveries are limited by the rate at which vessels can be fitted out with engines, boilers and equipment. Hull construction is no longer the neck of the bottle. Thus the first great task of the Emergency Fleet enterprise is well in hand.

Steel mills, fabricating shops and ship erectors have held their pace well in taking the lead of their fellow workers of the machinery department. When the great work of building a carrying fleet for the world was undertaken, shipyard capacity was small compared with engine- and boiler-shop capacity, but that handicap has been overcome and the ship erectors now are showing the way.

There must be no relaxation of shipbuilding effort, however. On the contrary, increased drive is needed in the hull department. Every ounce of energy must be put into the work. It is true we are setting new world's records in ship production, but the unprecedented September figures, noted on p. 733 of last week's issue, and the still higher figure expected of October, are empty distinctions if the world's urgent need for ships is not being filled. Launchings will be rapid enough only when we use every pound of available steel and every worker that can be enlisted. And the steel supply will not be large enough until it develops the maximum output of every shipbuilding berth.

To speed up the production of equipment and the work of installation is a separate task. As to production, the ultimate responsibility rests on the Emergency Fleet Corporation, which alone can coördinate and drive the shops and factories which it has put to the work. For accelerating the fitting-out operations, the yards themselves may be depended upon. Some are even now completing their ships within a month after launching. Others, which require three to four months for the same work, are not likely to stay behind very long. As the slow work comes up to the pace of the most rapid, it is certain that completions will crowd the fabricators and erectors, and that hull and machinery departments will enter upon a keen competition for speed.

Appreciation for the excellent launching figures is due both the shipyard men and the builders of the new yards that now are launching ships. Energy and efficiency have been in evidence in the yards since last fall, when the Emergency Fleet Corporation actively began its work. Old ideas of construction speed were the first to give way under the demands for fastest possible production. Thereafter, old ideas on shipbuilding schedules were made obsolete by new and undreamed-of speed in the fabricating shops and on the berths. The rate at which ships are now being launched is the product of more than mere growth in number of yards and number of ways. There is new working efficiency, new intensity of production in the shipyards.

The Significance of Dr. Mann's Report on Engineering Education

DR. MANN'S report on engineering education has been issued. The bright promise of his method of investigation has been borne out in the fruit. The document is epoch-making, provided the profession and the schools can rise to the responsibility which his analysis shows is placed upon them.

To the hasty reader the report may appear elusive. It does not lay down a hard and fast set of curricula. Rather it seems to pass the task to the schools.

The careful reader, however, will see in the report an inclusive and fundamental analysis of the essentials of engineering practice and of the purpose of engineering work. He will see in it a beacon not alone for the guidance of engineering education, but of the practicing profession. The document has come at a most opportune time—in this hour of searching analysis into the function, the status, the organization of the whole engineering profession. We trust that every engineer, no matter what his specialty or his rank, will read and digest the report, that he will freely express his views, and that the report will be the topic of at least one meeting of every engineering society in the land. We trust that it will be analyzed from every standpoint, that the disagreement and the approval will be equally frank, since in rallying the forces of engineering for great ends we must know what support will be accorded the new standard that will be advanced.

For ourselves, we subscribe heartily to the report. We do not assert that it is all new. In fact, no instrumentality, no individual or society or organ, has championed more strongly or expressed more clearly than *Engineering News-Record* and its constituent journals the broad responsibility of the engineer, the responsibility for the human as well as for the material factor in industry. Nowhere has the engineering foundation of our whole social and economic structure been so strongly emphasized. But most of us have talked about effects, about the objects to be attained, without perceiving the fundamentals, divested of all accidental and qualifying factors.

To strip off the unessential and to point to the unescapable conclusion from the fundamentals—that has been Dr. Mann's task, and he has performed it well.

For example, he crystallizes the whole purpose of engineering in the phrase, "to increase production." Therein we can find full justification for the advocacy of the handling by the engineer of all the human problems incident to industry—for the man is a factor in production. In turn, the industry reacts on the man. What he is, his wife and children, depend on his pay and treatment, the thoughts he brings back with him from the mill, and factory and mine. And in turn, the social structure is modified by what he thinks, by the thoughts—whether of satisfaction or discontent—he brings home from his daily work. Again, increase in production requires that the engineer inquire into the finances of industry, for finance is but the handmaiden of the productive process, and finance is going to be reconstructed along engineering lines.

Equally encouraging is Dr. Mann's definition of the professional engineer, "not as a conglomerate of classical scholarship and mechanical skill, but as a creator of machines and the interpreter of their human significance, well qualified to increase the material rewards of human labor and to organize industry for the more intelligent development of men."

The service Dr. Mann has rendered the schools in his report includes, of course, the statement of professional ideals and purpose, already commented upon. Of the more specific service he renders is his definition of the essentials of engineering practice—essentials long recognized by the practitioner but neglected, as to some elements, by the schools. He reduces the essential factors of engineering practice to three: Knowldge of engineering science, skill in technique of application, and judgment in the appraisement of values and costs—these three to be harmonized with respect to the fundamental elements in production, materials and men.

If this analysis be accepted as correct—and we look for no differences regarding it among practitioners, and but little difference in the schools—the kind of engineering education to be developed is not difficult to lay down in general terms. The difficulty comes in the machinery, in the content and mechanism of the courses which will impart the necessary theory, practical experience and judgment of values as to both the material and human elements of production.

Obviously, the application of Dr. Mann's ideas requires complete reorganization of the schools—reorganization of courses and of teaching personnel, and a change of the spirit of the institutions. But what a time for reorganization! The spirit is in the air. Ideas are unloosened. Prejudice has given way to openmindedness. We are more ready than in a generation to see and accept the truth.

Furthermore, the old curricula have been thrown aside. All schools are now army posts. The courses are even today undergoing a remodeling, and while the practical problems being woven into them are military rather than industrial, the fundamental plan is the same, and Dr. Mann, as a member of the educational committee of the War Department, sees that a good start is being made in the right direction. So, too, the objective-test system will soon replace the entrance examination for selecting the members of the Students' Army Training Corps. The transition will therefore be the easier when the war is over.

In sum, then, the Mann report has not only come at the right time to put a great task before the schools, but is opportune in its statement of engineering ideals and purposes. It displays a grasp that appeals to the intellect and a spirit of optimism with reference to the position of the engineer that calls strongly to those who have chafed in the narrow rut imposed by an apathetic profession and who understand the economic and social consequences of the industrial system which engineering has builded. And the word of encouragement is all the stronger in that it comes not from an engineer (albeit he is a scientist—a user of the scientific method), but from an outsider, one who looks on without prejudice and whose sole object has been to get all the facts.

His report is heartening. It is a guide to action in educational reconstruction and lays down the fundamentals which must be taken into consideration in professional reorganization.

Dr. Mann Reports on His Three-Year Study of Engineering Education

Proposes Not a Standard Curriculum but a Method by Which Engineering Colleges Can Construct Courses to Meet Present-Day Engineering Demands Which Are Fully Outlined in the Report

ENGINEERING education in its primary conception is a means by which production can be increased. This, the belief of Dr. Charles R. Mann, dominates the comprehensive report he has just made on engineering education. From that principle he argues that knowledge of the human factor in production is as important as that of materials; and his investigation indicates that engineering schools treat of materials extensively, but not of the human element. He also finds a need for much more instruction in the appraising of values and costs. What he proposes is not a standard curriculum, but a method by which engineering schools can construct courses to meet present-day demands, coupled with a more rational means of testing and grading the abilities of the students before admission and throughout the courses, thus directing them with greater certainty to the specialty for which they are best fitted.

What the Report Is

For more than three years Dr. Mann has been making his study of engineering education under the joint auspices of the Carnegie Foundation for the Advancement of Teaching and the Joint Committee on Engineering Education of the national engineering societies. In 1907, states the introduction to the report, the Society for the Promotion of Engineering Education invited the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society to join it in the formation of a joint committee to examine into all branches of engineering education. The next year the Carnegie Foundation was invited to appoint delegates to the committee, and subsequently the Carnegie Foundation undertook to carry out the investigation on a large scale and bear the expense of it. Dr. Mann was retained to give his entire time to it. The committee has been closely associated with Dr. Mann during the work.

The following signers of the introduction constitute the committee: Desmond FitzGerald, chairman; Onward Bates and Daniel W. Mead, for the American Society of Civil Engineers; F. H. Clark and Fred J. Miller, for the American Society of Mechanical Engineers; C. F. Scott and Samuel Sheldon, secretary, for the American Institute of Electrical Engineers; Clifford Richardson and Henry P. Talbot, for the American Chemical Society; J. R. Withrow, for the American Institute of Chemical Engineers; Henry M. Howe and John Hays Hammond, for the American Institute of Mining Engineers, and D. C. Jackson, G. C. Anthony and C. R. Richards, for the Society for the Promotion of Engineering Education. Henry S. Pritchett is president of the Carnegie Foundation.

Dr. Mann's study has covered not only the character of present instruction, but also the type of men demanded by present conditions. He recommends a method rather than a standard curriculum, because he holds that no school will make a success of a course planned in the light which his report furnishes, unless its faculty is thoroughly in sympathy with the new point of view—so thoroughly that it is capable of working out courses aimed to accomplish the new end.

Of the ideas which Dr. Mann offers as necessary ingredients of a new method of training engineers, one of the most important is the adoption of testing and grading methods which will not only eliminate from admission to the schools those not qualified to pursue engineering studies, but will reveal throughout the course the progress of the student—progress not with reference to purely academic ideals, but to the equipment he will need in active professional life. Such objective testing and grading methods, he contends, will not only eliminate the unfit at the start, and insure progress having a relation to the needs of engineering practice, but will furnish a sound test of the abilities of teachers and spur them on to creative teaching work.

Four "Common-Core" Essentials

The method Dr. Mann proposes for the actual formulation of the courses is to have in each school a standing committee which shall decide what he calls the "common core" of all engineering education, no matter what the specialty. This "core" being defined with reference to the needs of the engineer, the committee would determine the time necessary to cover it adequately and would shape the courses accordingly, instead of arbitrarily parceling off to the different departments the time predetermined as available and letting each department crowd as much as possible into its allotted time. The "common core" would have studies under four main heads: (1) Participation in real industrial work; (2) engineering laboratory work, including drawing and descriptive geometry; (3) mathematics and science and (4) humanistic studies. Participation in industrial work would best be interwoven with the three classroom and laboratory divisions of the student's work, and as an example of what can be accomplished in this line, Dr. Mann endorses emphatically the coöperative system of engineering education developed at the University of Cincinnati and since applied at other institutions.

At the beginning of the course and while giving the common-core studies, the testing and grading methods already referred to would be given.

In addition to the standing committee to take care of the "common-core" studies, there should be additional committees, one for each of the semi-specialties offered at the school, such as civil, electrical and chemical engineering. Here the same method would apply: that is, the committee, having a clear-cut conception of the demands of present-day engineering, would determine first the equipment needed by young graduates and

then the time required to obtain that equipment, and would develop the courses accordingly. This semi-specialized work would follow the "common core" studies, and again grading and testing methods would be used which would indicate the relationship between academic attainments and the qualities needed for success in engineering work, and would be a guide in choosing further specialization.

A clear conception of the spirit of Dr. Mann's study and of the line of reasoning which has led to his conclusions can best be obtained from the chapter of his report entitled "The Professional Engineer."

"Because the engineering schools have always made it their chief aim to impart the technical information needed in industrial production," says Dr. Mann in explaining the character of his investigation, "and because both scientific knowledge and industrial practice have grown so rapidly, the attention of technical schools has been focused chiefly on keeping up to date in science and practice. The university emphasis on research in natural science has also tended to magnify the importance of technique and to minimize the importance of personality. . . . Therefore it seemed necessary to consider the question whether this emphasis on technique is producing a new and higher type of engineer, or whether the engineering profession still stakes its faith on the fundamental thesis that personal character is, after all, the real foundation for achievement."

> THE general plan of the proposed reorganization of engineering education is based upon an analysis of engineering practice into its three essential factors—knowledge of engineering science, skill in technique of application, and judgment in the appraisement of values and costs. The overlapping claims of these essential factors must be harmonized with respect to the two fundamental elements of production—materials and men.

To arrive at the requirements of the engineering profession an extensive inquiry was made, outlines of which have been published in *Engineering News*, *Engineering Record* and elsewhere. Circular letters were sent to engineers throughout the country, asking them what they deemed the most important factors in determining probable success or failure in engineering. In the replies received personal qualities were mentioned seven times as frequently as knowledge of engineering science and the technique of practice. Of six groups of qualities headed respectively character, judgment, efficiency, understanding of men, knowledge and technique, the summarized votes of more than 7000 engineers placed character at the head of the list by a majority of 94.5%, and technique at the bottom by an equally decisive majority.

Thus it appears that even before our entry into the war—for the inquiry described was completed in 1916—there was keen appreciation of the importance of the personality of the engineer. Since then Dr. Mann thinks events have brought out that need even more clearly. The remainder of his chapter on "The Professional Engineer" is reprinted herewith substantially in full.

"Progress is being made toward the conception that there is really but one profession of engineering, in spite of its apparent division into the several well-known branches. War conditions have not only hastened public recognition of the engineer as an expert in applied science and fostered solidarity of the profession, they have also opened to him new fields of activity. Back in 1914 most people believed that the war could not last long because enough money could not be found to finance it. But three years of experience has made it clear to every one that although money is plentiful, it is useless if there is nothing to buy; so that winning the war depends on increasing production by an amount which has been estimated as the output of at least 10,000,000 additional industrial workers. This extra production may be secured either by training more workers or by increasing the output per worker by engineering methods. Hence there has arisen a pressing demand for men who can deal with labor and with business administration in the engineering spirit. This demand is further emphasized by the fact discovered by the Federal Trade Commission, that only 10% of the manufacturers in the United States know their actual costs of production. The determination of these costs requires a scientific study of production which only an engineer can make. This work involves the analysis and apportionment of overhead expenses, and thus leads at once to such fundamental questions of economic justice as: Should the capital invested in idle machinery be paid wages though idle workingmen are not?

"These new opportunities for the engineer have been gradually developing for a number of years, but the profession as a whole has been slow to discern them. The war has focused attention on them and precipitated a general recognition of them. It is also evident that the mastery of these new activities depends in greater measure than does mastery of the traditional types of engineering on the personality of the man. The success of a designer of bridges or of machinery is not necessarily impeded by lack of insight into human nature or of failure to comprehend the things that mankind considers most worth while. But to the man who would deal successfully with human labor and with business, personality is usually a greater asset than technical knowledge and skill. Therefore as engineering expands into the new fields now opening before it, the conception that character, judgment, efficiency, and understanding of men are no less necessary than technical knowledge and skill will become more and more impelling, and it will become more and more essential that schools of engineering pay greater attention to the effect of their work on the personal development of the students. . . .

"The ultimate aim of engineering education has

always been and still is more intelligent industrial production. Technical schools were founded when industrial evolution had progressed so far as to create a pressing demand for men who knew how to utilize the new and rapidly expanding knowledge of natural science to increase and improve production. Science was then little taught in high schools and colleges, so that both the public and the manufacturers were ignorant of it. Under these conditions the obvious need was for scientific enlightenment; and this the engineering schools were organized to supply. . . .

"The schools . . . have contributed enormously to the achievement of two striking results: namely, the extension of science instruction into the school system generally, and the development of public recognition of engineering as a profession, coördinate with theology, medicine and law. At the present day an encouraging fraction of the people are reasonably intelligent in science, the worker in applied science has become socially respectable, and there has been developed a large conception of the engineering profession. Meanwhile the methods of dealing with the material problems of industry in a scientific way have been in a measure established, while the more intricate problems of organizing and managing men are rapidly pressing forward and demanding engineering treatment.

"The net result is that the curricula and methods of instruction that were devised to supply the intellectual element in production by imparting knowledge of natural science must be reorganized to meet the new industrial demand for engineering administrators and the larger professional demand for men of strong personality. The general plan of the proposed reorganization is based upon an analysis of engineering practice into its three essential factors: namely, knowledge of engineering science, skill in technique of application, and judgment in the appraisement of values and costs. In every engineering project the overlapping claims of these three essential factors must be harmonized with respect to the two fundamental elements of production, namely, materials and men. Surely every engineer should have some conception of the present conditions and problems in at least the general aspects of all these essential factors and elements. If this be granted, it is easy for any school to discover where its curriculum is overloaded and where it is deficient.

"This analysis also indicates how the present organization of school work can be modified so as to furnish a more vital training for professional engineers. Thus, with regard to materials, the schools do give careful instruction in the laws of physical science and in the properties and uses of materials. Students are taught the relative strengths of substances in the materials laboratory, kinematics teaches the principles of gearing, the shapes of gear-teeth are worked out in the drawing room, the chemical properties are taught in chemistry, mechanics deals with the forces required to overcome inertia, machine work is relegated to the shop, and so on. But seldom is all this information coördinated in a single practical problem, such as determining whether mild steel, nickel steel or phosphor bronze is the best thing to use in making a particular gear wheel; nor is the student ever asked to judge what combination is likely to produce the most valuable result for the price. Yet this balancing of value and cost is the controlling factor in all intelligent production. Again, little consideration is given in courses in machine design to the comfort and safety of the operator. Yet a punch press, for example, that requires a workman to use both hands to operate it is far more intelligent than one that takes a large annual toll of fingers because the driver has one free hand. Similarly the importance of good heating, lighting, ventilation and sanitation in increasing the output of workers and in keeping them strong and healthy should always be taken into account. These human factors enter in large measure into the determination of the values secured for a given cost.

> THE first message of the profession to the schools is—Motivate your work by making it worth while; for character, judgment, efficiency and understanding of men develop best in men who work with enthusiasm and intelligence at things that they believe to be worth while.
>
> A second message—Training in ability to perceive relationships — interrelation — is one essential for the development of resourcefulness, common sense, perspective and efficiency.

"It thus appears that an adequate treatment of the first element in production involves not only a scientific presentation of the laws of nature and the properties of materials, but also an estimation of the values and costs from both the material and the human points of view. The chasm between the school and practical life is due largely to a failure to appreciate this fact. The introduction of the study of values and costs in all their phases is the most direct method by which the schools can bridge this chasm. Such study is also one of the most potent means of liberating creative energy and of developing the spirit of investigation.

"With regard to the second element of production—men—most schools at present are doing practically nothing to arouse the students to an intelligent appreciation of the problems of personal and human relations in production. Yet these problems are every day becoming more acute, as indicated by such movements as Americanization, human engineering, industrial engineering and scientific management, with their various efforts to improve the condition of the workman and to increase his output in production. Many of the burning questions of the time lie in this field. The loss to industry from turnover—the hiring and firing of workmen—is variously estimated at from \$150,000,000 to \$400,000,000 a year. This expense adds from 7 to 20% to the cost of production, and yet it injures rather than benefits the product. What are the means to prevent turnover—better housing? better social con-

ditions? higher wages? profit sharing? opportunity for self-expression? juster economic treatment? or more kindliness? Does the time-study method of speeding up work pay? Does it really relax or wear out the worker? Does it produce the best type of citizenship among the industrial classes? These and many other similar unanswered questions are now waiting for an engineering analysis, and the country looks to the engineering schools to train men who shall be able to answer them.

"The training of men for the solution of these human problems cannot be carried out in the schoolroom alone. The students must have some vital, first-hand, personal contact with labor and workmen's conditions, either by a coöperative system, as at the Universities of Cincinnati and of Pittsburgh, or through the industrial service movement, or in some other real and living way. Hence meeting this demand requires some form of closer coöperation between the engineering school and the industries, better understanding of their mutual relations, and willingness on both sides to approach the problem with the true research spirit. Such coöperation is needed not only to give the students a vital conception of the workman's point of view, but also to furnish that intimate personal knowledge of the details of production which cannot be secured in college laboratories and shops. The lack of this sense of the physical properties of materials is one of the chief reasons why less than five per cent. of the production managers in this country are college-trained men.

"It is, however, in the matter of estimating values and costs that this problem assumes its most far-reaching consequences. The following are some of the typical problems now pressing for solution in this field: What is the effect of good housing on the development of the men, the efficiency of production, and the size of the profits? What is the most effective incentive to maximum output—the bonus system? opportunity for coöperation in management? opportunity for creative work? or shorter hours? Does the assurance of justice and a square deal always tend to increase output and also to foster the growth of a social spirit and of patriotism? Does a plant pay better when profits and output are increased by efficiency methods which give workmen no chance for self-expression? or when the development of the workmen is made an aim as well?

"Every manager will estimate the values and costs of these various methods of treating workmen in accordance with his own philosophy of life. There is as yet no conclusive evidence to prove these cases one way or the other. The successful manager today is the one who estimates most accurately the human values involved. Therefore, one of the most important contributions that the school can make toward the education of the engineer is to guide him in developing an attitude toward life and a philosophy of living that will enable him to judge rightly as to the things humanity considers most worth while. This is the meaning of the professional demand for larger opportunities for cultural and literary studies. It cannot be met by merely requiring more work of the ordinary academic type in history, in economics and in languages; but rather by introducing the consideration of values and costs into the regular engineering instruction.

"Some attention has already been paid by the engineering schools to the problem of organizing men into effective working groups. At the Massachusetts Institute of Technology, Pennsylvania State College and several other schools special courses in engineering administration are now given regularly. These courses deal mainly with the various types of organization, the technique of different kinds of management, accountancy, banking methods and economic theory. All of this is, of course, essential to every engineering administrator. Industry sorely needs men thus trained; for the determination of costs is relatively easy so far as materials and labor are concerned, but the overhead, because it includes the cost of maintaining the organization, is a matter of great difficulty. Analysis by engineers shows that the largest wastes in production are in the overhead expenses, and result from faults in organization, such as idle machinery, inefficient maintenance, poor routing, lack of foresight in purchasing, delays from lack of instruction from the office, and so on. The study of overhead expenses has led to many searching questions of economics and industrial justice with which the student will have to deal after graduation, but to which the schools have not yet given serious attention.

"But it is gradually becoming evident that the ultimate success of any organization depends on its spirit; and this, in turn, is determined by the manner in which those in control coördinate and interrelate the intelligences and imaginations of men. Great organizers and leaders in industry are those who not only master the laws of nature, but who also shape and control their organization through their power of estimating accurately the value which each worker esteems most highly. The engineers instinctively recognize this fact and the educational implications of it when they declare that character, judgment, efficiency, and understanding of men are even more essential to the practicing engineer than is knowledge of the science and technique of engineering. The educational interpretation of this professional demand is not nearly so mysterious as many have tried to make it. For the schools have already discovered that students learn best when they are inspired by the conviction that the work is really worth while. One of the most effective ways of making work seem worth while is by constantly relating it to the consideration

> THE organization of curricula proposed embodies the modern conception of the professional engineer, not as a conglomerate of classical scholarship and mechanical skill, but as the creator of machines and the interpreter of their human significance, well qualified to increase the material rewards of human labor and to organize industry for the more intelligent development of men.

of the whole range of values involved and all the costs. *Every decision in daily life is an answer to the question whether the value is worth the cost.* The omission of this mainspring of all investigation and inquiry from school work is perhaps the chief reason for the chasm that separates the schools from life. Hence the first message of the profession to the schools is: Motivate your work by making it worth while; liberate the spirit of investigation by making the game worth the candle; for character, judgment, efficiency, and understanding of men develop best in men who work with enthusiasm and intelligence at things that they believe to be worth while.

"But there is a second message in the professional demand. For the spirit of investigation accomplishes valuable results only when the investigator is resourceful, accurate and efficient in mastering facts, and when he has judgment, common sense and a wide perspective. These qualities depend on the ability to put things in their proper places at the proper times, which ability depends in turn on the perception of intrinsic relationships. The most successful organizer and executive is the one who perceives relationships so clearly that he can build an organization which acts to liberate the creative energy of each in ways that prove most helpful. Hence training in ability to perceive relationships —interrelation—is one essential for the development of resourcefulness, judgment, common sense, perspective, efficiency and the rest. This is also one essential to the acquisition of knowledge. Therefore in so far as the school work develops the student's ability to perceive relationships, in so far do knowledge and the desired personal traits increase together.

"It thus appears that so far as the school work itself goes, the professional demand for upbuilding of character along with increase of knowledge suggests at least two promising lines of educational experiment; namely, motivation and interrelation. The lower schools have long ago recognized the possibilities of these fields of investigation. In fact, the educational progress of the past century has centered around these two conceptions. Many fruitful experiments and a large literature have gathered about the subject of motivation and the related topics of interest, formal discipline and transferable training. In like manner much has been accomplished toward interrelation through efforts that have been made to correlate various subjects, as indicated by the terms commercial-geography, business-arithmetic, household-science, domestic-economy, agricultural-chemistry, soil-physics and the like.

"The organization of curricula proposed is suggested as one practical method of harmonizing the conflicting demands of technical skill and liberal education. It coordinates the results of numerous individual experiments in a consistent program. It recognizes all the essential elements and factors of engineering as well as the educational requirements of motivation and interrelation. It is not a utopian dream, but a summation of the best that has been thought, said, and done in education during the past two centuries. Finally, it embodies the modern conception of the professional engineer, not as a conglomerate of classical scholarship and mechanical skill, but as the creator of machines and the interpreter of their human significance, well qualified to increase the material rewards of human labor and to organize industry for the more intelligent development of men."

Beginnings of Engineering Schools

In developing his thesis Dr. Mann begins with a review of the inception and growth of engineering schools, but it is not necessary to summarize that part of his report here. Turning to present conditions, he finds almost unanimous agreement among schools, parents and practicing engineers that at present the engineering curriculum, whatever its organization, is congested beyond endurance. It is obviously absurd to require from the student more hours of intense mental labor than would be permitted him by law in the simplest manual employment. Yet on all sides the pressure of topics and subjects that have become important because of the extraordinary growth of science and industry is constantly increasing. In 1870 a student might choose his specialty at the end of his second year; now he must decide in many cases in the middle of his first year. Formerly the choice lay among civil, mechanical and mining engineering; now the selection must be made from some 28 branches. No one school offers curricula in all of these specialties, but all are offered somewhere, and enough are given in every school to render the selection during the freshman year of his life's specialty a peculiarly difficult matter for the student.

High Mortality of Students

Counts made for two years at twenty schools have shown Dr. Mann that less than 40% of all freshmen of engineering schools complete the course in the allotted time. Nearly half of the elimination takes place in the freshman year and about one-quarter more in the second year. During these years almost all of the time is spent on English, mathematics, foreign languages, chemistry and physics, and little opportunity is afforded for contact with real engineering projects. Hence many engineering students are eliminated before they have a chance to show their ability at their chosen profession.

As to prevalent types of instruction, Dr. Mann finds that each subject is taught very much as a thing unto itself. In mathematics, for example, it is held that the student mind should not be distracted from the mathematical form by the engineering applications. In chemistry the student is not given such a project as: "Make baking powder and determine whether it is better and cheaper than any you can buy"; his problem is always in the form: "Determine the chemical composition of this powder." So with electricity, the student is asked to measure the efficiency of an electric motor rather than to decide which of three electric motors is the best for the price.

Discussing the problems of engineering education as he sees them, Dr. Mann points it out as evident that when 60 out of every 100 of those admitted fail to continue through the course, the present systems of admission, whether by examination or by certificate, are not satisfactory. Obviously, a fairly large number of students who ought not to try to become engineers are permitted to undertake studies for which they have little natural ability.

The determination of a candidate's fitness to enter college depends ultimately, Dr. Mann concedes, on tests of some sort; and, as tending to eliminate the fallacies and vagaries of individual personal judgment, and make grading more a measure of ability and less an expression of conformity to the conviction of an individual, Dr. Mann cites a series of experiments made by Prof. Edward L. Thorndike of Columbia University. Thirty-four students were asked, among other things, to read paragraphs and answer questions as to their meaning; to supply missing words in sentences; to solve mathematical problems; to draw graphs from given data; to match each of a series of pictures with one of a series of verbal statements, and to construct simple mechanical devices from their unassembled parts. Each test was constructed as a series of graded steps of increasing difficulty, the first being so easy that everyone was sure to accomplish it, and the last so difficult that only the ablest could master it. The questions as a rule could not be answered from memory, and were of a kind that had to be answered by a short, unambiguous statement. Independent scorers in the tests repeatedly gave practically identical ratings. The records of the 34 men tested have been followed for three years. Five of the seven who stood highest received general honors, while five of the seven lowest in the test failed in more than half of their work and left school.

> IT IS conceivable that before long, admission to college and achievement in college may be liberated from the bondage of personal equations as grading becomes less a matter of individual bias and more a valid record of actual accomplishment; then academic marks may become significant to employers.

Similar tests were made by Professor Thorndike at other schools, with results that prophesied academic achievements as accurately as the college ratings for one year prophesied those for the succeeding year.

Dr. Mann does not point to any tests yet worked out as a final solution of the college-entrance problem. He holds, however, that enough has been done to show that these principles of testing are worthy of further investigation, and that methods have been indicated that point to real progress. He feels that when the colleges are able to define their admission requirements in terms of abilities, as measured by objective tests, instead of in terms of subject matter covered, it may be possible to lift the incubus of ignorance that now oppresses the secondary schools, to supply the colleges with freshmen much better trained and sorted on the basis of ability, and to reduce the mortality of 60% to a more reasonable figure.

Practicing engineers and teachers of engineering are in substantial agreement, Dr. Mann finds, that specialization and subdivision of curricula have gone too far. There is too little time for persistent thinking, too little opportunity to realize the joy of achievement and too much inducement to join in the scramble for credits. For this condition he blames, in large measure, the dominance of the college of liberal arts in engineering schools. Emphasis is placed in the curriculum on pure science, pure mathematics and the humanities, in order to liberalize the engineering schools and keep them from becoming too materialistic. The difficulty is that when the various departments submit statements of topics which each department considers essential to the student, the hours required to cover them all would be double or triple the number available. The various claims are then reduced within reasonable limits by a process of cut and fit, and each department takes the time awarded to it and uses those hours in any way it likes. Respect for departmental autonomy then forbids any investigation or scrutiny by the faculty of the aims, methods or results of the work of any one department. The proper way to attack the problem, in Dr. Mann's estimation, is to determine the equipment in mathematics, physics and the like that is essential, and the best manner of coördinating the work of the different departments.

As coördination between departments is necessary with reference to the time schedule, so Dr. Mann finds it absolutely essential with respect to the content of courses. He lays emphasis on the need for more logical and coherent sequence of topics, and a better adaptation to modern scientific theories. He urges the use of practical problems, and commends in this connection Prof. R. H. Fernald's course in power plants at the University of Pennsylvania.

"While the topics of this course," says Dr. Mann, "follow one another in a logical sequence, they are chosen largely from engineering practice, and include much of the practical information every engineer must have when he goes to work. Many of the problems are actual cases that really occur in engineering, so that they appeal both to professional instinct and to the senses of values and costs—in fact, many of them are openly problems that deal with costs of operation and maintenance in working plants. Yet the course is not a mere mass of useful information; rather, useful information is the vehicle for conveying to the student a firm grasp of fundamental principles and engineering methods of attacking and analyzing problems, not only from the point of view of scientific theory, but also with due consideration to the limitations imposed by practice and by costs. . . .

"There has always been and still is a strong aversion on the part of colleges to placing emphasis on the material and financial aspect of the engineer's work. Yet it is a burning question whether the commercial bearings of each subject cannot be introduced into every course in such a way as to increase enormously its use and its vitality without in the least impairing its inherent scientific value. The enrichment of the content of courses by judicious appeal to practice and costs is a problem that offers rich opportunity for further experiment."

The two serious obstacles to coöperation in the content of courses, Dr. Mann finds, are reverence for department autonomy and the lack of generally intelligible and transferable details and methods of testing. The latter emphasizes again the need for a better system of testing and grading.

To this subject of testing and grading Dr. Mann gives much attention. "The reasons why grades under present conditions do not act as real incentives to good work are very similar to the reasons why payment of wages to workers on the basis of time spent at work fails to result in maximum output and even tends to scale down the efficiency of the skillful to that of the slothful." Students, like workmen, are inclined to "soldier," and work merely for passing marks. Their marks often depend as much on their ability to conform to the personal points of view of their instructors as on their real achievement in mastering materials.

Professor Thorndike's Objective Tests

For the purpose of making a beginning at removing some of the ambiguities of current examination practice, Professor Thorndike devised for seniors in electrical engineering a series of objective tests analogous to those used in his experiments with freshmen. Quoting Dr. Mann, "Each test is intended to measure a specific ability, such as arithmetical computation, geometric construction, paragraph reading, understanding of words, mechanical dexterity or comprehension of diagrams. Each of these is a single activity, although requiring a complicated coördination of psychological processes. Then the tasks are so selected that their accomplishment can be indicated with little or no use of words, so that ability to perform the task is not confused with powers of verbal expression; and the errors of personal judgment in deciding whether an answer is right or wrong are reduced to a minimum Because of this independence of the personal equation the results obtained by these tests at different schools, or at the same school at different times, are comparable with one another. . . . Cramming for any one set test may be avoided, since after the successful type has been found it is a relatively simple matter to construct 10 or 20 alternate tests on the same pattern. Again, the successive tasks on each test are arranged in the order of difficulty, beginning with one that can be correctly met by almost all students of the degree of training in question, and progressing gradually to one that can be done by only a few of the most gifted. Such a test is a scale up which the student climbs to the extent of his ability in the particular type of activity under scrutiny; so that, when the test is well constructed, his relative rank is determined without ambiguity by the difficulty of the task he can successfully master, rather than by an estimate of how much credit must be given for a partially completed task."

Objective Tests for Army

Similar tests are being tried on a very extensive scale on the members of the new National Army by Majors Yerkes and Watson, psychologists, who have accepted commissions in the Army for this purpose. Industries, too, are beginning to look to these tests to guide them in the selection and placing of workmen, in the hope of reducing the labor turnover that is costing the country several hundred million dollars a year. Although the movement is still in its infancy, enough has been done, Dr. Mann thinks, to forecast what may be accomplished by further scientific work in this field. "In engineering it is conceivable that before long admission to college and achievement in college may be liberated from the bondage of personal equations as grading becomes less a matter of individual bias and more of valid records of actual accomplishment. Then college grades may be transferable among colleges; then academic marks may become significant to employers; then the results of educational experiments may be stated in convincing terms, and then students may come to respect their records and strive to beat them without artificial stimuli in the way of academic honors and credit bonuses."

Closing his chapter on testing and grading, Dr. Mann concludes that, "Under present conditions, when current testing and grading systems are more largely estimates of the amount of static information possessed than of dynamic abilities, it is evident that ratings of personal characteristics and dispositions are essential for vocational guidance. Whether this will be so or not, when grades have been made to express abilities, whether correlations will be found between various temperaments and various types of ability or not remains an open question for further study. In the meantime, there is no investigation that is likely to give larger returns in fruitful progress than the scientific investigation of testing and grading systems; for tests control teaching, and objective records of achievement are one of the most potent means of releasing creative energy in both student and faculty."

Shopwork

Shopwork forms the last of Dr. Mann's problems of engineering education. "In American technical schools," he says, "shopwork still occupies a rather anomalous position. Few teachers of the mechanic arts have been granted the title 'professor,' and the work itself is seldom recognized as being of 'university grade.' Yet no one denies that it is an essential element in the equipment of every engineer; and therefore it has been tolerated by engineering faculties and allowed to develop as best it could. As a result there is no agreement as to the purposes and methods of shopwork. Nearly every school has a shop philosophy and a well organized shop method of its own."

The purpose of shopwork Dr. Mann conceives to be an aid in bringing to the student a conception of what is meant by production and what are its fundamental problems. Numerous forms of shopwork, as conducted by the schools, are described by Dr. Mann, but he gives most attention to the coöperative plan in operation at the University of Cincinnati, inaugurated by Dean Herman Schneider.

The Cincinnati Coöperative Plan

The students at the University of Cincinnati are divided into two groups, one of which is assigned to work in industrial plants while the other goes to school. At the end of each biweekly period the two groups change places, so that the shops and the school are always fully manned. In the shops the students work as regular workmen for pay, but the nature of their work and the length of time each stays on any particular job are subject to approval by the university. The emphasis of the school work is on theory and principles, but these are related to the shopwork by "coördinators,"

who visit the students during each shop period and then meet the several groups during the university period in special coördination classes.

About 100 of the industries of Cincinnati and vicinity are now coöperating with the university. The companies represent every important phase of engineering, so that the university is able to arrange the work schedules in such a way that each student progresses regularly through every phase of his specialty, from the crude and rough work to the more difficult and responsible positions.

Financially, this coöperative plan is very economical both for the university and for the students. The university has access without expense to shops and shop equipment that are worth millions of dollars and are never allowed to deteriorate or become antiquated. The total cost to the university per student per year is about $130, compared with $250 to $600 at schools of equal grade. The money earned during shop periods makes possible an engineering education to many a boy who could not otherwise afford it.

In addition to the financial advantage, however, Dr. Mann points out many educational advantages. The work, he says, has three marked points of superiority over that done in college shops: (1) It is real commercial production that must succeed or fail on its merits; (2) the variety is much greater than is possible in any college shop, and (3) the student is thrown into personal touch with workmen, thus coming to know their point of view in a sympathetic way, and securing a conception of the human problems of industry and the appraisement of human values and costs that cannot be acquired so well in any other way.

Another educational advantage pointed out is the use of "work observation sheets." Because it is obviously impossible for an industrial plant to permit its workmen to spend time giving instructions to green college boys, each student when he begins a new job is given a work observation sheet containing from 50 to 200 questions concerning the details of the job, and directing him to sources of information where he can find the answers. He is required to be able to answer and discuss these questions during the coördination periods. Shopwork thus becomes a series of exercises in defining and solving problems.

"With such rich opportunities for education lying plentifully about in every industrial plant," says Dr. Mann, "it is a striking anomaly that the schools make so little use of them. . . . The neglect of the possibilities of shopwork is responsible in large measure for the professional criticism that the graduates cannot apply theory to practice, for the establishment by large corporations of apprentice schools where its engineering graduates may complete their training on the practical side, for the preference shown by many firms for shop-trained rather than college-trained men, and for the insignificant percentage of production managers who are college graduates."

Suggested Solutions

The concluding part of the report is entitled "Suggested Solutions." As previously stated, Dr. Mann does not propose a standard curriculum, but rather a method by which engineering schools can work out courses to meet present-day engineering demands. As to the curriculum, the suggested solutions can be summarized as follows:

1. The number of required credit hours per week should be less than 18—preferably 16. This is not to decrease the hours of work done by the students, but to enable them to do all of their work more thoroughly. It necessarily involves extensive changes in the content of the courses.

2. Not more than five subjects should be studied at a given time.

3. Orientation, contact with real engineering projects, and practical experiences are essential.

4. Interrelation between the concrete and the abstract is necessary throughout the entire course.

In addition to these four requirements, professional engineers agree as to the need for broad and sound training in engineering science rather than narrow specialization; for considerable attention to humanistic studies, and for some conception of business management and the most intelligent methods of organizing and controlling men.

To reorganize its curricula along these lines, the first step for any school is the appointment of a small standing committee composed of men interested in the problem of better teaching, and able and willing to give considerable time to the work. The committee must first study the relations of the school with the adjacent industries, and, having selected the type of coöperative industrial work best fitted to the environment, it may proceed to formulate a curriculum for the school work itself.

"Common-Core" Studies

If it is agreed that the chief function of school work is to give the greatest possible mastery of the essential principles of engineering science, then there is a common foundation on which all curricula must be built. The first step, therefore, in framing a course of study is to define this common basis of all engineering as clearly as possible; that is, to make a list of all the facts, principles and processes that are essential elements in the equipment of every engineer. This will constitute a "common core" made up of three distinct parts: (1) Science (mathematics, chemistry, physics and mechanics); (2) mechanic arts (drawing and shop) and (3) humanities (English and foreign languages).

The current organization of the "common core" recognizes no inherent or intrinsic relationship among these parts. The sciences are usually treated as sciences pure and simple, without regard to their function in engineering; in the mechanic arts the instruction shops are as a rule purposely separated from the construction shops; and the humanities generally strive consciously and vigorously to get away from engineering in order that the student may get at least a glimpse into the mysteries of language and of literature, and a touch of culture. Before a more effective "common core" can be constructed, it is necessary to adopt a classification of the subject matter that obviously expresses the intrinsic relationship of the several component parts to the needs of every engineer.

More intelligent production, as frequently pointed out, is the ultimate aim of engineering; and every production project requires the coördination and adjust-

ment of three factors—scientific theory, mechanical practice and cost. Success in engineering comes to him who most often judges soundly concerning the best adjustment of these three complex factors. Therefore, engineering education is likely to be more effective in proportion as it fosters the development of skill in determining the most expedient adjustments among theory and practice and cost. A curriculum that recognizes the intrinsic relationships involved is not difficult to construct, after the fundamental common elements of all engineering have been selected; until these elements have been chosen, it is impossible to give more than a general outline, or skeleton, on which any school may easily construct a program by filling in with subject matter appropriate to the environment and its educational aim.

Four Types of Work Needed

A curriculum that satisfies all of the requirements mentioned would include at least four types of work as follows:

1. Actual participation in real industrial work, either during summer vacations or, better, through continuous coöperation with industries. This industrial experience must be supervised by the school and used as a source of problems and projects for scientific analysis in the classroom.

2. Engineering laboratory work, including drawing and descriptive geometry. Here the student would make the measurements and carry out the operations needed to enable him to solve the problems and projects that originate either in his industrial work or in his class work.

3. Mathematics and science, developed systematically in logical order, to furnish the backbone of the course.

4. Humanistic studies. The professional criticisms of the schools indicate that this field offers the greatest opportunity for effective changes in current practice, because lack of good English, of business sense and of understanding of men are most frequently mentioned by practicing engineers as points of weakness in the graduates of the schools.

The difficulty in present school practice evidently lies in the exclusion from the technical work of all consideration of the question of human values and costs; and, conversely, the isolation of the humanistic studies from all technical interest. But experiments show that technical work is more impelling and is, therefore, more fully mastered when it includes the consideration of values and costs; while humanistic work becomes significant, and therefore educative, when it starts from and builds upon the professional interest.

> EVERY production project requires the coördination and adjustment of three factors—scientific theory, mechanical practice, and cost. Success in engineering comes to him who most often judges soundly concerning the best adjustment of these three complex factors.

After the essential topics have been selected, as much time as is required to teach them thoroughly should be taken for this purpose. Two years may be enough, but if this is found to be inadequate, more time should be assigned. The important thing is that the essential elements be first selected, and then that time enough to master them be given, instead of the current practice of assigning the time and then covering as much as possible within the set limit.

The first step toward successful specialization is intelligent sorting of the students, so that each is led as definitely as possible into that type of work for which he is best fitted temperamentally. This requires that while the students are working through the "common core" every effort be made to discover the particular abilities and specific bent of each, not only by means of ordinary examinations and academic grading but also through objective tests of graded ability, personality estimates by members of the faculty, consideration of boyhood interests, and observations of each student's reactions to the different portions of the "common core." The work in the latter offers an excellent chance for vocational guidance.

"Common Core" for Semi-Specialization

For each main branch of engineering a curriculum must be framed on the same plan as that used for the "common core." Thus, for a civil engineering group a competent committee must first select all the elements essential to all civil engineers but not already included in the "common core," and these essentially civil-engineering elements would be organized into a consistent curriculum composed of the same four types of work required for the "common core." As with that, so here, the amount of time needed to master the material selected as essential in each group has to be determined by experiment.

The number of the semi-specialized groups at any one school may well depend on the location and the capacity of the school. The great majority of institutions will unquestionably have one of each of the four major divisions—civil, mechanical, electrical and chemical engineering. Because of the establishment in mining districts of state schools of mines, a number of strong schools elsewhere no longer offer courses in mining engineering. While every technical college should offer the "common core," it is an open question how many of the semi-specialized groups each should attempt to supply. There is an urgent demand, however, that a number of these schools add to these semi-specialized groups one in production engineering or engineering administration. The seriousness of this need has been emphasized by war conditions, which have demonstrated how essential it is, if maximum production is to be obtained, to apply engineering methods to accounting, to the management of men and to the organization of business. Until recently most schools have specialized in design, but the opportunity for the college-trained engineer is now much larger in the field of production and administration than it is in the field of design.

Same Humanistic Work for All

Throughout the period of semi-specialization it is desirable to continue all of the four types of instruction comprised in the "common core," but the technical work

of the several groups may be very different. In the humanistic work, however, the subject matter presented may well be the same for all, thus developing among engineering students a unity of purpose and outlook. This will be a great asset in developing a professional consciousness among engineers, because it tends to establish engineering standards by which to interpret and attack the industrial and social problems of the day.

The systems of grading and personality analysis used during the early portion of the course should also be retained.

Specialization

When the student has completed the semi-specialized work, if he has shown particular ability in some specific line, opportunity should be afforded to pursue his specialty in elective courses of highly technical content. Since these courses are for specialists who have elected them after a long process of vocational selection, they should deal with the more abstract and general phases of each subject.

> THE scientific study of industrial education ranks with industrial research as a bond of union between the engineering schools and the industries. On the fuller development of both teaching and research depends the realization of the ultimate aim of engineering education, namely, more intelligent production.

Seven Differences from Present Curricula

To summarize, the plan of curriculum proposed differs from curricula as at present constructed in seven important ways:

1. The subject matter essential to the equipment of the engineer determines the time schedule, instead of arbitrary time limits determining the amount of this subject matter that can be given.

2. The proposed plan calls for the student's participation in real industrial work and the utilization of his experience there as a source of problems for the classroom.

3. Engineering laboratory work is proposed for the *first* two or three years instead of in the *last* years.

4. Close coördination is required between the scientific courses of the "common core" and the practical work.

5. Emphasis is laid on the problems of values and costs.

6. For short independent courses in the technique of composition, literature, history, economics and so on are substituted humanistic studies extended into a consecutive course carried through the entire curriculum and consisting of live discussions and study of the best that has been thought and said concerning the immediate and the ultimate values in life.

7. Specialization is subordinated to vocational guidance. Because the "common core" gives a student a chance to choose his specialty on the basis of experience, and furnishes the faculty with a broader range of activities on which to base judgment of special aptitudes for particular work, the attention of the faculty is diverted "from the construction of specialized grooves down which the student may be shoved by routine administrative mechanisms, to the study of the personalities, the temperaments and the capacities of young men eager to do the work for which they are best fitted."

As soon as it is possible to measure the results of teaching by impersonal means, successful teaching will be as easy to recognize as profitable research. Objective records of achievement have been found in industry to be one of the best incentives to creative work. Hence the line of progress in education does not lie in the direction of making arbitrary distinctions between research and teaching, but rather in the direction of removing the limitations placed upon the spirit of inquiry, so as to encourage its expansion to include education and human relations generally. Any faculty that will get together and take time to think out its problems can create an organism that will be a live influence in education; and the doing of this will in two years bring more joy to all concerned than forty years of weary effort to maintain things as they are. "The scientific study of industrial education ranks with industrial research as a bond of union between the engineering schools and the industries. On the fuller development of both teaching and research depends the realization of the ultimate aim of engineering education, namely, more intelligent production."

Rapid Precise Levels by Geodetic Survey

Work done in March by a precise-leveling party of the United States Coast and Geodetic Survey near Houston, Tex., represents the fastest precise leveling ever accomplished in this country, according to advices received from the superintendent of the Survey. The new record was made by M. Steinberg and party, in running a line of levels 165.4 miles; the best previous record was made by John H. Peters of the Coast and Geodetic Survey in September, 1916, in running a line of 159.4 miles in Michigan.

In the case of the Texas levels the total length of single line of level for the month was 349.4 miles, as every part of the line was leveled forward and backward and a small portion of length was leveled over three or four times. The accuracy of the levels came within the requirements for high-precision leveling, the highest class of leveling called for by the International Geodetic Association.

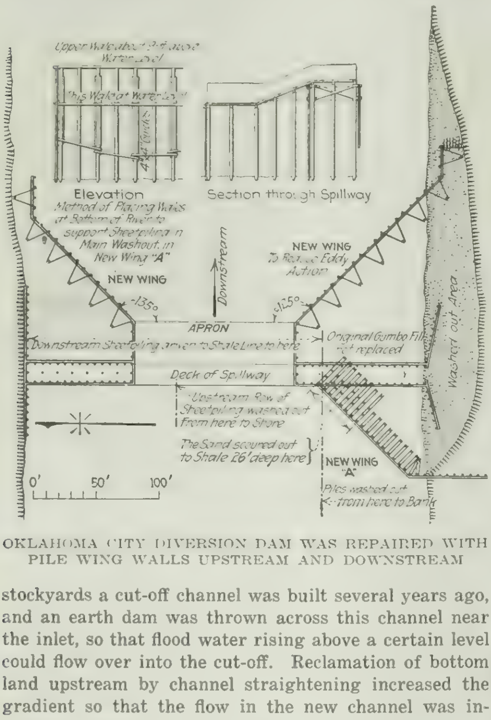
The party traveled by railway motor velocipede car for three weeks of the month, from Mar. 1 to Mar 23. The tripod of the precise level was mounted on the car, as has been the custom in the Survey's precise-level work for several years. The rod readings were recorded on a listing adding machine, also in accordance with recent improved practice. During the fourth week in March, however, an automobile truck had to be used in place of the motor velocipede for transportation, and the instrument was set up on the roadbed.

R. L. Faris, acting superintendent of the Coast and Geodetic Survey, states that no information is available to show that in any other country precise leveling has been done at a rate of progress approaching that of the March performance in Texas of the Steinberg party.

Oklahoma City Wages Strenuous Fight For Water

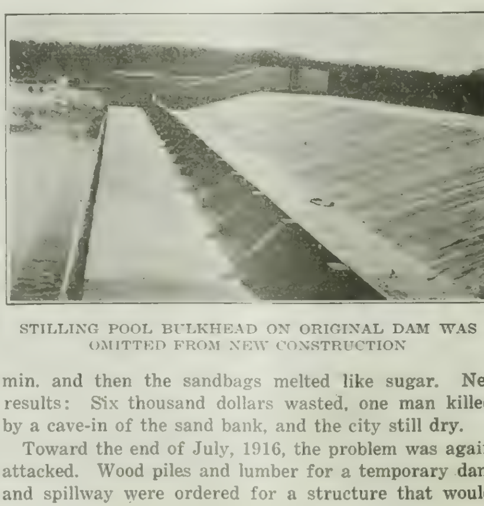
Farmers Dynamite Dam Diverting Supply, and Engineers Rush Temporary Dam for Use Until New Storage Reservoir Is Available

A WATER-WORKS without a supply was the Oklahoma City plant two years ago, when farmers diverted the river, and again the first of June this year, when a spillway across a diversion was washed out. The Canadian River, from which the city obtains its supply, makes a long loop toward the west side of the city to the present water-works pumping station. Across a narrow neck of land in this loop near the stockyards a cut-off channel was built several years ago, and an earth dam was thrown across this channel near the inlet, so that flood water rising above a certain level could flow over into the cut-off. Reclamation of bottom land upstream by channel straightening increased the gradient so that the flow in the new channel was increased, thereby flooding lands in the vicinity of the junction of the old and the new channels. The construction of a cut-off diversion to relieve land owners near the junction, with its disastrous effects on the water supply of the city, was the next step. By agreement between the city and county officials, the grade of the relief channel was to be maintained 6 ft. above the bed of the old channel, to insure a sufficient flow by the pumping station. The cut-off ditch, 3000 ft. long, was constructed with a base 30 ft. wide on approximately a 0.2% grade, coming back to the old channel at an elevation of 6 ft. above the bed of the old channel. All of the material through which this channel was cut is a fine sand. To protect the ditch against scouring, a narrow concrete wall was constructed, conforming with the cross-section 600 ft. from the upper end. This cut-off wall extended several feet below the grade of the channel and into the slopes of the banks, the shale being about 26 ft. below the grade of the ditch at this point. Soon after the completion of this cut-off channel and the concrete wall across it the river rose, but before it was 2 ft. deep in the ditch the wall had been washed out and the channels widened to an average width of 100 ft. Observing the effect of the flow with this small head of water in the cut-off channel, and knowing that a greater volume of water was coming down the river, the superintendent of the water-works, by quick action in making use of baled hay and sand bags, succeeded in closing the channel across the upper end of the cut-off, thus forcing all the water to follow its former course by the pump station. However, the valley below the new river channel was seriously overflowed and the land owners who were looking for relief were drowned out. During the second flood the water superintendent placed guards on the dam. While parleying went back and forth between city and county officials over the construction of a permanent diversion dam, the third flood came. The land owners became enraged, and on "a dark and stormy night," with a supply of artillery, in true wild-west fashion, they ran off the two armed guards and cut the dam at the middle. With the force of the water, in sandy soil, this gap widened to 25 ft. in a few minutes and to 200 ft. in 10 hours. The old channel and the water-works were left high and dry while the flood went through the cut-off.



OKLAHOMA CITY DIVERSION DAM WAS REPAIRED WITH PILE WING WALLS UPSTREAM AND DOWNSTREAM

Two attempts were then made to dam this new channel. First, an earth dam was built out to the center where, when all was ready, a wooden gate was dropped to shut off the water. The gate lasted about two minutes and the river pushed out the sand bottom underneath. Second, the remainder of the dam was reinforced with sandbags and light piling, and more sand bags were placed in the middle. This dam lasted 30 min. and then the sandbags melted like sugar. Net results: Six thousand dollars wasted, one man killed by a cave-in of the sand bank, and the city still dry.



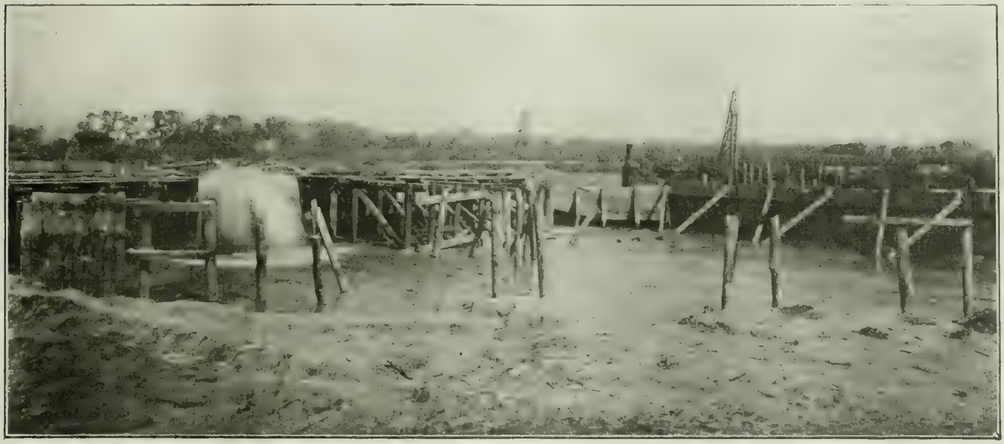
STILLING POOL BULKHEAD ON ORIGINAL DAM WAS OMITTED FROM NEW CONSTRUCTION

Toward the end of July, 1916, the problem was again attacked. Wood piles and lumber for a temporary dam and spillway were ordered for a structure that would

insure a supply to the city until the new $1,500,000 concrete dam and 8,600,000,000-gal. storage reservoir, eight miles away, could be completed. When this new work with the connecting conduit is ready the river can be let back into the cut-off, but high water and labor and material shortages have operated to postpone the date of completion to the end of this year.

Before the spillway dam was completed four motor-driven centrifugal pumps with a capacity of 12,000,000 gal. per day worked on the cut-off channel pumping into the old channel, so that the water would run down to the water plant. The maximum daily consumption during that period was 8,000,000 gal. per day.

The temporary dam contained 290 piles, 24 to 36 ft. long, driven in a double row across the cut-off, the space between them being filled in with gumbo. This dam is about 460 ft. long. In the center of the dam an extra row is added between the two outside rows of piling. Three-ply sheeting of 2 x 12-in. planks, spiked together and driven tongue-and-groove on the upstream side of the two rows of piling, hold the gumbo. The sheeting was bolted to horizontal 6 x 10-in. wales, in turn bolted to the piling. The timber spillway, which is 34 ft. wide and 130 ft. long, is 6 ft. lower than the crest of the dam. Its approach is of lumber supported on five rows of piling driven upstream for the width of the spillway.



DOUBLE ROW OF ROUND PILES IN DAM AND HEAD WALL STRIPPED OF SHEET PILING

In June of this year the water scoured down to the shale, undermining the round piles and sheet piling at one end, as shown in the drawing. There was again the same rush to set up the 10,000,000-gal. temporary motor-driven pumping outfit, with prayers on the part of the superintendent that this would be the last flood before the new supply is available.

Repairs were made while the water was still running through the gap around the south end of the spillway. At the closure to prevent the sheet piles from being forced downstream at the bottom, an 8 x 8-in. wale was

MOTOR-DRIVEN SAND PUMPS FILLING CHANNEL CUT AT END OF SPILLWAY

submerged to the sand level on the upstream side of the round piles. The wales were bolted to the ends of 4 x 4-in. guides along the round piles. The sheet piles were made up of four-ply of 2 x 12-in. planks, and driven in every case into the shale.

A sand pump was started as soon as the gap was closed, pumping into the wash on both upstream and downstream sides of the piling. A hole 40 ft. wide and 26 ft. deep to the shale had been scoured out. Four rows of piles heavily braced were necessary to hold back the head of water and close the gap.

Wing walls were installed on the downstream side of the apron, tying the ends into the original banks. The upstream wing wall at the south end was started well back into the undisturbed bank, because of the rapid caving.

One of the photographs, taken at point A in line with the double row of piling, shows how completely they were stripped of sheet piling. It also shows the discharge from the sand pumps to fill in behind the upstream wing wall. The photograph taken from point B shows the sand pumping outfit mounted on a raft made of empty barrels, pumping from the sand thrown up when the current shifted from the spillway to the break.

The latest repairs to the break were made under the direction of B. M. Hart, city engineer. J. W. Bennett is the superintendent of the water-works.

Advantages of Wood Water Tanks Under War Conditions Cited

THE economy and advantage of wood tanks under present conditions of steel supply and price were reviewed at the annual convention of the American Railway Bridge and Building Association by C. R. Knowles, superintendent of water service of the Illinois Central R.R. He explained that within recent years the steel tank had been adopted generally for railway water stations, on account of low cost and improved design, together with the decreasing supply of suitable timber. But at present steel is costly and scarce and its use has been prohibited for water or oil tanks, except in high tanks, for which it is essential.

Treated timber seems to Mr. Knowles to provide the solution of the problem of increased cost and scarcity of tank timber suitable for use without treatment, especially for the larger sizes of tanks. The Illinois Central R.R. has made the creosoted tank its standard, using loblolly pine coming under the general specifications for tank timber, except that no restrictions are made as to heart or sap. It is air-seasoned for about three months and is treated by the Rueping process, applying 5 lb. of oil per cubic foot.

All timber more than 1 in. thick is framed before treatment, and it is rarely necessary even to bore a hole during the field erection. Framing and treating are done at the railway's creosoting plant at Grenada, Miss., and the tanks are erected by railway gangs. Presence of creosote in the water is hardly noticeable and has no detrimental effect upon the water. Creosoted timber is used throughout, including the tower, roof and frost box.

The tanks are now built mainly of uniform diameter. Until a few years ago they were usually tapered, following early practice, when hoops were riveted complete and driven down until tight. Sectional hoops put together with lugs and bolts are more satisfactory, especially for the larger tanks, and have eliminated the necessity of tapering the tank. A nonshrinking stave has at the top a deep groove which is filled from the pump discharge. This keeps the top of the staves moist even when the tank is only partly filled.

As to size, a tank 20 ft. in diameter and 30 ft. deep, with a capacity of 100,000 gal., is about the economical limit, said Mr. Knowles. Larger capacity would be obtained by increasing the height rather than the diameter, as the former would require only longer staves and more hoops. However, the cost per 1000 gal. of storage would probably be greater for the larger tank than for two or more 100,000-gal. tanks.

The life of tanks varies with the locality as well as with the kind of timber used. Mr. Knowles stated that timber usually gives longer life when used in the territory where it was grown. Redwood tanks have a life of 26 to 48 years in California and 15 in Wisconsin. White pine tanks have given a life of 35 years in Michigan and 13 years in Missouri. Of 184 tanks in service, the average life has been 32.6 years for redwood, 25 to 32 for cypress, 30 to 35 for white pine.

Standardization of tank hoops is desirable, he thinks, mainly to reduce the quantity carried in stock. A manufacturer who had on hand a dozen types of hoops could not supply hoops that were badly needed until he obtained steel to make the particular type required. Tank hoops are made of round, half-round, oval and flat section. Even with flat hoops, some roads use a varying thickness and uniform width, while others use a varying width and uniform thickness. With a standard type there would be lower cost of manufacture and more prompt delivery.

Search Months for Eighteen Drag-Lines

For three solid months the engineers of the Miami Conservancy District traveled the country for the equipment needed to begin construction on the detention dams and channel enlargements which are to make safe from future floods the cities of the Miami River valley in Ohio. In this period large equipment costing $1,500,000 was bought. It included 18 drag-line excavators, five hydraulicking outfits of pumps and pipe line, five gravel washing and screening and concrete mixing plants and 17 locomotives, besides numerous smaller machines. The real task was assembling the 18 drag-line excavators, some of them the largest ever built. Practically only three manufacturers in the United States make these large excavators, and in January of 1918 two of the three were not in position to produce them. The third manufacturer had three machines partly built which could be obtained. All the others, 15 in all, had to be searched out and purchased from the jobs on which they were then or had been working. One of these came from open-mine work in northern Michigan, three from excavating the Calumet branch of the Chicago Drainage Canal, two from drainage work in Mississippi and the others from nearly half a score of other construction works. Altogether, the 18 machines cost $425,000. Eight are operated by steam and 10 by electric power.

Construction Teamwork Builds "Eagle" Plant in Two Months

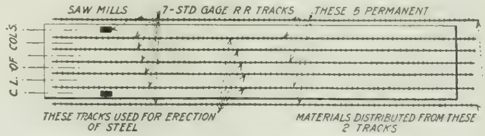
Coöperation and coördination of the efforts of contractors, engineers and architects made possible the early launching of the first "Eagle," by building the River Rouge plant at unprecedented speed. It was realized that the Navy was in urgent need of quick work; coöperation of the highest type and unusually efficient field organizations were vital elements in producing the result. Accounts of how the work was done, obtained from the general contractor and the steel erector, throw a clear light on the spirit of drive, the organizing ability that created the "Eagle" plant. These accounts, summarized by the editor, are given here.

Contractor's Preparation and Efficient Organization Speed Work

ORGANIZATION, coördination and coöperation of construction men and methods explain the success of driving the boat-building plant of the Ford Motor Co. to completion in a few months. Owner, architect and contractor were represented on the job by men capable of deciding, and with authority to decide immediately, any question of construction procedure which arose. A systematic construction plan was worked out and executed by a closely knit organization of superintendents and foremen, each in charge of a specific operation or group of operations, and all responsible to the trinity of owner, architect and contractor through a general superintendent of construction. Scheduled performance was planned and adhered to with exactness. Construction was resolved into elements of work involved, and crews were organized to perform each the specific set of tasks constituting an element of work.

Eighteen acres of buildings, stretching in line a mile along the River Rouge, house the boat-building operations of the Ford Motor Co., at Detroit, Mich. The structures included are: A punch shop, an assembly shop, two fitting-out sheds, a transfer table, a launching bridge and several service buildings. Construction of these structures required the placing of 25,000 cu.yd. of concrete, 4150 tons of structural steel, 3,500,000 ft. b.m. of lumber, 1,250,000 brick, 185,000 sq.ft. of steel sash and 480,000 sq.ft. of cement tile roofing. About 2000 men were employed at the height of construction operations.

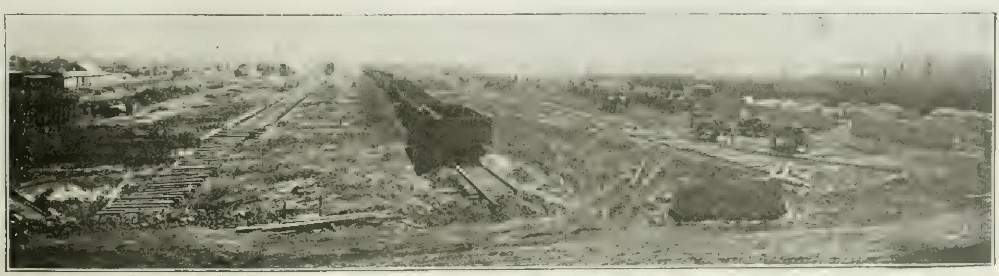
Construction of the punch and assembly shops, buildings of very large size, was the governing operation. The punch shop is 160 x 600 ft., and the assembly shop 305 x 1700 ft.; both have brick walls and wood floors; but while the punch shop is a simple timber-frame structure, the assembly shop is a steel mill building with tile roof. Technically, the buildings offered only



SEVEN TRACKS BRING IN MATERIALS AND CARRY ERECTING CRANES

the simplest of erection problems; no machine or method out of the ordinary was needed for assembling or erecting any part. The construction problem lay in the volume and area of the operations and in the speed of erection required. For example, the assembly shop involved the erection of 86 transverse rows of columns, and the total steelwork comprised 516 columns, 430 trusses, 8400 purlins and some 8000 miscellaneous bracing members.

Preliminary preparation had much to do with the quick start of construction. As soon as it became apparent to the contractors that they were likely to obtain the contract, they began preparations to jump immediately into actual construction operations. Stock was taken of all the organization available or which could be made available for the work. Local dealers in builders' supplies were rounded up and lists made of all their available stock. A construction organization was designed, and the men for the various positions were selected. In the same manner plans were made for a construction plant and the necessary equipment units were located for immediate shipment. Plans were then formulated for carrying out all construction operations, schedules of required materials were made up, and time of delivery determined. Study was made of the site, with reference to quick commencement and rapid prosecution of construction operations, developing two broad facts: As the site was eight miles from Detroit and two miles from the nearest car line, ample means must be



PARALLEL SERVICE TRACKS COVER ENTIRE AREA OF ASSEMBLY SHOP

provided at once for transporting workmen to and from the work. The ground, while comparatively level, would be too wet and soft for hauling, once the spring thaw, which might be expected any time, had taken out the frost, so that road construction had to be started at once. Thus, so far as was practicable, all problems were determined and the methods of solving them were decided upon before the contract had been signed.

Construction started with a jump. Contracts were signed late Friday afternoon, Feb. 15. Immediately, by telephone and telegram, men and equipment already selected were ordered into the work. Delivery of gravel, sand, cement and anchor bolts for the foundations began Saturday morning. On Sunday surveyors were establishing grades and staking out the punch shop site. Excavation and foundation construction began Monday. Meanwhile, from the lists already made up, material had been ordered for the punch shop, and enough for a good start on the assembly shop. At the same time several hundred carloads of cinders for roads were rushed to the job and distributed by large steam tractors and trailers. Lumber for the punch shop began to arrive Monday from local dealers. This was the start.

MIXER CREW CONCRETES FOOTINGS CLOSE BEHIND EXCAVATING GANGS

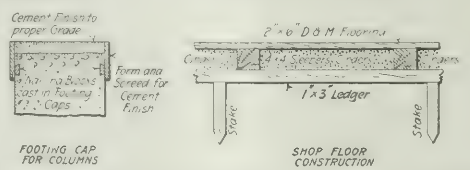
Material and labor supply was the first big problem. By means of the definite schedules of construction operations and the material lists previously prepared, all materials were ordered so that delivery would be made as the various kinds were required for construction. To insure shipment and delivery according to schedule, the Government gave special priority to all shipments, and the Ford Motor Co.'s highly organized traffic department was placed at the disposal of the contractors. As this organization has men stationed at practically all transfer points throughout the country, all cars could be traced and located quickly and their progress checked, so that all possible delays in transportation could be avoided.

Inter-job handling of materials was accomplished by railway tracks lengthwise of the building sites. From these tracks most of the materials were unloaded so close to the point of use that they could be handled directly into place. Where this was not possible, teams, motor trucks and tractors distributed the materials.

Labor was recruited by all the usual methods. First the contractor drew on his own forces; then, by advertisements and by canvass of the labor agencies, this nucleus was added to. The workmen assembled each morning at a point in the city and were transported by motor truck to the job and brought back in the evening free of charge, until a line of specially-built buses was established by the Ford Motor Co. to make connection with the nearest car line.

Construction organization and procedure were substantially the same for the two main building units. The chart shows the construction organization. Work was begun first on the punch shop, and when this was finished the organization there was absorbed into the assembly shop organization. Construction was begun on both buildings at their north ends, and proceeded in successive across-building zones, one operation following another as closely as was practicable. Approximately, the order was as follows: (1) Excavation for column and wall footings; (2) footing construction; (3) frame erection; (4) lean-to roof construction; (5) sash setting, glazing and tile roofing; (6) floor construction. Brick-wall construction proceeded separately but in progress with the other work, keeping ahead of the lean-to construction and sash setting.

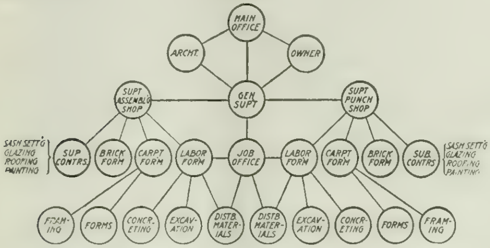
The assembly shop erection illustrates the construction procedure in detail. Seven lines of standard-gage railway track run lengthwise of the site, as shown by the sketch. Excavation for wall and column footings by a special gang was begun first and proceeded in zones across the building. While excavation was going on the footing cap forms were being made ready. A concreting gang followed the excavating gang and poured the footings, except the caps. This gang was followed by carpenters setting the cap forms and the anchor bolts. Another mixer gang with small portable mixers concreted the caps. Following this gang came a crew of carpenters putting on screed boards for finishing the column bearings to true grade and level, as shown by the sketch. This last operation made the footings ready for steel erection.



SPECIAL CONSTRUCTION METHODS HASTENED PROGRESS ON FOOTINGS AND FLOORS

Immediately upon arrival of the steel four or five bays were erected, and then all hands were set to unloading cars and distributing the steel along the site, as shown

by the picture, in the position most advantageous for quick erection. In the meantime, the bays first erected were being permanently connected up by the riveting gangs, so as to get a start on the succeeding lean-to construction, roofing, sash setting and floor construction. Construction of the lean-to roof was then begun. The walls had been previously built and roof material distributed along the work. Placing the main building roof and sash setting and glazing followed.



CLOSELY KNIT CONSTRUCTION ORGANIZATION INSURED COÖRDINATION OF DIRECTION

As soon as enough of the building had been inclosed floor work was started. The floor consists of plank and sleepers, on cinder fill. As shown by the sketch, stakes, carrying ledgers held the sleepers at grade while the cinders were tamped in place. Then the planking was placed.

By these successive operations the building was completed in transverse sections. In fact, the first operations of assembling boats had commenced at the north end before the south end was under cover. Forty days after the first bays of steelwork were erected the completed building was turned over for occupancy, and the first chaser keel was laid 79 days after construction began. So closely did the successive operations follow each other that in 15 days after the last steel was connected up the entire building was completed.

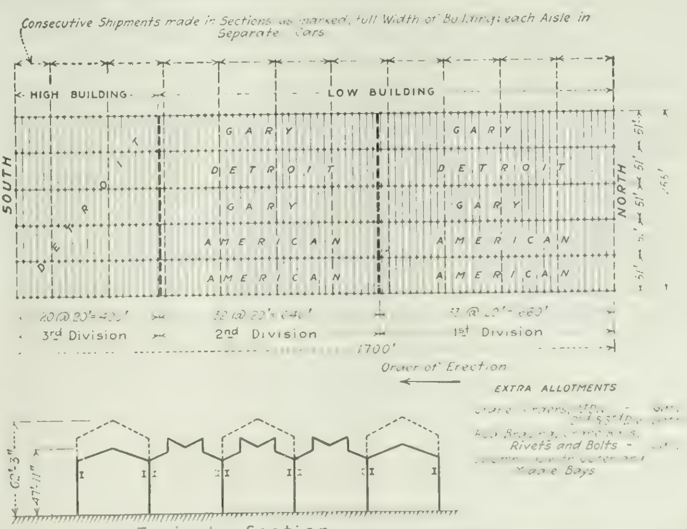
As fast as plant and men had finished their work on the assembly shop they were transferred to the foundation work on the transfer table, to the general contractor's portion of the launching bridge construction, and to the fitting-out sheds and the various service buildings. Time-scheduling all operations was a very important factor in maintaining speed of construction. This scheduling was applied not only to the general contractor's gangs but to the crews of the subcontractors. Also material deliveries for subcontractor's operations were followed up as closely as they were for the larger operations of the general contractor. In emergency, men were supplied to the subcontractors from some less important work of the general contractor. In fact, the policy of shifting workmen as occasion demanded was followed throughout the construction operations. If some part of the work was falling behind men were immediately transferred from another part to speed up the lagging operation.

Team work, following a careful study of the requirements of the job and of means of anticipating them, was the method employed to speed up construction. Team work was not limited to the directing heads of the construction operations; there was also wonderful coöperation on the part of the workmen. The superintendents and the foremen were animated with the feeling that they were not working alone for so many dollars' profit, but to help the Government win the war. This spirit permeated the whole working force, from water boy to the highest official. Evidence of this was shown by the manner in which the men worked under conditions which no mere money inducement could have made them endure.

The H. G. Christman Co., Detroit, Mich., and South Bend, Ind., was the contractor for the work described. The work was done for the Ford Motor Co. under the direction of Albert Kahn, Detroit, Mich., who was the architect.

Fast Steel Erection Due to Joint Drafting Room, Shop and Field Work

FORTY-TWO hundred tons of steel, the frame of the 300 x 1700-ft. assembly shop, had to be erected in four weeks' time in order to carry out the rush construction of the Ford submarine-chaser plant at River Rouge, near Detroit. The task set called for unprecedented speed. By hard driving, on the basis of a carefully studied plan of operation, it was carried out successfully. On Apr. 13 the American Bridge Co.'s erection forces set the first piece of steel; on May 11 they set the last, and a few days later finished the riveting and left the ground. A leading official of the company says, "It was a little bit faster than any other erection work we have done."



RAPID FABRICATION MADE POSSIBLE BY SPECIAL ALLOCATION OF SHOPWORK

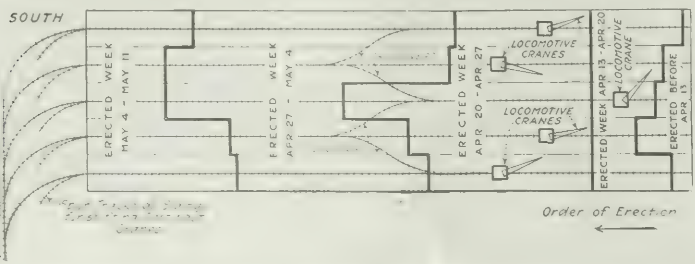
SHIPBUILDING STARTED IN FINISHED NORTH END OF SHOP, ERECTION BEING RUSHED AT SOUTH END; STEEL FRAMING JUST COMPLETED

Rush methods started the moment the contract was awarded. The performance was made possible only by the arrangement of the entire work from mill to erection on a single general plan laid out for speed.

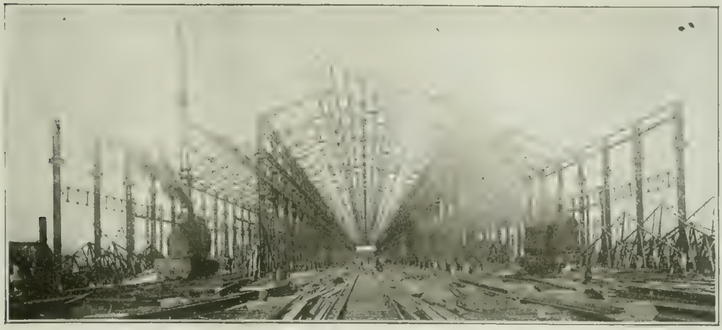
All the working drawings were completed, checked, and put into the shop within fourteen days, by close cooperation between Albert Reichmann, western division engineer for the bridge company, and J. T. N. Hoyt, chief engineer for Albert Kahn, architect. Details were approved and drawings checked by Mr. Hoyt directly in the company's Gary drafting room, as fast as they were turned out, and prints then went to the shop without further delay.

Fabrication of the steelwork had to be arranged to suit the erection plan. As a much larger field force and more equipment were to be used than are employed on a similar building under ordinary conditions, the order of work necessarily was different, and the shops had to fabricate and ship accordingly. Absolute coördination of all units engaged in the work was essential to meeting the schedule. Because this coördination was obtained, the erectors were able to set the steel in the building virtually direct from the cars.

Although the size of the building resulted in an unusual amount of duplication, fabrication had to be divided among three plants in order to save time, and part of the saving in duplication was lost. Economy had to be sacrificed to speed. In order that the erectors might be able to carry the whole width of the building forward at an even pace, the plants had to work on separate longitudinal slices of the structure. The allotment of fabrication was made as indicated in the plan shown, the five bays being distributed among the three plants as noted. The length of the building was cut up into three divisions, each to be completed before the next division was started. That a remarkable degree of coördination in the shopwork was obtained, and thereby record-breaking speed of fabrication, was in large part



FIVE LOCOMOTIVE CRANES WORKING DOWN THE FIVE BAYS ERECTED ALL STEEL IN FOUR WEEKS



LOCOMOTIVE CRANES ERECT STEEL IN SUCCESSIVE TRANSVERSE BAYS

due to the constant efforts of E. A. Smith, western division operating manager for the bridge company. Fabrication and shipment took only five weeks. Both the order and the rate of shipment were closely adjusted to the requirements of erection, except that during the first week or two of the erection period the steel arrived at such a rate that the erecting force had to stop for a time and turn all hands to unloading material, in order to clear up the congestion of cars. Five erection crews were put into the field. Each was assigned to one of the five bays, and operated a locomotive crane down the center of its bay. A track was laid down each bay, with crossovers between tracks at mid-length of the building and at the far end. This layout proved extremely convenient in handling material and shifting cars and cranes.

STEEL DISTRIBUTED ALONGSIDE CRANE TRACKS READY FOR ERECTION

Shipments of steel were received in sections of eight panels each. The material for each of the five bays was sent in separate cars, moreover. It was therefore possible to distribute the material exactly as needed and, as each following shipment contained the material next in order of erection, no difficulties or delays chargeable to piling or storage resulted. The columns were, in general, taken direct from the cars and erected. The rest of the material was unloaded at the point where it was to be used, in order to release the cars and clear the tracks. The 51-ft. trusses, designed of such depth as to permit shipment in vertical position, were riveted up complete at the shops and were shipped in sets of eight on three flat-cars.

After the preparatory period on the ground, during which a few columns and trusses were erected, erection began in earnest on Saturday, Apr. 13. The start was made with a rush, but work was soon delayed by the arrival of several shipments of steel simultaneously, after previous delay in transportation, and unloading took part of the force off the erection. With the accumulated material ready for the cranes, the following week was very active. Even bigger tonnage was handled in the fourth week, the heaviest week of the entire job, 1400 tons being erected. Material crowded the men throughout the field work, and this was a main factor in getting rush work by the erection crews. A special case that occurred on the job illustrates this effect. For a period of several days only four of the erection crews were at work, the other crane being put to unloading material. This bay got so far behind that when the crane resumed erecting it made remarkable speed in the crew's effort to catch up with the others and get ahead of the stored material. Twenty-two trusses and their purlins were set by this crew in a single day—a marvelous performance, in the opinion of steel erectors.

Getting together the large erection force and equipment required was a matter of serious anxiety at early stages of the job, due to the large amount of work already in progress. J. L. de Vou, central division erection manager for the American Bridge Co., who was in direct charge of the work on the ground, found himself with only 10 men to start the work, owing to the great drain of this class of skilled labor to other industries. By energetic efforts, however, the company succeeded in assembling within ten days about 250 men, all experienced bridge erectors.

The maximum working force at any one time was about 170, and the average force throughout the job was about 150 men. This included four or five riveting gangs. The total number of rivets used, slightly over 30,000, was small in proportion to the size of the building.

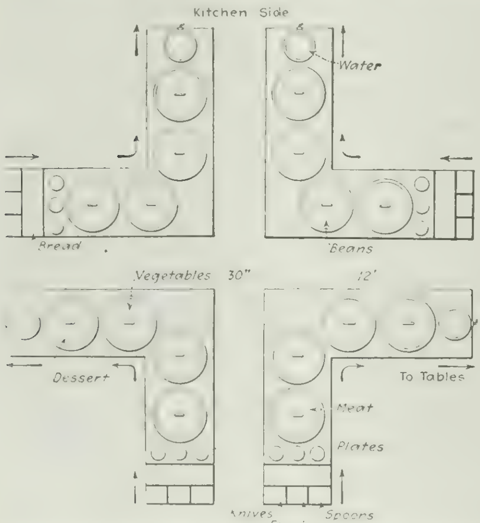
Only the truss connections to the columns and the crane-girder connections were riveted—this to provide the desired degree of stiffness in the structure—while all bracing and other connections were bolted.

The work was under the general direction of C. W. Bryan, chief engineer of the American Bridge Co., and Richard Khuen, Jr., general manager of erection.

Commercial Body Takes Up Vocational Education

Classes in Indianapolis Taught One Subject at a Time Until Mastered—Cafeteria Plan Saves Time in Mess Hall

FOUR detachments for the training of skilled mechanics are maintained by the Indianapolis Chamber of Commerce This commercial organization handles the eight-week training problem taken up by many universities and engineering schools in practically the same manner as they have. It has taken over the State School for the Deaf, the State School for the Blind, an entire hotel, the vocational facilities of two high schools and the state fair grounds. Courses are given for mechanics, chauffeurs, blacksmiths, electricians, gunsmiths,



LAYOUT PERMITS SERVING 580 IN EIGHTEEN MINUTES

carpenters and woodworkers, sheet metal workers, telegraphers and radio operators. The city's vocational director was obtained, and some of the best men in the factories of Indianapolis were released to act as instructors.

Many thousand dollars' worth of motors and other equipment was loaned for the use of the instruction staff. The Chamber of Commerce organized an instructional staff of 125 men, purchased equipment and contracted with the Government for the housing and subsistence of 1100 men. The schedule of work on the student's part consists of six to seven hours' vocational work per day and three hours of drill, with Maj. J. D. Crawfis as commanding officer. This autumn, when the high school buildings were required for their regular students, the contingents were removed to the State School for the Deaf. Additional barracks, a mess hall and a power plant have been installed to care for a maximum of 1800. The regular students for this institution number only 220, and they are asked to remain home for this school year, at least. The equipment and grounds are ideal, and the plant will be used to capacity.

Some of the work handled in the city as instruction includes putting 250,000 rough gun-sights into finished condition, overhauling for two army camps all of their trucks, side-cars and motor cycles, making garbage cans, tools, springs, helping in war building construction, cleaning up and salvaging machinery and all kinds of material after a serious fire, and harvesting grain in record time.

As at the University of Pittsburgh, the subjects are presented always with the actual object under consideration in hand, but not so much stress is laid on assembling and dismantling. Classes in auto mechanics, for instance, are larger and are handled almost entirely by technical graduates. The work is divided into departments such as ignition, carburetor, steering, transmission, repair, motor, driving and "trouble shooting." The time spent in each depends on the speed with which the average man gets a grade of 3 out of a possible 5. Carburetion takes five days, but the remaining subjects usually take less time.

There are 63 technical instructors, each expert in certain lines. The remainder of the instructional staff is recruited from detachments gone before. Many of these men will eventually be sent to officers' training camps. Each of the four detachment points has trained one set of men and are on their second unit. No. 1 at the hotel building is on its third contingent of 500 men.

The gunsmith training, typical of the carpenters, and wood and metal workers, is divided into a series of seven different steps in the course, each given for a week. The work is done on various floors of the Dolman Building. Each class of 19 men is given an instructor. Class 1 includes chipping and filing; 2, patching, countersinking, drilling and filing taper pins; 3, keyways, making geometrical shapes from sheet metal and cylinder patching; 4., rifle assembly and small-part repair; 5, babbitting, spring hardening and all kinds of forge work; 6, bicycle assembly and general repair of miscellaneous machines.

Mess hall arrangements at the State School for the Deaf are on the cafeteria plan. The hall will seat 580 on the ground floor and 540 on the second floor. The men march in from three sides to a central station of four tables, arranged as shown in the sketch. The men are helped to everything except bread and water. The usual time for meals is 30 min.; 10 min. of serving and 10 to 20 min. of eating. The men leave irregularly. The time has on occasion been cut to 18 min. Tables accommodating 10 men each are set up with cups, coffee pots, vinegar, sugar bowls, salt and pepper, the commissary department hiring 60 employees to handle the 100 students. The tables are of the ordinary contractor's camp type with attached seats on a 2 x 4-in. scantling nailed to the table legs.

Four canteens are maintaned, all profits going to the entertainment funds. Both the Y. M. C. A. and the Knights of Columbus have established recreation centers as at regular army posts.

Ernest N. Smith, secretary of the Indianapolis Chamber of Commerce, is business manager of the schools, and E. C. McCullough is assistant business manager.

Expect Increased Use of Machinery on Iowa Road Maintenance

Will Cover More Mileage With Fewer Men—Shortage of Labor and Limited Funds Due to the War Enforce Economy

HIGHWAY maintenance methods in Iowa have to be developed on economical lines, as the funds available at this time for this work are small in proportion to the mileage of roads requiring to be maintained. Machinery is used to some extent even for dragging, and it is expected by T. H. MacDonald, chief engineer of the State Highway Commission, that next year many more small tractors and motor trucks will be employed on this work. As compared with teams, such equipment will. it is thought, allow heavier drags to be used and a larger mileage of roads to be covered with a smaller number of men.

Maintenance organization includes road gangs, road patrolmen and road draggers. For the gang system the most economical method is found to consist in the use of a tractor pulling graders with one blade or two. A tractor with two graders requires three men, and preferably a team and driver, for hauling supplies and doing odd jobs. Most of the country roads have been built to standard cross-sections, and it is found desirable to have the tractor outfit go over each mile once in two years. At that time the gang cleans the ditches, reshapes and builds up the shoulders and leaves the road in condition for dragging. With good equipment and an experienced crew very economical results are obtained, it is said, and the roads are left in good condition for travel.

Mandatory Patrol

A mandatory road patrol law, under the immediate direction of the county boards, exists in Iowa, and a road-patrol system is being built up. The patrolman is equipped ordinarily with a team, wagon, hand tools and small grader. He does not do all the dragging, but endeavors to keep the roads in shape and true to section by the use of the small grader, and makes small repairs, in addition to the maintenance work. In dry weather he is ordinarily employed in hauling gravel. The patrolman also has charge of the draggers on the roads under his jurisdiction. In some counties small tractors or light motor trucks with two men each are being used for the repair work.

Road draggers, who work short sections of road after rains, form the third factor in the maintenance system. In practically all cases these men are local farmers having teams available for this work. At the present time, however, owing to the lack of farm labor and the difficulty of getting the roads dragged at proper times, the commission is trying small trucks, which are expected to prove satisfactory and economical for this purpose.

Organization for road maintenance is not very definite, varying with the places. No considerable mileage is maintained where all of the three methods named above are employed in the order and for the purpose for which they are most suited.

Bridge and culvert improvement has progressed so well for several years that there is now no great difficulty in maintaining them on the principal roads. There are important structures, however, the building of which will have to be deferred. It is even possible that in isolated cases unimportant and little used roads will have to be closed on account of bridge conditions, but the program carried out for the past five years has made it possible to curtail new construction very materially without closing important roads.

Suspension Bridge Aqueduct Twice Built in Six Weeks

Quick Construction Work With Makeshift Materials and Plant Saves War Crop from Drought in Wyoming

By F. C. Emerson

Superintendent Big Horn Canal Association, Worland, Wyo.

RAPID emergency construction methods restored last year in 30 days a 250-ft. irrigation aqueduct which had been swept away by a flood in the Big Horn River. A second collapse, just as the first restoration had been completed, was repaired, by salvaging the fallen structure, in 16 days. Construction materials had to be gathered from a dozen places where available, and in some cases it was possible to obtain only makeshift materials. Progress was further handicapped by a swollen stream and by intensely hot weather. By restoring the flow of water in a little more than six weeks a considerable portion of the crops on 12,000 acres of irrigated land was saved.

Upper Hanover Canal, on which the accident occurred, crossed the Big Horn River about 16 miles above Worland, Wyo., by a steel flume on steel trusses over 80-ft. spans caried on concrete-filled, twin-tube piers. Flood water on June 20, 1917, destroyed the bridge structure, apparently by undermining one of the piers. The length of aqueduct destroyed was 239 ft. The construction problem was to restore this gap and to do it quickly, as the preservation even in part of 12,000 acres of crops depended upon the quick restoration of the water flow.

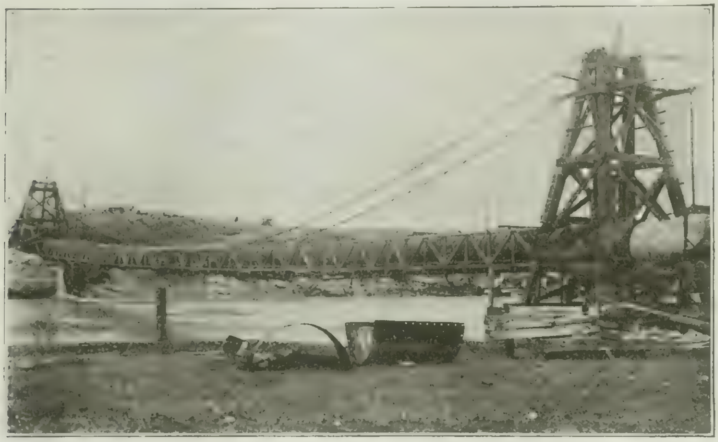
The time that would have been needed to obtain and install a pumping plant large enough for the service required placed this solution out of consideration. Timber trestle construction was dismissed because of the uncertainty of the piles holding on portions of the river bottom where rock outcropped. It was finally decided to construct a suspension bridge.

Two lines of 2¼-in. cable, 6 ft. apart, carried on wood towers and anchored to a concrete deadman on each bank, formed the main suspension element. Hung 4 ft. apart from the cables ⅝-in. rods carried 8 x 8-in. timber sills braced together by a lateral system of 4 x 4-in. timber horizontal and diagonal members. Stiffening trusses 4½ ft. deep, consisting of 4 x 6-in. chords, 4 x 4-in. struts and ½-in. ties, were bolted to the sills and braced together across the top. The pipe was 4-ft. ingot iron pipe resting on the sills and having a 10-in. expansion joint at midspan.

Since it was probably the cause of the second accident, one detail of the main cable construction deserves special mention. At the west shore anchorage the

fastenings for the cable lines are 4-in. round forgings. The 2¼-in. cables lacked 42 ft. of reaching to these forgings. To fill the gap eight strands of ⅞-in. galvanized cable were rove between the forging and the 2¾-in. U-bolt through the socket on the end of each cable.

The company was without equipment of any kind, it was very difficult to obtain materials for construction, and the high stage of the river and the intense heat that prevailed all added to the difficulty of the work. It was found necessary to take such materials as were then available, rather than wait for such as would be best suited to the work. Obtaining the necessary cable was the first hard matter, for the Government had called into use for submarine nets practically all of the idle supply of large cable in the country. However, a supply of 2¼-in. steel cable, of one of the best grades, in very good condition and sufficient in amount to provide two lengths, was finally found in the yard of a Denver dealer in second-hand materials. Before leaving Denver this cable was cut into the required lengths and the ends were bushed and babbitted into standard closed sockets. Hangers of ⅝-in. rods, with the necessary fittings, cast saddles to carry the cables over the towers, and other parts, were made up in Denver and, together with the cable, were shipped to the work by express. The required amount of 54-in. ingot iron pipe was also made up in Denver and hastened to the work.



SUSPENSION BRIDGE AQUEDUCT REBUILT TWICE IN SIX WEEKS

Valuable assistance was rendered by all agencies in the vicinity of the work that could be of service. From the Wyoming Sugar Co., then constructing a factory at Worland, heavy timbers were obtained for the towers and other parts of the work; the Monarch Engineering Co. supplied rods for U-bolts, tools and men; the Big Horn Canal Association, materials and equipment; the Lindstrom drainage force sent a crew of muckers used in the excavation of the deadman pit on the east side of the river; and from many others anything that would help the work.

The flume was wrecked the night of June 20. Four days thereafter were consumed in deciding upon the type of structure and in gathering data relative to the availability of materials for construction. It was then necessary for the engineer, accompanied by the president of the water users' association, to make a hurried trip to Denver in the interest of getting materials and equipment for the work. Actual work on the ground was started June 29. After three weeks of intense effort the workers turned the water into the completed structure July 20, only to see the west end of the structure plunged into the river by reason of the failure of one of the lines of ⅞-in. cables connecting the main cables with the deadman on the west side of the river. When the second failure occurred the west tower was overturned into the river, about half the pipe was twisted or bent out of shape, and the stiffening trusses and other woodwork were considerably damaged. Work was immediately resumed. The structure was fished from the river; the task was attended with much difficulty by reason of the high stage of the water that yet prevailed. As considerable delay, it was held, would occur in replacing and repairing the damaged iron pipe, it was decided to substitute 48-in. wood-stave pipe, a supply of which was available within hauling distance. In the reconstruction the ⅞-in. cables on the west side were replaced by 42-ft. U-bolts, two on each line of 1¾-in. and 2-in. diameter; also 1¾-in. U-bolts were added to the deadman ties on the east side of the river, to overcome any weakness on the part of the sets of four strands of ⅞-in. cable used. The remainder of the structure was repaired and rebuilt as before.

After considerable delay in waiting for the heavy U-bolts, the structure was complete and water turned in on Aug. 5. The head was turned out again, long enough to allow of the readjustment of some of the hangers. A full head of water was finally turned across the river Aug. 7.

Six hours were allowed for the first loading of the pipe, in order that all parts of the structure might have sufficient time to adjust themselves properly. On later occasions, when trouble elsewhere on the canal caused the partial unloading of the pipe, the reloading was performed without any particular checking of the flow in the canal. The continuous stave pipe, with ½-in. bands spaced 10 in. apart and with double spacing at the lapped joints, proved an excellent waterway, as the pipe combined great strength with the elasticity so desirable in such a structure. After 24 hours of service no leak of any consequence was shown. A heavy wind which struck the loaded bridge shortly after its completion and before the ½-in. guy lines, later added, were in place, produced no lateral vibration of amount, although when another heavy wind a short time later struck the bridge with the pipe unloaded, a sway of 4 or 5 in. was produced. At the east end the pipe

was free to move back and forth in the round end of the transition section of ingot iron, water-tightness being obtained by the well packed joint of oakum.

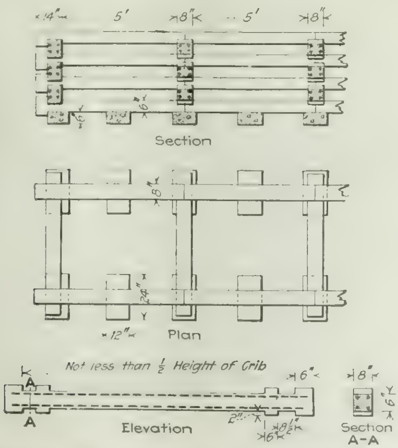
The work was all performed under force account, under the direction and supervision of the writer. It cost $20,000. In connection with the engineering features of the work the writer was advised in different phases by C. C. Madser, of the Monarch Engineering Co., N. A. Lockwood, of the Wyoming Sugar Co., and F. N. Cronholm, of the United States Reclamation Service.

Precast Concrete Lumber Forms Cribs To Retain Fill

Oregon Highway Commission Finds Cribwork Useful as Retaining Walls in Side-Hill Road Work

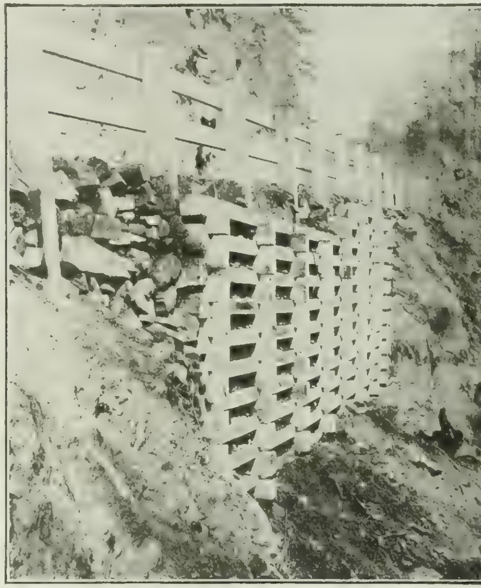
PRECAST concrete units are being used by the Oregon State Highway Commission for cribwork to retain fills on sidehill roads. The cribs are designed for use where the height of the walls desired is between 6 and 16 ft. The width of the base is not less than half the height. The structure is founded on mud sills 1 x 2 ft. in plan and 6 in. thick. On these mud sills are placed alternately tiers of longitudinal members and cross ties, each of which has notches that permit of interlocking the members. For convenience in casting and handling, the longitudinal members and cross ties are usually made of the same length, the length of the cross tie being determined, of course, by the height of the wall to be built up.

All the members are reinforced with ⅜-in. rods placed about 1 in. from the face of the concrete. The members are usually made of 1:2:4 concrete and 6 x 8 in. in cross-section. In the use of this type of crib it was found that the outside face should have a batter of at least 1 in. per foot, and transverse members should be set normal to the face. After the crib is completed it is filled with rock as in the crib of ordinary timber construction.



CONCRETE LUMBER USED IN MAKING CRIBWORK

The plan has been worked out and applied under the direction of Herbert Nunn, highway engineer of the commission. Cribwork has this advantage over monolithic construction, that it does not show cracks under uneven settlement, but timber cribs have so short a life that their use is not economical. The concrete lumber should prove acceptable in this respect.



CONCRETE CRIBS BOTH PERMANENT AND FLEXIBLE

Road Work Set Back Ten Years in England

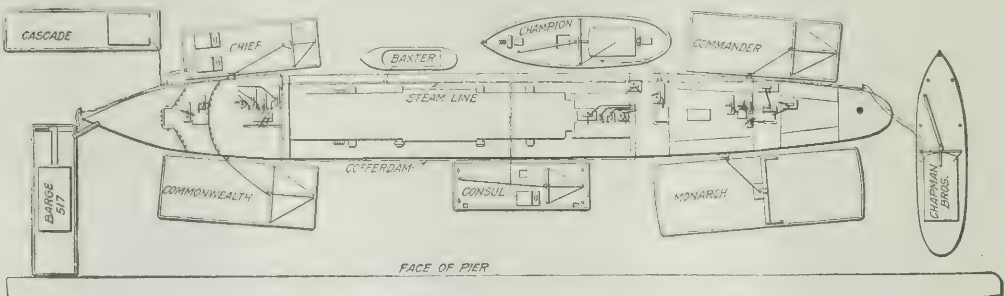
That road work has been put back ten years, so far as progress and efficiency are concerned, was the statement made by George Crowder, engineer and surveyor, Godstone Rural District Council, in an address before the meeting of the Institution of Municipal Engineers held at Oxted, England. Mr. Crowder suggested that the only way to improve conditions is a change in highway administration which will free roadwork from local control and put it under the national government as a means of administering a system of national highways. While insisting that the road question must always be a matter for civil governments, and not for military jurisdiction, he favored greater centralization in highway authority, and maintained that the Government Road Board should have direct jurisdiction over all trunk highways. Secondary roads which could not be considered national routes should come under county jurisdiction, while the only roads to be left with the local authorities should be the district roads. In fact, he favored a system which has been in successful operation in many parts of the United States for a number of years, and expressed the opinion that only by such a program could the after-war problems of reconstruction be met.

Thirteen-Thousand-Ton Vessel Righted by Rolling and Lifting

"St. Paul" Raised After Settling on Side in Mud Between New York Piers—Cofferdam Put On and Hull Pumped When Partly Righted—Under-Water Cutting Torch Developed

RAISING the "St. Paul," a 13,000-ton liner, which sank from an unexplained cause and turned over on its side in the mud between North River piers 60 and 61 in New York harbor early in the summer, was accomplished by using lifting pontoons and pulling tackles to roll the vessel partly upright, in which position it was then possible to place a wood cofferdam around the low side of the hull and float the vessel by pumping. After an enormous amount of under-water work, which included finding and closing a large number of openings, all buried in the mud on the low side of the vessel; the placing of wood cofferdams; the cutting of steel bulkheads to drain some compartments, and the placing of concrete bulkheads to make possible the pumping of others; the removal of a thousand tons of mud from the interior of the wreck and, after the ship had been brought to almost even keel, the distribution of sufficient ballast on the high side to right the vessel under the load of another thousand tons of mud which could not be removed, the ship was turned over to the owners, the International Mercantile Marine, on Sept. 27. She is rapidly being overhauled and refitted, and will soon be placed in service.

The "St. Paul" lay in the slip, bow toward the bulkhead and a little higher than the stern, port side under the mud, which came up 12 to 14 ft. on the main deck, and starboard side largely expposed. She continued to settle slowly into the mud until the righting operations began. Through various openings and over the port rail about 2000 tons of mud entered the vessel.

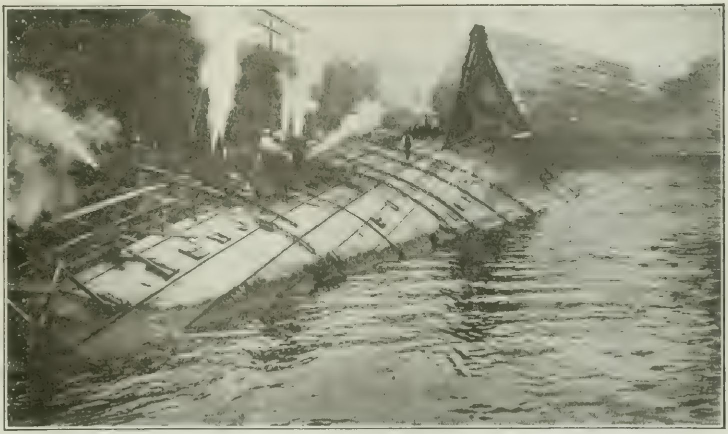


POSITION OF DERRICK BOATS, COFFERDAMS AND PUMPS DURING RIGHTING OF "ST. PAUL"

As it was not possible at first to extend the sides of the vessel above water by cofferdamming, as is usually done, until the hull was at least partly righted, another operation had to be undertaken first. A series of 21 timber and steel A-frames was attached to the starboard side of the vessel, each frame being set over one of the ship's transverse frames and bolted to it through the plating. Only two bolts were used to secure the lower corner of each frame, where the stress was all in compression, to facilitate removal. These points came below the water line after the vessel was righted. The front leg of each frame was secured with enough bolts to take the tensile stress exerted by the tackles. Ten-part pulling tackles of ½-in. wire rope were used, each tackle being led direct to a hoist mounted on the lower

THE "ST. PAUL" ON HER SIDE THE DAY AFTER SHE TURNED OVER

deck of pier 60, downstream from the wreck. For an anchorage to pull against, these tackles were shackled to 2-in. hawsers secured to heavy U-bolts embedded in 10-ton blocks of concrete. Each of these blocks was a truncated pyramid with a lifting bolt at the top for handling, and the bolt for the pulling anchorage extending through it from side to side in line with the pull. The blocks were made on the end of pier 61, a concrete mixer being taken out on the pier and the blocks being cast within reach of one of the big derrick lighters. This lighter placed the blocks in a 25-ft. trench dredged down the middle of the slip between piers 59 and 60. A total pull of 840 tons with a leverage of 100 ft. about the keel of the "St. Paul" was obtained with this tackle.



DURING THE FIRST PUMPING—A-FRAMES IN PLACE, AND TACKLES LEADING TO CONCRETE ANCHORS ON PIER 61

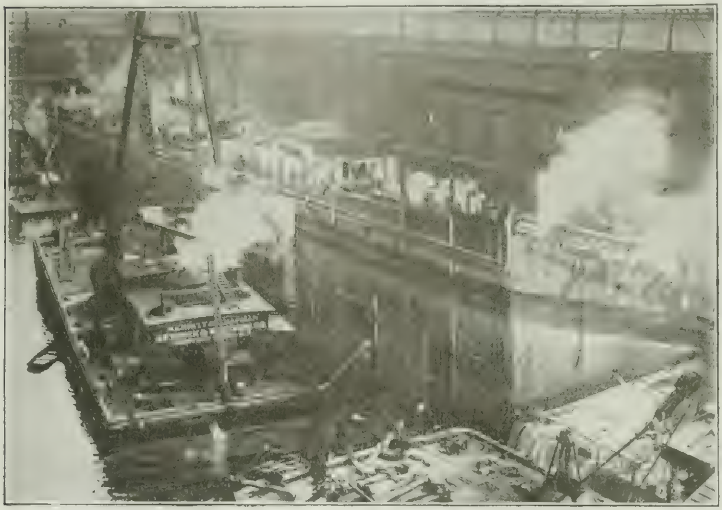
In addition, a direct lift of 1200 tons was obtained by using four pontoons attached to chains passed under the port side of the vessel and around the keel. To prevent the vessel from slipping downstream under the pull of the righting tackles and the lift of the pontoons, a number of steel hawsers attached to the starboard side and swept under the keel and the port side were anchored to the substructure of pier 61.

Before these cables and the chains from the pontoons could be swept under the hull, it was necessary to dredge down under the lower side along the deck and also along the keel. This dredging also helped the divers to get mud out of the hull and also to get at the port holes and close them. By anyone familiar with the internal architecture of an ocean liner, with its closely-spaced decks, its numerous bulkheads and partitions, its winding passageways, and narrow and steep stairways in the machinery and cargo compartments, the difficulty of a man in a diving suit making his way through this labyrinth, lying on its side, in muddy water, and finding and closing a large number of port holes (many of them 10 ft. under the mud) can be appreciated. Excellent time was made with this work by having one or more divers assigned to each compartment, and letting them work there until everything was finished. These men, after having made careful surveys of their compartments under water and having compared with the ship's plans what they found, became familiar with their surroundings and worked to much better advantage.

MUCH WORK FOR DIVERS TO CLEAR WAY TO START CLOSING UP SHIP
A 6-in. gun similar to the one shown had to be removed from the under-water side

A large ash port was closed with a double plate made above water. The divers first took down a thin lead sheet, and, using a hammer, made a perfect templet of the opening and the bolt holes surrounding. A $\frac{1}{2}$-in. plate was then cut and drilled to fit this templet and then was placed by a diver. The entire patch did not leak a drop during the raising of the vessel. A number of holes were cut in the bulkheads under water to drain some of the compartments into others for pumping. At first this work was done by dynamite, but before more than a few plates had been removed in this way a successful under-water oxy-acetylene torch was perfected. This torch lights at will and cuts almost a foot a minute in $\frac{1}{2}$-in. plate, at depths up to 54 ft., which was the greatest depth at which it was necessary to cut. A covered lighter was in the head of the slip at the time of the sinking, and lay in such a position that it could not be removed. It was fitted up as a small machine and repair shop and used throughout the work.

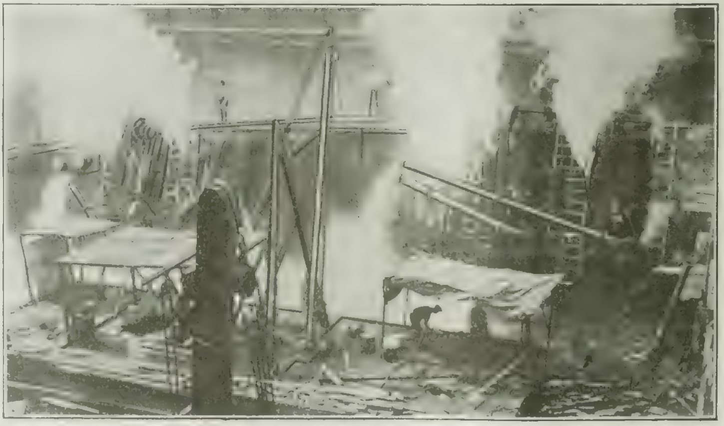
Of the mud which entered the lower part of the ship or lay in the alleyways on the port side on decks 1 and 2, as much as possible was removed before the first rolling operations. A second effort was made to remove mud before the next phase of the work was undertaken, but even after the vessel was floated it was found that approximately 1000 tons of mud was left in the port side of the ship.



COFFERDAM ALONG PORT SIDE—DECK 1 AT BOW AND STERN JUST OUT

In the first rolling of the vessel, it was decided to pump the forward and aft ends, the pilot house, the captain's and officers' rooms forward, and the smoking room at the after end of the ship. Rolling was started on July 22, during which day the vessel was brought up to within 36 deg. of being on an even keel. Subsequently, a gain of little less than 2 deg. a day was made until the rolling operations were suspended, on the night of July 28. The pontoons were then taken off and work was begun on closing up the entire vessel. A part of the cofferdam work consisted of placing two large mass concrete bulkheads and several smaller ones. One of these closed a companionway on the port side of the vessel and the other closed three hatches on deck 2. The concrete, which was mixed with small stone by hand above water, was shoveled into a hopper and carried to the forms through the water in a 1½-in. flexible hose. With each bulkhead a back form was built complete, and a form on the face was carried up by the divers as filling progressed. The closure at the top in each case was calked after the concrete had set, although it is doubtful if this was necessary. Very dense, hard concrete, which was difficult to remove, resulted.

The rest of the cofferdam work was of wood. It extended around hatches 2 and 3 and along the port side from forward of the bridge to 6 ft. aft of the aft end of the engine room. This cofferdam was made of 3-in. tongue-and-groove planking, framed dry in sections, lowered under water and secured to the steel rail on the main deck with hook bolts. With this in place it was possible to pump the ship and roll it at the same time. The A-frames were used, and the derricks "Monarch" and "Commander," lifting on the chains which had been attached to the pontoons used in the first operation. By this means the vessel was brought up to a 16-deg. list, when the A-frames were removed from the starboard side. About 600 tons of rock ballast was next put into the ship, 250 tons being placed in hatch No. 4 by a chute, so that it lay from amidships as far toward the starboard side as possible, 100 tons being put in hatch No. 2 in the same way and 250 tons being placed through a coal chute, reinforced for this work, in the forward coal bunker on the starboard side. After the ballast was placed in the vessel divers were used to trim the ship by moving the ballast as far to the starboard side as possible.



PUMPS HAD TO BE AWKWARDLY PLACED, OPERATORS WORKING FROM LADDERS

The third stage of the work consisted in pumping the entire ship, steadying it by the derricks "Monarch" and "Commonwealth" on the port side and the derricks "Commander" and "Chief" on the starboard side. The

vessel first righted up to about 4 deg. from vertical, and floated forward and aft approximately five hours after the pumps started. This was accomplished Sept. 11. As everything movable within the vessel had fallen over to the port side, she continued to list from 3 to 5 deg. during the remainder of the pumping operations. These continued for two weeks, during which time the vessel floated higher and higher as weight and sections of cofferdam were removed from the upper part of the ship and mud and wreckage from the port side, starting on the upper deck and gradually working down to deck 2, deck 3 and deck 4.

When it was seen that the vessel would still hold a definite list to port, 305 tons of additional ballast was put in hatches 1 and 2. Twenty-five tons of chain and 280 tons of slag were used.

On Aug. 28 a force of workmen was placed on the ship for cleaning and renewing the winches, ventilators, the ship's windlass and other parts of the ship's machinery, and on Sept. 12 a much larger force was put to work repairing and cleaning the ship and putting its machinery in running order. On Sept. 27 representatives of the International Mercantile Marine formally took over the vessel.

The work of raising the "St. Paul" from the mud was carried out by the Merritt & Chapman Derrick & Wrecking Co., under the immediate direction of Capt. J. M. Tooker, superintendent, and Ralph E. Chapman, salvage engineer.

PONTOONS AND A-FRAMES PULLING SHIP FROM 73-DEGREE TO 27-DEGREE LIST

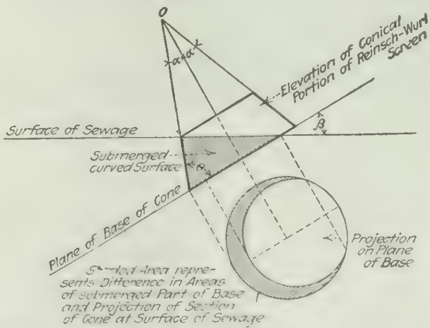
SMOKESTACKS AND MASTS OF THE "ST. PAUL" HAD TO BE BLASTED OFF

Finding Submerged Curved Area of Reinsch-Wurl Screen

BY FRANK S. BAILEY

Assistant Engineer, Metcalf & Eddy, Boston, Mass.

IN ORDER to make comparisons of the efficiency of different types of sewage screens, it is necessary to know the area of the portion of the screen which is submerged in sewage. This area can be easily found in most cases, but the Reinsch-Wurl screen, a part of which sometimes consists of a frustum of a cone set at an angle with the surface of the sewage, presents some difficulties. A simple method of determining the area of the curved surface of the submerged portion of the cone has been found which gives exact results and which can be applied about as easily as an approximate method.



SUBMERGED AREA OF CURVED SURFACE OF REINSCH-WURL SCREEN IS EASILY FOUND

A section through the cone at the surface of the sewage is a segment of an ellipse. To find the submerged area, determine the area of the projection of this segment on the plane of the base of the cone (see sketch), subtract this area from the area of the submerged portion of the base, and multiply the difference by the secant of θ, or what is the same thing, divide the difference by the sine of α; the result represents the area of the submerged curved surface of the side of the cone.

Floating Target Facilitates Wire-Drag Work Off Florida Coast

By J. H. Hawley
Hydrographic and Geodetic Engineer, United States Coast and Geodetic Survey, Washington, D. C.

FLOATING signals of the type shown in the accompanying photographs were used last summer on wire-drag work in the vicinity of the westerly Florida reefs, where practically all of the work was out of sight of land, and the only triangulation signals available were three lighthouses and a tall hydrographic signal erected on a small sand key.

The floating signal consists of a heavy center pole with a target at the top and a counterweight at the bottom, supported, at a point about two-thirds of its length down, by three barrels securely lashed and braced, the mooring chain being attached to a bridle at the water line. The signal was quickly and cheaply constructed, and was durable, and sufficiently large to be visible for miles; it was easily handled from small vessels.

In a period of four months an area of 232 square miles was examined. It is the first wire-drag work ever done in Florida in the summer season, and the decrease in unfavorable weather as compared with the winter season resulted in a considerable decrease in the unit cost of the work. It is also the first wire-drag work ever done out of sight of land, in open and entirely exposed waters.

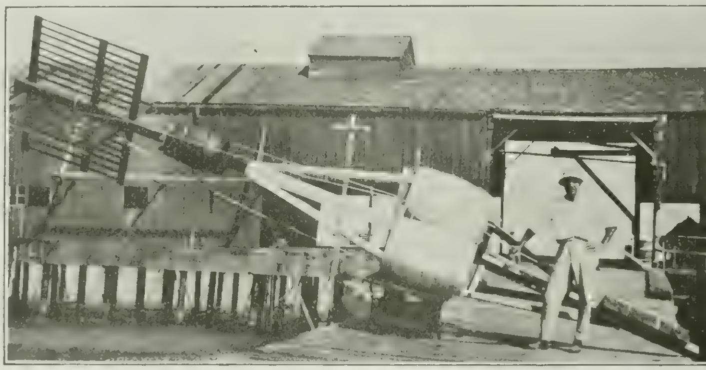
Imperial Valley All-American Canal Progress

Last summer much enthusiam was expressed in the Southwest over the possibilities of an all-American canal to the Imperial Valley in California, and the engineers of the United States Reclamation Service were ordered to investigate. W. H. Schlecht, project manager, Yuma Project, reports in the September *Reclamation Record* that trial lines, including topography, have been finished, and that work on test pits, estimates and additional topography at the west end of Laguna Dam is under way.

Traveler Handles Forms and Steel for Ore Dock

Timber Structure Spanning Site Gives 60 x 90-Foot Clearance—Concrete Spouted Into Place By Floating Plants

IN THE construction of a concrete ore dock at Ashland, Wis., the forms and reinforcing steel were handled by a large timber traveler of the type employed in the erection of steel truss bridges. This traveler, which spanned the structure, as shown in the accompanying view, was carried on a pair of sills 40 ft. long, mounted on grooved wheels on two rails forming a track of 62 ft. 8-in. gage. It had a clearance of 90 ft. in height above the rails and 60 ft. in width between the plumb posts. The top consisted of two trusses 14 ft. apart and 14 ft. deep, giving a total over-all height of 104 ft. The full load was six tons on each of the four hoisting lines.



FLOATING TARGET PROVES CHEAP, DURABLE, EASILY HANDLED AND VISIBLE FOR MILES

Each sill consisted of two 8 x 8-in. timbers 40 ft. long, spaced 2 ft. on centers and trussed with two 1¼-in. rods. These carried the platforms on which the hoisting and propelling engines were mounted. Under each sill were two trucks, each with a pair of grooved wheels spaced 4 ft. on centers. The two sides or towers were built of four 8 x 8-in. spliced posts 86 ft. long, with 1⅛-in. rods and 6 x 8-in. braces seated on cast-iron brace blocks. The towers were 14 ft. square at the top and carried the two trusses, which had five panels of 12 ft. 4 in. These trusses were built of 8 x 12-in. and 8 x 8-in. timbers and 1¼- to 1½-in. steel rods.

Timber forms for the superstructure consisted of heavy trusses 60 ft. long, built in three sections. These were quickly set up by the traveler and seated on wedges placed on transverse 14 x 14-in. timbers which passed through the 3 x 10-ft. concrete columns, thus making it unnecessary to use supporting falsework. Forms for the ore pockets were built up of heavy skeleton trusses filled in with small sections of panel forms which were placed by hand. These panels were moved up as the concreting progressed, so that the steel reinforcement was accessible at all times in advance of the concrete.

The trusses for the pockets had each a collapsible side, which permitted their being withdrawn in pairs by the traveler and carried to the next position.

Concreting was done by two floating plants, each mounted on a 34 x 110-ft. scow, 10 ft. deep. Upon the scow was a $\frac{3}{4}$-yd. mixer serving a 1-yd. elevator bucket in a timber tower 120 ft. high. The boom and chute could be adjusted to any desired height on the tower. Gravel and sand were delivered at a dock by large derrick scows, and transferred to bins or hoppers on the concreting plant by smaller derrick scows using 1-yd. clamshell buckets. Cement was unloaded from cars at a storage house and transferred to the sheds at the mixers by a derrick scow. For moving, the mixer plants were equipped with hoisting engines operating two cables.

This reinforced-concrete ore dock was built for the Minneapolis, St. Paul & Sault Ste. Marie Ry. in 1916-17. It is 1132 ft. long, with its deck 80 ft. above the water level. Its design was described in *Engineering News* of Aug. 10, 1916, p. 243, by W. E. King, of the Toltz Engineering Co., St. Paul. The work was done under the direction of C. N. Kalk and E. A. Whitman, successively chief engineers of the railway. The general contractors were Foley Brothers, St. Paul, Minn.

City Has Much Land Under Lease

Scattered along its aqueduct and in the drainage area from which the aqueduct draws, the City of Los Angeles owns nearly 77,000 acres of land acquired for water and power project purposes. The lands are leased under charge of John T. Martin, land department, Department of Public Service. For small tracts full cash in advance payment is required.

Montezuma Aqueduct on Erie Canal Is Demolished

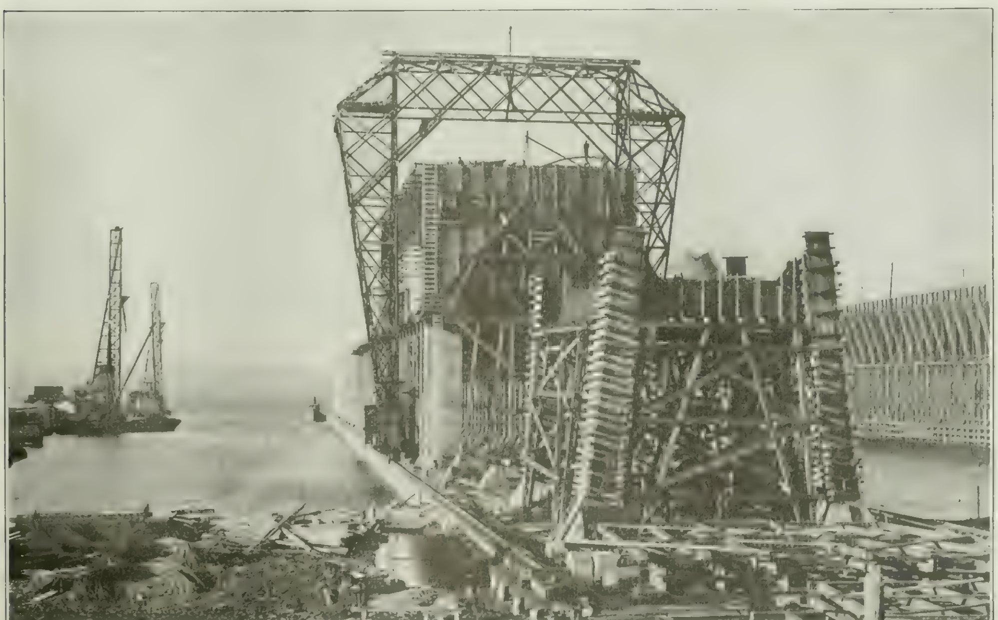
Masonry Arches and Timber Flume Started 69 Years Ago Were Last Impediment to Opening of New York Barge Canal

By J. G. Palmer
Assistant Engineer, Department of State Engineer and Surveyor, Port Byron, N. Y.

MONTEZUMA aqueduct, perhaps the most notable structure on the old Erie Canal, was removed this year to provide clearance for the New York State Barge Canal, which lies in the bed of the Seneca River crossed by the aqueduct. A masonry and timber structure nearly 70 years old, its condition after years of service, and the method of its demolition, all have engineering interest.

The aqueduct, located in the Montezuma marshes a mile west of the village of Montezuma, N. Y., and $\frac{1}{2}$ mile below the junction of the Seneca and Clyde Rivers, was built during the first enlargement of the Erie Canal. The first contract for its construction was dated Sept. 27, 1849, but, because of the failure of the contractor after most of the foundations and about half of the masonry had been completed, a second contract was let on July 15, 1854. The structure was completed and placed in service in the spring of 1856, at a cost of $216,510. Some of the data used in this article were taken from the final estimates for these contracts.

The aqueduct consisted of a wooden flume which carried the canal, and a series of stone arches along the downstream side of the flume, which arches carried the towpath. Both the flume and the arches spanned the openings between the masonry piers. The flume was



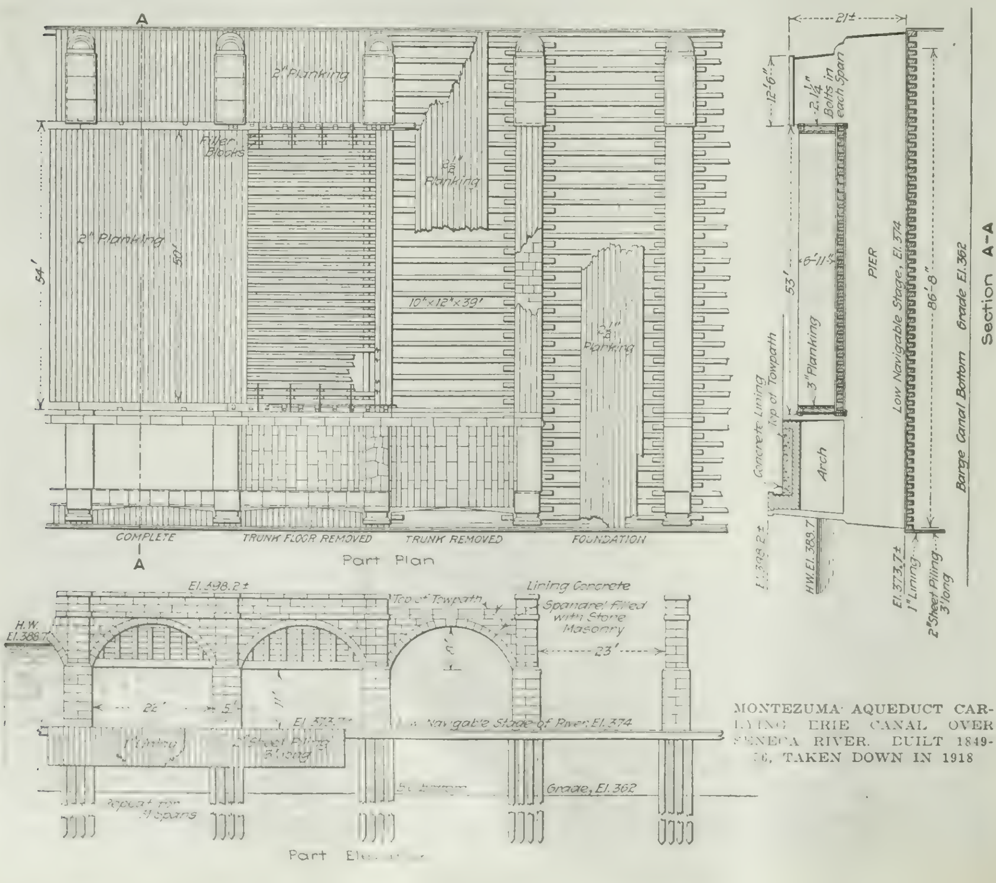
TIMBER TRAVELER HANDLES FORMS AND REINFORCING FOR ORE DOCK—FLOATING PLANTS PLACE CONCRETE

about 840 ft. long, 50 ft. wide and 7 ft. deep. The towpath was 13½ ft. wide. The piers were 90 ft. long by 5 ft. wide, and their ends extended above the flume to support its sides against the horizontal pressure of the canal. On the towpath side the spandrels of the arches were filled with dimension stone masonry, continuous over the piers. This masonry was covered with a 6-in. layer of concrete and a 12-in. layer of gravel which formed the towpath.

LOOKING TOWARD MONTEZUMA AQUEDUCT SECTION

The masonry was Onondaga blue limestone laid in "hydraulic lime" mortar. The soffits and the copings were bush-hammered, and the remainder was quarry-faced ashlar in courses which varied from 1 to 2 ft. thick. The copings were doweled with iron rods set in melted lead. This masonry was found in excellent condition, unweathered, free from cavities and not greatly in need of repointing, although the mortar was weak.

A pile and grillage foundation supported the structure. The grillage timbers or caps extended from pier to pier and were covered with plank laid close which formed the bottom of the river and the base for the piers. The grillage was protected from underscour by a line of double-lap sheet-piling and riprap along both sides, which has been effective, although the sheet-piling was only 3 or 4 ft. long. The cap timbers were 40 ft. long, 10 in. thick, vertically, and in some cases, 12 in. wide, while others were tapered in the latter dimension. The fact that they were hewed accounts for this variation. No other hewed timber was found in the structure. There were four rows of piles under each pier, with 30 piles in a row. The piles were staggered so that each cap rested on two piles in each pier. The caps were fastened to the piles with wooden pins, and the planks were fastened with square, tapered pins.



MONTEZUMA AQUEDUCT CARRYING ERIE CANAL OVER SENECA RIVER. BUILT 1849-56, TAKEN DOWN IN 1918

Between the piers there were short piles under the outside caps "to support the sheet-piling," as stated in the estimates.

The foundations were well preserved, with the exception that the plank were somewhat water-worn, having been reduced in places from 2½ in. to 1½ in. thick.

Since the current through the aqueduct was accelerated by the lowering of the water that accompanied the completion of the prism of the Barge Canal, it was considered unsafe to excavate near the structure until it was time to abandon the Erie Canal. For this reason, in 1911 a bulkhead of triple-lap sheet-piling was

TOWPATH ARCH SIDE OF THE AQUEDUCT CARRYING ERIE CANAL OVER SENECA RIVER

The piles were mostly soft wood, ranging from 8 to 12 in. in diameter and from 7 to 35 ft. long, though the estimates show that some of them had been spliced to a length of 56 ft. They had been cut off to grade with axes. The load was about 7 tons per pile. The crushing stress on the caps, across the grain, was as high as 280 lb. per square inch, and, although they were hemlock, there was very little evidence of crushing.

Although it has been renewed more than once, the flume was found to agree closely with the original plan,

placed across the bottom of the river, 800 ft. below the aqueduct. Excavation was stopped at this point and 400 ft. above the structure. Preparatory to the opening of the Barge Canal last spring a contract was let for completing the prism, removing the bulkhead and 20 spans of the aqueduct, and other work in the vicinity. The contractor assembled his plant, for the demolition, by boat on the Erie Canal, placing it on the banks at the ends of the aqueduct, and moved it into position as soon as the canal was drained. A hy-

CANAL WAS CARRIED ON TIMBER FLUME SPANNING BETWEEN MASONRY PIERS

except that there were more floor stringers than are shown. The stringers were yellow pine, the side frames were oak, and the lining was white pine, match planed to tight joints. It was 3 in. thick on the sides and 2 in. thick on the bottom of the flume. The sides were decayed and very leaky. The floor was sound and tight. The newest stringers, which were about 13 years old, were sound, and the oldest spans contained many sound ones. The sides of the flume were at the canal water level, forming a spillway, and there were 15 drainage gates, about 2 ft. square, in the downstream side of the flume, the bottoms of which were at the level of the floor.

draulic dredge was brought up the river and excavated in the prism during the month of December. With the exception of a short time during the spring flood, work on the aqueduct progressed continuously until it was completed in July, 1918. This was remarkable, considering the exposed location and the unusual severity of the winter.

In the spring a dipper dredge was brought on the work, which removed the pile foundations and some hardpan that was in the vicinity. This material was either cast over or hauled by scows and dumped in the prism, where it could be disposed of by the hydraulic dredge. The plant for the demolition consisted of a

traveling derrick on the bottom of the flume, a narrow-gage locomotive and two side-dump cars on the towpath, a compressor, an air drill, two skips and a clamshell bucket. The derrick and the train removed everything above the foundation piles, finishing one span at a time and moving toward the dump, which was at the west end of the aqueduct. The stone, pine and hemlock were dumped over the back of the towpath bank, which is 14 ft. high, and the oak was burned under the compressor boiler.

Progress was slow during the winter because of frost in the masonry below the spillway level. Practically all of the masonry below this level was blasted, while very little blasting was done after the frost was out. Only two spans were removed in any winter month, but this was increased to four or five spans per month in the spring and summer.

As the flume was not anchored it was easily pulled apart. A span of flume having been removed, the pier and arch were attacked together. Several methods were tried on the arches, but the following was finally adopted: A timber platform, supported on the masonry and on posts, was placed under the arch. The spandrel filling having been removed from the half that was further from the derrick, the key was taken out, racking back to the springing line. In this way the half arch stood until the last keystone was removed; the other half with its spandrel filling remained standing until it was taken down. None of the piers showed a tendency to overturn after the removal of an arch from one side. The stone that was under water was removed by the clamshell after having been drilled and blasted. In one case the water was 6 ft. deep. The plank and caps were also removed by the clamshell, reaching over to the next span away from the derrick.

The contractor was the Mohawk Dredge & Dock Co., Herkimer, N. Y.; the subcontractor on the demolition was Scott Bros., Rome, N. Y. The writer was in charge for the state and F. J. Beach, junior assistant engineer, was in local charge.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Three-Stage Concrete Mixing in Single-Barrel Mixer

Sir—I am very much interested in Frank B. Walker's letter in *Engineering News-Record* of Sept. 26, 1918, p. 595. It would not be necessary to use the "three-stage mixer" referred to by Mr. Walker to obtain the results he desires. I obtained these results for a number of years by mixing concrete in an ordinary mixer, by the following method:

First, place in the mixer the required amount of water; next, add the required amount of cement (which makes the cement "solution" referred to by Mr. Walker); then add the coarse aggregate, which becomes thoroughly coated by the cement "solution"; last, add the fine aggregate; and the result will be obtained.

The above description is for concrete mixed in a one-bag batch mixer from a loading platform. However, should a large mixer be used the loading side should be equipped as follows: Water tank; cement hopper; coarse-aggregate hopper; fine-aggregate hopper.

The concrete could then be mixed in the proper manner, using a minimum amount of water, by first putting in the water, then the cement, then the coarse aggregate, and then the fine aggregate, by opening the various measuring hoppers in the rotation mentioned.

This has been demonstrated in the manufacture of reinforced-concrete pressure pipes, on a number of large contracts, which are working successfully under internal hydrostatic pressures up to 45 lb. per square inch, the concrete being water-tight.

COLEMAN MERIWETHER,
Manager, Cement Products Bureau, Portland Cement Association.
Chicago.

Wood Borers in Southern Waters

Sir—The correspondent writing in *Engineering News-Record* of Sept. 19 on "Marine Wood Borers Work in Deep Water" seems to have a misapprehension of the habits of certain of these destructive pests. The borings shown in the reproduction of a photograph in the lower view on p. 551 certainly were not made by limnoria. Apparently they are the work of the teredo; probably that of the very common teredo navalis.

Limnoria inhabit the surface of a pile on a zone coinciding approximately with the tidal range, wherein they make holes ranging in diameter from that of a common pin head to that of the pin point. Their borings being visible on the surface of the wood, the extent of their ravages may usually be ascertained by inspection at low water. The teredo enter a pile when very small, grow rapidly in length and increase the diameter of their bores up to ½ in. or ¾ in. They seem generally to enter as near as possible to the mud line; the first foot or two above that level may be completely honeycombed, while at a height of 4 or 5 ft. but few can be found. For this reason the services of a submarine diver are usually required for the inspection of teredo-infested piles in place. The entrances being so small, and the animals never emerging from their self-made prisons, the pile may appear to be sound, while in reality it is only a thin shell covering a honeycombed interior. When a teredo-weakened pile breaks it will almost certainly break just above the mud line.

The bores of the teredo are always lined with shell, wherefore calcareous shores of warm seas are especially favorable for the rapid growth and propagation of this pest. Certain species of wood, especially hardwoods, resist the teredo better than others, but it is believed that none is wholly immune from their attacks. A timber structure built in waters where none had existed previously may have quite a long life, because a considerable time may elapse before the borers discover and colonize it in large numbers; but where untreated wood piles are driven in a locality known to be already badly infested they cannot be expected to last long. It is more than probable that, in the Cuban case mentioned, the same sort of pile used for repairing a pier that has failed will last much less than the five-year life of the original piles.

While on this subject it may be well to direct attention to an important point not generally appreciated, namely, the necessity of preserving absolutely intact the continuity of the protective coats of wooden piles protected by any process. Just as a pin prick in the human hand may permit a fatal infection to enter, so may a split, axe cut, pike pole or chain-dog puncture of the armor permit the entrance of the borers, which will proceed to consume the interior, leaving the protective coat standing as a hollow shell.

Oakland, Cal. EDWARD M. BOGGS.

Sir: Referring to Mr. Hobby's letter on marine borers, I would say that we have had a similar experience here, but with creosoted instead of native hardwood piles. I have in mind especially some 12-lb. treatment shortleaf pine piles driven in 1912 in 42 ft. of water. Late in 1917, about 5½ years after driving, these piles were eaten completely off at the mud line. We have very little trouble here with piles being eaten at the water line; they go much more quickly at the mud line.

There are, I believe, three varieties of worm working on the piling here: a species of limnoria working near the water line, which takes 12 or 14 years to ruin a native hardwood pile; the teredo, which works from the water level down, and another kind of worm which works at or near the mud line.

This mud-line worm seems to do more damage in comparatively deep, clear water than where the water is shallow or fouled with sewage, etc. I think one reason for its working near the mud line is the presence of less marine growth on the pile at that point.

The pictures in Mr. Hobby's article are very typical of the action of this worm.

The life of a creosoted pile in deep, clean water in Cuban bays cannot be safely figured at more than seven or eight years. CHARLES H. JOHNSON,
Foreman Public Works Department.
Guantanamo Bay, Cuba.

Tests of Flow in Brick-Lined Water Tunnels in Chicago

Sir—Referring to your article in *Engineering News-Record* of Sept. 5, p. 445, entitled "Flow in Chicago Water Tunnels is Tested by Salt Solution Method," the writer believes it may interest your readers to know that, shortly after the completion of these tunnels, he made very elaborate experiments to determine the elements of flow in these tunnels. The results of these experiments and calculations, which covered a considerable period of time, were published in the *Journal* of the Western Society of Engineers, Chicago, Vol. XVI, October, 1911.

A brief comparison of the average results then obtained, and those later obtained by salt-water tests in 1917, is given in the accompanying table. It should be noted that at the time of the first experiments the capacity of the stations had not been fully developed. Therefore, the velocities of water in the tunnels were considerably less than at the time of the later experiments, when additional pumping machinery had been installed.

It is also to be noted that the divisions of the 10-ft. tunnel for experimental purposes were different during the two sets of tests, in that the intermediate observation points were at different places. The short piece of 10-ft. tunnel from Kingsbury St. to Green St. in the first test was especially well constructed, and this short piece of tunnel in which more favorable results were obtained would not influence the general average when compared with the results on the longer stretches.

In the section from Carroll Ave. to Central Park Ave., in the first test (which forms a part of the section from Green St. to Central Park Ave. in the second test), there is a stretch of 850 ft. where the diameter had been reduced from 8 ft. to 7 ft. 2 in. by the introduction of an extra ring of brick. This was not taken account of in the second test. JOHN ERICSON,
Chicago, Ill. City Engineer.

[Mr. Ericson's paper in the *Journal* of the Western Society of Engineers is nearly 50 pages in length, including discussion, and is accompanied by numerous diagrams and other illustrations.—Editor.]

Counties Maintain Nebraska Roads

Highway maintenance in Nebraska is taken care of by the county authorities, their work on state-aid roads being subject to the approval of the state highway department. Each county is required to lay out all main roads connecting towns, not to exceed 20% of its total mileage, as county roads. In maintenance work, the state-aid roads come first and then the county roads, the balance of funds available being spent on the less important roads. The county engineer makes inspections at regular intervals and orders such repairs as may be necessary. Earth roads are taken care of by districts, each having from three to six miles. Hard-surface roads in Nebraska are practically all paved with brick. George E. Johnson is state engineer.

COMPARATIVE RESULTS OF TESTS OF FLOW IN THE NORTHWEST LAKE AND LAND TUNNELS, CHICAGO

Average Results of Four Gagings by John Ericson, 1902 and 1903

Section	Diameter of Tunnel, Ft.	Length of Section, Ft.	Ave. Vel., Ft. per Sec.	Ave. Slope per 1000 Ft. (1000 S)	Ave. Factor "c"	Ave. Factor "n" (by Formula)
Crib to Kingsbury St....	10	20,483	2.123	0.1288	118.6	0.0145
Kingsbury to Green St..	10	2,216	2.123	0.1108	127.2	0.0135
Green to Keith St.	8	3,328	1.470	0.1060	105.5	0.0155
Keith to Springfield Ave.	8	18,855	*1.373	0.0822	109.1	0.0149
Green to Carroll Ave...	8	2,759	1.814	0.1140	119.6	0.0138
Carroll to Central Park	7 2"	850	2.200	0.1152	119.2	0.0138
Ave..................	8	16,647	1.814			

* Three gagings only in this case.

Average Results of Three Salt Solution Tests, 1917

Section	Diameter of Tunnel, Ft.	Length of Section, Ft.	Ave. Vel., Ft. per Sec.	Ave. Slope per 1000 Ft. (1000 S)	Ave. Factor "c"	Ave. Factor "n" (by Formula)
Crib to Chicago Ave. Junc.	10	14,033	3.559	0.333	123.1	0.0142
Chicago Ave. Junc. to Green	10	8,666	3.145	0.279	122.4	0.0144
Green to Springfield Ave.......	8	22,183	2.327	0.203	115.6	0.0144
Green to Central Park Ave.....	8	19,856	2.583	0.240	118.5	0.0141

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

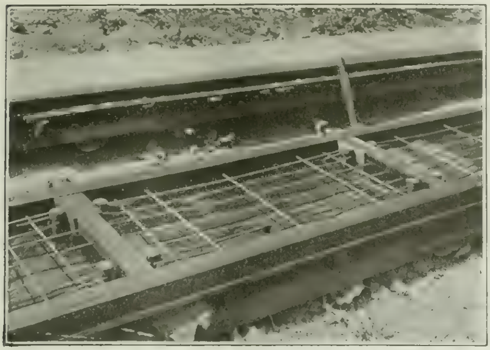
Traveling Spouting Hopper and Derrick Minimize Work in Slab-Casting Yard

CASTING 10,000 pieces, embracing 120,900 sq.ft. of rod-reinforced-concrete walkway slabs for the Frankford elevated line in Philadelphia, was looked upon by George B. Klopp, subcontractor for the Keystone State Construction Co., as enough of a job to require a carefully worked out plant. Availing himself of a vacant lot nearly a block long on the west side of the structure, near the center of the line, he laid out four lines of casting platforms long enough to accommodate in all 320 5-ft. 3-in. slabs. In the center is a traveling hopper on a light track, which is filled by the ½-yd. mixer at one end of the yard and is able to spout concrete to any of the platforms. On the east side, mounted on light rails, is a small traveler derrick which handles and stacks the slabs after the forms have been removed. The mixer is charged by hand with sand and gravel delivered by truck. The traveling hopper holds a little more than a yard, and as each slab contains about 1¾ cu.ft., a good many can be poured from one loading.

The forms are low platforms of 1-in. plank, on top of which sheet iron is placed. At the edges of the sheet iron are screwed 3 x 4-in. strips, the blocks being separated by 2-ft. strips of the same size fastened with a pair of screws. When the blocks are finished they can be readily removed by taking out the screws and lifting off the strips. The slabs are reinforced with ⅜-in. rods both ways, and at each of the four corners is a cast-iron socket for bolting them to the elevated structure. The cast-iron sockets and the reinforcing rods are set and enough forms prepared for pouring 60 to 80 of the blocks in one run. The gang then turns to and mixes a hopperful of concrete which is placed before any more mixing is done. As an entire run takes only 5 or 6 yd. of concrete, the work can be done by a few men. The finishing is the big item, this amount of concrete requiring the finishing of 630 to 840 sq.ft. Before the concrete has hardened each slab is marked with the date.

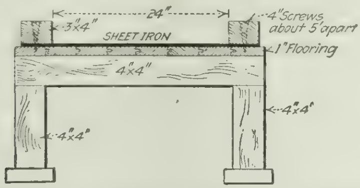
Other Articles of Interest to Contractors In This Issue:

COMPACT YARD SERVED BY MIXER, TRAVELING HOPPER AND DERRICK



THE SCREW PLUGS HOLD BOLT SOCKETS

After being allowed to set for two to five days, according to conditions, the strips are removed, the blocks turned around crossways on the form, and the small traveling derrick comes along and picks them up and stacks them for curing. The derrick is fitted with a lifting rig made of a square frame of $\frac{3}{4}$ x $\frac{3}{4}$-in. angles about 2 x 4 ft. in plan, which is hung horizontally from the hook with light wire rope. From

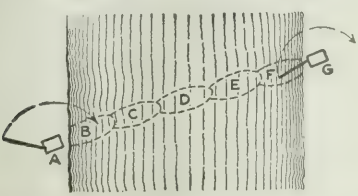


THE SIDE FORMS ARE HELD ON BY SCREWS

the corners of this frame are suspended two long strips of 4-in. belting, one at each end. These flexible strips are slipped under the ends of the slabs, and can be used to raise anywhere from one to six at a time. The slabs are separated by 1-in. wooden strips in stacking and handling. They are distributed along the line of the elevated in motor trucks and hoisted to the deck with a light outrigger and electric hoist.

Dragline Crosses Stream by Picking Up And Laying Down Islands

DRAG-LINE excavators possess qualities peculiarly their own in making paths for themselves when required to travel from one location to another. At Day-



DRAGLINE CROSSES STREAM BY BUILDING ISLANDS

ton, O., a large drag-line excavator working on channel improvement has crossed the Miami River several times without a boat, or getting its feet wet, or flying. The sketch explains the method used. Starting at A the machine, excavating from the bank, builds a peninsula, B, out into the water and moves out onto it. From its new stand it picks up the peninsula behind and lays it down as an island, C, onto which it moves. From there it picks up island *C*, and lays it down as island D. These operations are continued until the excavator reaches the point G, when it picks up the last island and leaves the channel as clear of obstruction as it was originally. No great depth of water existed at the crossing. The dragline which made the crossing was one of the largest sizes, with a 100-ft. boom and a $4\frac{1}{2}$-cu.yd. bucket. It is working on the flood protective works of the Miami Conservancy District.

Currency in the Pay Envelope Confounds the Dram Shop

ANY consideration of labor efficiency which fails to recognize the human side of the workman is bound to fail. Returning recently from a half day's travel about the operations of a war-time job in a large mid-western city, the editor and his contractor host arrived at headquarters as the procession of workmen was filing past the pay clerk's window. Watching the men as one after another they tore open their envelopes and pocketed their money, the contractor remarked: "Wages should never be paid by check, and always in bills of small denomination." He went on to say, noting his guest's look of interest, "It keeps the men out of the saloons." "Merely a notion," is the first thought. Further thought, however, develops reasons. Few workmen have other than a savings-bank account if they have even that banking relation, and their hours of work make a visit to the bank impracticable under any circumstances. Consequently, they go to the saloon to get cash for their checks or change for their large bills. The saloon keeper is glad to accommodate; he requires no identification, asks no embarrasing questions, and does business through no supercilious clerk. Custom decrees that the man accommodated shall stand treat. One treat begets another, and if the saloon keeper plays his game well he gets back into the till a fair percentage of the currency he passed over the bar. One of these gentry once boasted to the editor that he got back 25% of every check he cashed.

Perhaps this was an exaggeration, but the mere fact that he dared to make so great a claim indicates that the actual percentage was not inconsiderable. Besides the money tax which the saloon bank levies on the workman, it deals out to him the poison which makes of him a less efficient, if not an irregular, workman.

All this is why the wise contractor has scant use for the saloon bank, and why the particular contractor referred to above took pains to make certain that by no action of his should his workmen have reason to visit a saloon on pay day. Pay in currency and in bills of small denominations, and the workman won't go to the dram shop—at least he won't go there to get his earnings transformed into the medium of exchange which he can conveniently employ. C. S. H.

NEWS OF THE WEEK

New York, October 24, 1918

St. Paul Engineers Urge Reconstruction Measures

Adopt Resolutions for Taking First Steps in Planning for Return of Army

Resolutions urging public officials and private interests to take immediate action in formulating plans for reconstruction work, with a view to furnishing employment to a large number of men who will be available as soon as the war is over, were adopted by the Engineers' Society of St. Paul at a meeting held Oct. 14. An interesting discussion on "After-the-War Problems for Reconstruction" was a feature of the meeting. The discussion was based on the following questions: "What is the attitude of the engineer and of engineering organizations to the returning soldiers, particularly the engineering units, and what should be done for making available for homes the large tracts of state-owned lands in Minnesota?"

The following is the text of the resolution adopted by the society:

"Whereas, we believe that the matter of furnishing employment to the great number of returning soldiers and men released from the ship-building yards, munition factories and other war industries presents a serious problem, and

"Whereas, a large field for the employment of both skilled and common labor can be provided by promptly undertaking the construction of extensive public improvements, such as highways, paving, bridges, sewers and waterworks, and also of private projects, many of which have been suspended during the war, and

"Whereas, before such construction work can be started it will be necessary to formulate plans for the work and to do much preliminary work which often requires several months,

"Be it therefore resolved, that public officials and private interests who will have such construction work in charge be urged to take immediate action toward completing the preliminary steps and formulating plans for such construction work, so that when the war is over the actual work of construction can be started promptly, thereby furnishing employment to a large number of men at the time when it will be urgently needed and at the same time helping to revive the nonwar industries and to reëstablish normal conditions."

A committee was appointed to make a report upon the state's resources for furnishing farm homes for those adapted to farming. This work will be conducted along the lines laid down by the committee of the National Research Council.

Heavy Artillery Wants Engineers for Officers

Artillery in the United States Army is divided into field artillery and heavy (coast) artillery. The former has its officers' training school at Camp Zachary Taylor, Louisville, Ky.; the school for the latter, which handles all of the big guns, is at Fortress Monroe, Virginia. A special appeal is now being made to engineers to offer their services for the heavy artillery officers' training camp.

Men in deferred classification, due to dependent families, have the option, if they do not gain commissions, of reverting to their previous civilian status, or remaining in the service as enlisted men. Otherwise they take the same chance as if they were selected by their draft board and assigned to the heavy (coast) artillery.

Full information will be obtained by writing to the Commandant, Coast Artillery School, attention of the Communication Officer. The school can induct any registered citizen of the United States who is physically qualified for general military service.

Concrete Ship "Faith" in Good Shape After Long Voyage

The "Faith," the 4500-ton concrete freighter which was launched in San Francisco last spring, has successfully completed a trip from the Pacific Coast to the west coast of South America and from there, laden with nitrates, through the Panama Canal to New Orleans. It is reported that she had a very successful trip so far as ease of handling is concerned, and that structurally she is quite satisfactory. No cracks were observed in the beams or girders. It is expected that the "Faith" will sail soon for New York.

More Funds Are Asked To Buy Technical Books for Soldiers

At the head of the list of books sought by the American Library Association for the American Army are technical works relating to special branches of army service. The association is making a drive for $3,500,000 instead of a contribution of books, as was originally asked for. It is stated that it has been found impossible to build up camp libraries properly with hit-or-miss contributions.

The association states that the men in the Army—the Aviation Corps, the Engineer Corps, radio students, gunners, signal men—all want the latest and best books on the subjects in which they are particularly interested, since the men realize that extra rating and early transfer overseas depend largely on study.

Railway Bridge Men Hold 28th Convention

Urge Utilization of Full Life of Structures as War Necessity—Wood Tanks Advocated

How to adjust railway practice in the maintenance and renewal of structures, in order to meet the war conditions affecting labor, material and finance, was the dominant question at the 28th annual meeting of the American Railway Bridge and Building Association, held in Chicago Oct. 15-16.

Necessity for reducing new construction to a minimum and providing continual repair and maintenance of existing structures under these war conditions was emphasized by C. A. Morse, formerly chief engineer of the Rock Island lines and now director of maintenance in the operating division of the United States Railroad Administration. He considers it not now advisable to rebuild small structures on account of limited waterway, unless there is real danger of washouts. The old structures should be repaired, kept clear and carefully watched. Economize in work that is really essential and postpone that which is less essential—this was Mr. Morse's message.

Universal Standards in Bridge Work

With the railways now forming one Government-owned system Mr. Morse urged standardization of methods and plans in bridge work. There is greater variety in practice than any one railway would have permitted on its own lines, and there is opportunity now to crystallize the good and eliminate the poor in such practice. He suggested that the association should take up this matter in its work for the coming year.

As to buildings, the enormous amount of Government work will, it was brought out, exercise a check on railway work. Few new stations will be required, but attention should be given to keeping the existing structures in good repair and well painted, as a means of extending their lives and of giving good appearance, so as not to arouse public objection. New buildings may be required for the mechanical department owing to the increase in size of equipment, but in many cases sufficient accommodation may be obtained by enlargements and extensions.

Economics of Bridge Repair

Special stress was laid on the economic importance of getting the full life and value from existing bridges. While timber structures were noted particularly by Mr. Morse, steel bridges were considered at considerable length in a paper on "Carrying Bridges Over," by C. F. Loweth, chief engineer of the

Chicago, Milwaukee & St. Paul Ry. Deterioration and overloading are the principal reasons for renewal. Methods of systematic study of the conditions of old bridges carrying increased or comparatively heavy loads were reviewed, together with possible means of reinforcement and discussion of the economic question as to whether replacement or repair is the more desirable.

That more frequent inspection must accompany the policy of carrying over old bridges by means of continual repair work was one of the points brought out in the discussion. Such inspection must be planned specially to guard against failure of details. On one railway, where refrigerator cars are a cause of corrosion in stringers and floor-beams, it is now the practice to clean off the brine frequently and apply patches of paint. As to overloading, many old bridges will carry a moderate or even considerable increase in load without reinforcement, but these structures should be inspected frequently and watched for any signs of distress. It was stated that girder bridges placed on the New York Central R.R. in 1880 are still in service, carrying the greatly increased loads of modern equipment.

Repairing and strengthening of old masonry was the subject of a long report which included a description of the underpinning of a washout under the Coon Rapids Dam, taken from *Engineering News-Record* of July 25, pp. 186-189. This led to a discussion in which individual jobs and experiences were noted. The suggestion was made that when indications of failure appear more study should be given to their causes and remedy, instead of the assumption being made at once that reconstruction is necessary.

Movement of an old stone pier in an important bridge was investigated and repair decided upon. Vertical I-beams were bolted to chases dressed in the stone and covered with a concrete jacket to protect the masonry. After this had set, a new grillage was placed under one end of the footing and no further work has been required. In other cases old brick arches were condemned on account of apparent signs of failure. On investigation, however, it was found the trouble was in the footings. These were reinforced, and the arches are likely to continue in service indefinitely.

Material for Water Tanks

Wooden tanks were advocated strongly in a paper by C. R. Knowles, superintendent of water service, Illinois Central R.R. High cost of steel and prohibition of supply of steel for tanks make wood economical, he said. Wood-stave pipe of small diameter was suggested also as a possible substitute for iron pipe in some cases. Little was said as to concrete tanks. Discussion brought out reference to many long-life wood tanks and to troubles with modern steel hoops as compared with old-time wrought-iron hoops. Methods of frost-proofing where temperatures go far below zero were also discussed.

Bridge decks and guards were the subject of a brief report which advocated the use of tie-plates on bridge ties and stated that at least one railway places them also under the inside guard rails. Standard spacing of girders and stringers was recommended, so as to permit of uniform length of ties and uniform spacing of outer guard timbers.

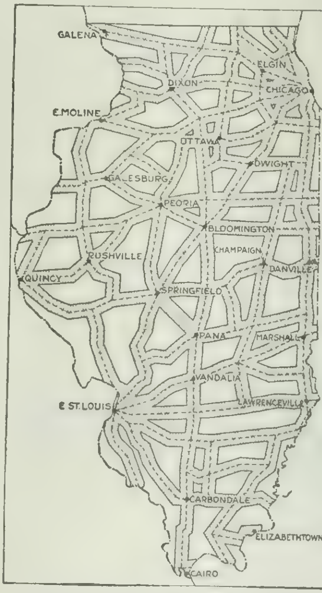
Labor-saving devices in use by bridge and building forces were noted in another report.

Lee Jutton, division engineer, Chicago & North Western Ry., was elected president; C. A. Lichty, Chicago, is secretary. The next meeting is to be held at Cleveland.

Illinois to Vote on Great Highway System

$60,000,000 Bond Issue Planned to Put 85 Per Cent of Population Within Five Miles of Roads

A great after-the-war project for good-road work in Illinois comes up for decision on Nov. 5 when the public will vote on a $60,000,000 bond issue for a 4800-mile hard-surface road system. A strenuous campaign of education has been under way for six months by an organization created for the purpose, for it is believed that although the project has merit in every way people will not vote for additional expenditures in these times unless for some



EIGHTY-FIVE PER CENT. OF PEOPLE IN ILLINOIS LIVE WITHIN FIVE MILES OF PROPOSED $60,000,000 ROAD SYSTEM

good reason which is made perfectly clear in their minds. Literally, tons of literature have been distributed. Addresses by the thousand have been made, and organized efforts have been carried into each county, city and town in the state. A 2000-ft. moving picture reel, "Over Unchanged Roads in a World of Change," depicting conditions existing and as they might be, with suitable "sales talk" between scenes, was made last summer. The moving picture outfit traveled 3000 miles, all over the state, guided by engineers, for a month and a half. Ten prints were made up and booked to be shown all over the state. Unfortunately, the educational value will be materially lessened, due to the closing of all moving picture theaters Oct. 15 by the State Board of Health in an attempt to curb the epidemic of influenza. Particular efforts have been made to reach the laboring classes through their unions. Gov. Frank O. Lowden and other notables have been rushed on speaking tours from shipyard to steel mill, from universities to farmers' institutes.

The principal arguments used in these brief talks are as follows: The automobile owner will pay the bills; no additional taxes are to be levied; no bonds will be sold until after the war; $30,000,000, or one-half of the money, will go for labor; 65% of the people live on the roads and 85% of the people live within the five-mile zones paralleling each side of the system; and after-the-war work should be provided for the reconstruction period.

Canada May Have To Ration Electric Power

The seriousness of the electric-power situation in Canada, if the demand is increased, may make it necessary for the Government to resort to rationing, according to an opinion expressed by Sir Henry Drayton, Canadian power controller, at a conference on the power situation held in Toronto, Oct. 18, by the Canadian Manufacturers' Association, Sir Henry Drayton and Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission. It was stated, however, that the rationing of power consumers would not be undertaken except in the greatest emergency.

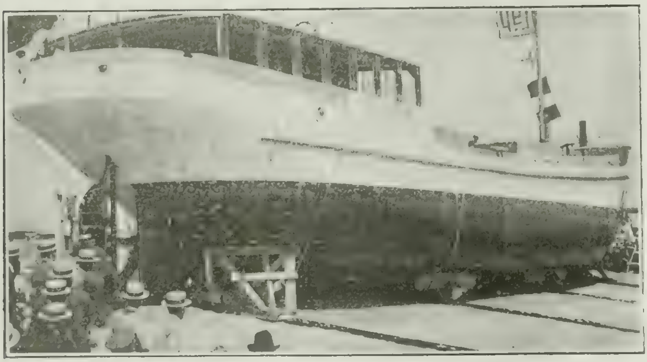
One source of possible relief seemed to be in the curtailment of the quantity of power delivered to the United States, which at present is about 108,000 hp. Sir Henry said he would take the question up with the authorities in Washington, and hoped it might be possible to secure some portion of the power for Canadian consumers. The suggestion of power rationing was opposed by Sir Adam Beck, on the ground that such a restriction would necessitate the laying off of workmen on stated days, adding to the difficulty of manufacturers in maintaining their working forces, which difficulty is already great. He expressed his opinion that if every source of supply, including stream power, were utilized, and consumers coöperated in conserving power, it would be possible, with the additional 50,000 hp. which will be available in a few weeks, to continue as at present without adopting drastic measures.

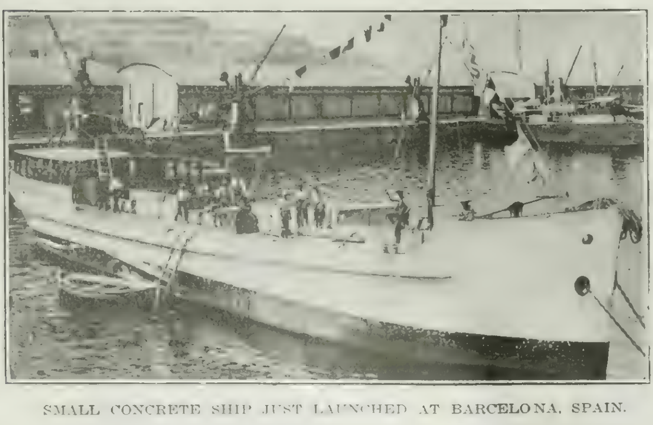
France to Operate Her Railways During Remainder of War

A bill to put the railroads of France under government operation during the remainder of the war, and for a year thereafter, is to be introduced into the Chamber of Deputies, the Council of Ministers having approved such a plan. Hitherto the railroads have been run under the management of their respective boards of directors, subject to a general undertaking to give priority to the transport of all troops and war material.

Experimental Concrete Ship Built in Spain

A small concrete ship, driven by Bolinder oil engines, has recently been launched at Barcelona, Spain, by the Construcciones y Pavimentos Co., a well-known Spanish concrete construction firm. The two views show the ship, on the ways just previous to its side launching, and in its berth after launching. The size of the boat has not been reported by its builders, but it appears to be about 200 tons burden. It was built as an experiment, and the announcement is made that the success of the trial is such that the company will start the construction of 1200-ton boats.





SMALL CONCRETE SHIP JUST LAUNCHED AT BARCELONA, SPAIN.

Central Repair Units for Motor Transport Corps

War Department Divides United States Into Districts for Upkeep of Its Motor Equipment

Division of continental United States into six districts, each of which will be served by a central repair unit, to facilitate the maintenance of the motor equipment used in this country, is covered by General Order 86, issued by the Army General Staff. New machines only are sent to the American Expeditionary Forces, but, in order that the steady flow of them may be maintained at a maximum, the old trucks that serve the Army's needs here must be kept in service as long as possible. The new district system will greatly facilitate repairs and reconstruction, and it will be the policy of the Motor Transport Corps to discourage major repairs at any points other than the central units.

Each district is to be commanded by a district motor transport officer, to be appointed by the chief of the corps. He will have, under the authority of the chief, control and supervision of all matters pertaining to the operation, maintenance and repair of class 1 vehicles and a technical supervision of class 2 vehicles. Class 2 vehicles are those assigned to various units outside the corps. The corps is responsible only for their repair and maintenance. Class 1 consists of all vehicles operated directly by the corps and also the new trucks that are moved from the factories to the seaboard in convoy, relieving the railroads by moving under their own power and by loading with Government freight. Thousands of tons are being moved in this way all the time, states the order.

The repair units are located at Camp Holabird, Baltimore; Atlanta; Fort Sam Houston, Texas; El Paso, Texas; Chicago, and San Francisco. The most important one is that at Camp Holabird, because it serves the largest district and the one that contains nearly all the important truck factories and all the principal ports of embarkation for France. The states in this district are: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Virginia, Kentucky, Ohio, Indiana, Michigan (lower peninsula) and the District of Columbia.

Water-Works Experience Meeting

The opening meeting of the New York Section of the American Water-Works Association, Oct. 16, was devoted to practical experiences. A new feature was an exhibit of models of various important structures connected with the Catskill Aqueduct.

In the enforced absence of George C. Andrews, water commissioner of Buffalo, E. D. Case, manager, the Pitometer Co., New York City, outlined the water-waste survey, now being carried on in Buffalo, which has resulted in a material reduction in water consumption and waste.

John M. Diven, secretary of the association, spoke briefly of the vigorous canvass of water consumption and waste which is being undertaken by the United States Fuel Administration. He thought that this survey will accomplish more to reduce consumption and excessive coal use than many years of effort of water-works men. If necessary, the Fuel Administration will issue notices to water-wasting cities limiting the amount of coal that they may use at their water-works pumping stations during the coming winter.

Aviation Corps Has Problem for Instrument Men

The need for a special compass, which could be placed near the outer end of an airplane wing and at the same time could be read from the driver's seat, is pointed out in a circular issued by the invention section, General Staff, Army War College, Washington, D. C., which invites ideas and suggestions. It is explained that on night bombing expeditions and even in the day time, when passing through fog or clouds, an airplane is guided entirely by compass. Unfortunately, the instruments now in use, placed where the aviator

can see them, are directly between him and the engine, a position which greatly affects their accuracy.

If a compass could be placed near the outer end of a wing, or at the rear end of the fusilage, it would be practically outside of the magnetic influence of the engine, but at present there is no way to read a compass in either of those positions. What is needed is some device or arrangement whereby a compass can be mounted far enough away from the engine to be outside of its magnetic influence, and still be so arranged that it can be easily read by the aviator.

Ideas and suggestions should be sent to the invention section, General Staff, Army War College, Washington, D. C.

Plan Motor-Truck Highway Along Chicago Drainage Canal

After-war construction of 50 miles of hard roads leading out of Chicago, and intended specially for motor-truck freight haulage, is the plan of the Sanitary District of Chicago. This will utilize the unoccupied right-of-way of the drainage canals and the piles of waste rock remaining from the original excavation. There would be a 30-mile route along the main drainage channel from Chicago to Joliet, a 10-mile line along the Sag channel to South Chicago, and an 8-mile line along the North Shore channel to Wilmette. A committee has been appointed to take up the matter with the public authorities and, if necessary, to obtain legislation granting power for the construction of these roads.

To Study Port Improvements at Vancouver

Vancouver, B. C., is to be studied by the Canadian Government with a view to improving its port facilities. The Minister of Marine and Fisheries has decided to send A. D. Swan, harbor engineer, to Vancouver to report on a policy of local harbor development and equipment to cover the requirements of the port for the next twenty years. Greater wharfage facilities are seriously required, and appliances such as traveling cranes are needed. The construction of a terminal railway to connect up the main harbor with English Bay and False Creek is projected, and also the construction of a series of wharves on the English Bay harbor, which has hitherto been neglected for shipping

Motor Trucks Prominent in Forest Fire Relief Work

In the forest fires which took place in the Moose Lake district in northern Minnesota, during the week beginning Oct. 12, many villages being destroyed and several hundred lives lost, relief rendered by automobiles and motor trucks through the Minnesota Motor Reserve Corps was credited with being the most valuable aid employed in fire-fighting and relief work in the district, according to a statement made by Attorney General Clifford L. Hilton on his return from the fire zone.

Army Construction Division Wants Surveyors

Announcement has been made by the United States Civil Service Commission in Washington that the Construction Division of the Army is in urgent need of a number of surveyors. Present calls are for 50 chiefs of survey party, at $2700 to $3000 a year, 50 transitmen at $2400 a year, 25 levelmen at $2100 a year, 125 rodmen at $1800 a year, 150 chainmen at $1800 a year, and 50 topographic draftsmen at $2100 a year. These positions are open to men only, except the drafting positions, which are open to both men and women. All the positions are in the civil, not the military, service.

Persons interested should apply to the United States Civil Service Commission, Washington, D. C., or to the secretary of the local board of civil service examiners in Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle or San Francisco. Applicants will not be required to undergo a written examination, the examinations being of the nonassembled type; that is, the ratings will be based upon education, training, experience and physical ability, as shown by the application and corroborative evidence.

Federal Government Helps Locate Bankhead Highway

Federal Government highway interests are represented upon the Bankhead Highway Location Commission by M. O. Eldridge, of the Office of Public Roads and Rural Engineering, according to an announcement made by J. A. Rountree, secretary of the Bankhead National Highway Association. The commission, which will locate the highway between Memphis, Tenn., and El Paso, Tex., consists of four representative and disinterested citizens living east of the Mississippi River, and this member from the Office of Public Roads.

Work has been started already, a beginning having been made at Memphis Oct. 15. Several routes are suggested between the various cities connected, and it will be the duty of the commission to select the most desirable of these. Mr. Rountree will be in charge of the party on a trip which will take about five weeks.

Camp Mills To Be Made Permanent Cantonment

The plans for transforming Camp Mills, Garden City, L. I., from a tent city into a permanent cantonment, involve an estimated cost of $13,000,000, which includes an item of $2,500,000 for a 2500-bed hospital that is to be located at Mineola. According to plans, the camp will have accommodations for 50,000 men, which is five to fifteen thousand greater than any of the original cantonments. It is said that the explanation of any increased cost that is noted in the estimate for Camp Mills lies largely in the increased labor cost over that which obtained a year ago, but that this is not large when the fact is considered that a larger number of men are to be housed in Camp Mills than in any of the other cantonments. It is pointed out that the 16 original cantonments cost from $6,000,000 to $12,000,000 each, instead of $3,000,000 as originally estimated.

The construction at Camp Mills is to be lumber and not brick.

Cleveland Society Opens Doors to Other Organizations

By a vote of 142 to 7, the Cleveland Engineering Society has changed its constitution so that it may now have joint members with any other engineering or technical organization in the United States or Canada. Details of arrangements as to splitting of entrance fee and dues are left open so that they may be suited to the occasion. A special feature is that no initiation fee is to be charged an applicant if he has already paid one to another society. As to qualifications, joint members become members on application and election, as provided for any other applicant.

This action ratifies the joint arrangement effected some months ago by the board of directors with the American Association of Engineers.

Research Council Wants Information on Laboratories

The Engineering Foundation and the National Research Council are cooperating in the compilation of information concerning research laboratories throughout the country, and in the promotion of industrial research. It is the purpose to aid the Government and the war industries through the advancement of American industry, engineering and science. To this end all laboratories are requested to send to the New York office of the Research Council a brief statement covering the following: Equipment; capacity for research work, and members of staff.

ENGINEERING SOCIETIES

The Iowa Section of the American Water-Works Association has indefinitely postponed its fourth annual meeting, on account of the influenza epidemic. The meeting was to be held Oct. 23-24 in Iowa City, as mentioned in *Engineering News-Record* of Oct. 3, p. 648.

The Kentucky Highway Engineers' Association, formerly the Kentucky County Road Engineers' Association, will hold its annual convention Nov. 12-14 at Owensboro. It is planned to have only a few of the addresses made indoors, but to have practically everything that pertains to the building and maintenance of roads delivered in the open on the road where the work is in progress. The program includes out-

Calendar

Annual Meetings

CITY MANAGERS' ASSOCIATION; Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

door lectures on the following subjects: "Macadam Maintenance"; "Ditching on Surfaced Roads;" "Earth-Road Maintenance and Ditching"; "River-Gravel Road Construction and Maintenance"; "Bank-Gravel Road Maintenance and Construction"; "Bridge Painting" and "Rock-Asphalt Surfacing."

The San Francisco Association of Members of the American Society of Civil Engineers was addressed at the meeting Oct. 15 by Herman Schussler, who delivered an illustrated talk on "The Construction of the Copco Dam on Klamath River." Mr. Schussler described interesting tests of concrete and other materials, the largest gate valves ever built on the Pacific Coast, and general features of California's latest hydro-electric development.

The New York State Waterways Association will hold its ninth annual meeting Nov. 7-8 in Brooklyn, under the auspices of the Brooklyn Chamber of Commerce. United States Senator William M. Calder of New York and James Sherlock Davis, president of the Brooklyn Chamber of Commerce, are included in the list of speakers. Senator Henry W. Hill of Buffalo is president of the association and Edwin T. Coffin of Albany is secretary.

The Detroit Engineering Society will be addressed Nov. 8 by Lieut. G. I. Back, technical adviser in the training department of the course for telephone electricians, University of Michigan, who will speak on the work of the Signal Corps. The meeting will be held under the auspices of the American Institute of Electrical Engineers, members of the Detroit Engineering Society being invited.

The Houston Engineers' Club, Houston, Tex., at its annual meeting Oct. 10, was addressed by Prof. A. Deussen on "The Origin and Production of Petroleum." The following officers were elected: President, J. C. McVea; first vice-president, F. C. Smith; secretary-treasurer, F. P. Risdon.

The Engineering Society of St. Paul was addressed by L. P. Wolff on "The Engineering Features of Camp Dodge," at the meeting Oct. 14.

Personal Notes

L. C. FRITCH, formerly general manager of the Seaboard Air Line Ry., has been elected vice president of the corporation of the Rock Island lines, and also vice-president of the Minneapolis & St. Louis R.R. Co. Mr. Fritch, past president and one of the founders of the American Railway Engineering Association, was chief engineer of the Chicago Great Western R.R. from 1909 to 1914. In the latter year he was appointed assistant to the president of the Canadian Northern Ry., and the following year was made general manager of the eastern lines. Subsequently he went to the Seaboard Air Line Ry. as general manager, remaining at that post until a few months ago, when a Federal manager was appointed by the Railroad Administration.

L. F. LOREE, chairman of the board of directors of the Kansas City Southern Ry., has been elected president. Mr. Loree is an engineer and was in engineering work about 12 years before going into railroad operation.

MAJ. G. B. STRICKLER, Construction Division, U. S. A., who was commissioned in July, 1917, has been promoted to the rank of lieutenant colonel and assigned to duty as constructing quartermaster, Camp Hancock, Augusta, Ga.

H. D. HAMMOND has resigned as managing editor of *Engineering News-Record* to join the forces of the Lakewood Engineering Co., with headquarters in Philadelphia. Mr. Hammond studied for two years at Vanderbilt University, Nashville, Tenn., and later at the Sheffield Scientific School, Yale University, from which he was graduated with the degree of Ph.B. in 1908. He entered the engineering field in 1909 with the Foundation Co. in New York City, where, except for a few months with the American Bridge Co. he remained until 1914. He joined the editorial staff of *Engineering Record* in 1915 and his work since that time has been largely in the construction field.

C. LOOMIS ALLEN, who has retired from the firm of Allen & Peck, Inc., engineers and managers of public utilities, Syracuse, N. Y. and Baltimore, as mentioned in these columns last week, has entered private practice, under his own name, in general engineering and management of public utilities, with offices in the Vinney Building, Syracuse.

W. C. CURD, contracting engineer for the Layne & Bowler Co., Memphis, Tenn., has resigned to enter the service of the William Graver Tank Works, Chicago. Mr. Curd, who was educated at Purdue University, was in the employ successively of the Southern, Louisville & Nashville, Union Pacific and Missouri Pacific railways, before going to the railroad department of the Layne & Bowler Co. He was with the Missouri Pacific Ry. 11 years, first as assistant engineer and later as drainage engineer.

A. A. MILLER, engineer maintenance of way of the Missouri Pacific Ry. at Little Rock, Ark., has been transferred to Kansas City and his title has been changed to district engineer. He succeeds J. R. Leighty, whose appointment as chief engineer of the corporation was noted in these columns Oct. 10.

C. S. HERITAGE, bridge engineer, and R. E. Van Atta, principal assistant engineer of the Kansas City Southern R.R., have had their jurisdiction extended to include the Missouri & North Arkansas R.R. Their offices remain at Kansas City, Mo.

LIEUT. D. A. TOMLINSON, coast artillery, Fort Monroe, Virginia, who was formerly assistant engineer, Chicago & Western Indiana Ry., has been promoted to the rank of captain.

W. M. NEPTUNE, assistant engineer of the Missouri Pacific Ry. at St. Louis, has been appointed principal assistant engineer, with charge of drainage, flood and river protection.

MILTON J. RUARK, chief of the municipal bureau of drafting, Baltimore, has been appointed engineer in charge of sewers and will be attached to the highway engineer's department. Mr. Ruark's headquarters will be in the health department building. He succeeds Thomas D. Pitts, who resigned several months ago, as mentioned in these columns, to enter the service of the United States Shipping Board.

CAPT. CHARLES T. LEEDS, Corps of Engineers, has been promoted to the rank of major and assigned to duty as district military inspector for the territory including California, Nevada and Utah.

J. A. LAHMER, drainage engineer of the Missouri Pacific Ry. at St. Louis, has been appointed district engineer at Little Rock, Ark. He succeeds A. A. Miller, the title being changed from engineer maintenance of way to district engineer.

T. L. PHILLIPS has been appointed division engineer of the western division of the Western Pacific R.R., with headquarters at Sacramento, Cal.

LIEUT. COL. WILLIAM BARCLAY PARSONS, of New York City, has been promoted to colonel of engineers, and is now in command of the Eleventh Engineers at the front. This is one of the early railroad regiments

which went over to France the beginning of last summer Colonel Parsons has been attached to it since that time.

V. V. KIRKPATRICK has been appointed valuation engineer of the Missouri & North Arkansas R.R., with office at Kansas City, Mo.

EDGAR B. THOMAS, member of the committee on development of the American Society of Civil Engineers, mentioned in *Engineering News-Record* of Oct. 10, p. 688, as having advanced in the city engineering department of Cleveland from transitman to chief engineer, should have been mentioned as having advanced from transitman to engineer in charge of the river and harbor development department, which is a subdepartment under the chief engineer.

H. J. ARMSTRONG has been appointed division engineer of the Missouri & North Arkansas R.R., at Harrison, Ark.

G. H. BALLANTYNE has been appointed division engineer of the eastern division of the Western Pacific R.R., and has jurisdiction also over the Deep Creek R.R. His office is at Elko, Nev.

OBITUARY

LIEUT. CHESTER H. PLIMPTON, 21st Railway Engineers, who was previously plant engineer for the American Malleables Co., Lancaster, N. Y., was killed in action Sept. 27. He was 25 years old and a graduate of Yale University in the class of 1914.

LIEUT. ROBERT JOHNSTON, a civil engineer lent to the Canadian Government by the United States in connection with the construction of naval air stations on the coast, died in Ottawa, Oct. 14.

WILLIAM ARTHUR O'BRIEN, chief engineer of the Little River Drainage District, Cape Girardeau, Mo., died from influenza Oct. 12, at the age of 35. Mr. O'Brien entered engineering work in 1903 as a rodman and instrumentman for the Terminal R.R. of St. Louis, soon afterward going to the Chicago, Peoria & St. Louis Ry. as assistant engineer. From 1906 to 1907 he was assistant instructor in railway engineering at Purdue University, after which he became assistant engineer for the Terminal R.R. of St. Louis. In 1908 he became principal assistant engineer of the Little River Drainage District and shortly afterward became a member of the board of engineers on this work, which involved the reclamation of 550,000 acres of land in southeastern Missouri. From 1909 to 1910 he was chief engineer of the Chicago, Peoria & St. Louis Ry. He became chief engineer of the Little River Drainage District in 1910.

LEONARD S. CAIRNS, general manager of the Eastern Pennsylvania Railways Co., died Oct. 10, at Pottsville, Penn. He was 36 years of age. For a number of years Mr. Cairns was general superintendent of the Twin City Rapid Transit Co., of Minneapolis and St. Paul. In 1912 he resigned from the operating organization of that company to join the staff of the J. G. White Management Corporation, New York City, and was assigned to the position of assistant general manager of the Manila Electric Railroad & Light Co., Manila, P. I. He was promoted by the management corporation in 1917 to the office of general manager of the Eastern Pennsylvania Railways Company.

A. N. BULLITT, who was assistant chief engineer of construction for the St. Louis-San Francisco system from 1894 to 1904, died in Memphis, Tenn., Oct. 8. He was resident engineer in charge of the construction of the Arkansas River bridge at Little Rock. After 1904 he was chief engineer of construction for the Mobile, Jackson & Kansas City Ry. and the Gulf & Chicago Ry. Until the merger with the Norfolk & Southern he was in the service of the Virginia-Carolina Coast Ry. He went to Memphis several years ago to engage in municipal improvement work, specializing in the construction of drainage tunnels. During the last two years of his life he was engaged in highway construction work. Recently he completed a 21-mile highway in Mississippi.

JULIUS L. JACOBS, southern manager for James Stewart & Co., contractors, died of pneumonia at Norfolk, Va., Oct. 2. Mr. Jacobs was born in Texas in 1882 and was graduated with the degree of B. Sc. from the University of Texas at the early age of 17. He then entered Cornell University and was graduated with the degree of C. E. in 1904. After three years of railway work he entered the employ of James Stewart & Co. in February, 1907, and at the time of his death was in charge of the many contracts of that company in the Hampton Roads district.

OGDEN MERRILL, of the firm of Merrill-Ruckgaber Co., contracting engineers, New York City, died Oct. 5. After his graduation from Cornell University in 1899 Mr. Merrill entered engineering work as a rodman for the Arthur McMullen Co. of New York City, later serving as draftsman and inspector for the construction department of the American Smelting & Refining Co. From 1901-02 he served as engineer on the Park Ave. tunnel of the New York subway system under Ira A. Shaler, after which he became associated with the United Engineering & Contracting Co. as engineer and superintendent of the electric pumping station at the Brooklyn Navy Yard. Later he was engaged by the Pennsylvania R.R. as engineer and superintendent on tunnels under the North River, and was with the New York Tunnel Co. in the same capacity on tunnels under the East River for the Rapid Transit Commission. Mr. Merrill had been president of the firm of Merrill-Ruckgaber Co. since 1908.

REID TULL, county highway engineer, Spartanburg, S. C., died at his home in that city Oct. 3. Mr. Tull was 33 years old and a graduate of the North Carolina Agricultural and Mechanical College. After his graduation he spent several years in the West with the United States Geological Survey, after which he was engaged by the Southern Power Co. in locating the line of the Piedmont & Northern Electric Ry. in Virginia. Before his election as city engineer of Spartanburg in 1913 he was resident engineer for the Greenville, Spartanburg & Anderson Ry. He became county highway engineer in 1917.

WILLIAM STEYH, for a number of years city engineer of Burlington, Iowa, died at Sterling, Colo., Oct. 6. At the time of his death Mr. Steyh was in the service of the Chicago, Burlington & Quincy R.R. He was born in Germany in 1845 and came to this country at the age of 21; from that time he made his home in Burlington.

DR. CHARLES S. CAVERLY, professor of hygiene, college of medicine, University of Vermont, and president of the State Board of Health since 1891, died in Rutland, Oct. 16, at the age of 62.

FREDERICK M. DICKIE, editor of the *Pacific Marine Review*, died of appendicitis at his home in San Mateo, Cal., Oct. 11. Mr. Dickie was 35 years of age and a native of San Francisco. He was a son of the late George W. Dickie, naval architect and marine engineer, whose death was noted in *Engineering News-Record* of Aug. 29, p. 427.

J. C. NELSON, engineer maintenance of way of the Seaboard Air Line Ry. at Norfolk, Va., died Oct. 6.

HENRY J. WIDENMANN, member of the California Highway Commission, died Oct. 4 as a result of a hunting accident. Mr. Widenmann succeeded the Hon. Charles D. Blaney, who resigned in 1917.

LOUIS H. MATHER, superintendent of construction for the city of Norwich, Conn., gas and electrical department for the past year, died in that city Oct. 2, in his 34th year. Mr. Mather severed his connection with Stone & Webster Co., New London, two years ago, after having been associated with that company for 12 years.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Merchant Marine Creates Need for Consuls

Large Tonnage Available After the War Brings Demand for Larger and Better Paid Consular Force

After a study of our rapidly growing merchant marine and the enormous tonnage that will be available after the war, Edward N. Hurley, chairman of the United States Shipping Board, urges the need for more consuls. They will be necessary to take care of the many details incident to the handling of our foreign trade by this merchant marine. He gives the facts to the nation so that an intelligent opinion may guide Congress when appropriations for the consular service are made this winter.

The United States will have approximately 25,000,000 tons of merchant shipping within two years. Every ton that is delivered now goes into the service to France, but if peace comes soon and this present tonnage is scattered over the world's trade routes, the consular service will be inadequate to handle the business that will result. Not only will there be an insufficiency of men in the consulates, but those that are at work are handicapped by obsolete shipping regulations and in many cases by lack of experience. The lack arises from the fact that until the war brought on a shortage of ships from the European trade and forced American ships into the trans-Atlantic trade, the American flag was rarely seen on any vessel. At Queenstown, Ireland, one of the greatest ports of call in the world, no vessel carrying the American flag had touched in more than nine years until early in 1915, and this is true of other great ports abroad and illustrates the shipping decadence now being remedied.

"Of course, there is no question about the high character of our consular service," said Mr. Hurley, "but we have some splendid officials abroad working at salaries far below what they might obtain by leaving the service and entering private employ. There are not enough of them and they are not justly compensated, and several consuls have died or broken down in health during the past year under the strain of overwork imposed upon them by war conditions."

Mr. Hurley states that there is not only a need for more consuls and larger consular staffs to carry on the increased burden of work, but there must be more adequate compensation and a revision of the shipping regulations and other laws and forms that now obtain. These regulations and customs, established at a time when the United States merchant marine consisted of sailing vessels, are therefore obsolete. Chairman Hurley makes this appeal to the country so that when Congress appropriates money to cover the work for the coming year, it will be sufficient to call to the service men of highest education, business and technical experience. "We might look to Great Britain for an example of straight thinking and enterprise in the matter," he asserts. "Despite more than four years of struggle for her national life, she has kept her industries alive, given the best possible service to her customers all over the world, and designs an orderly scheme for reconstruction after the war."

Fuel Priority List Names Only Some Industries Affected

That only a partial list of industrial products is covered in the preference list, issued by the Priorities Committee, on which is based the distribution of fuel, is indicated in a recent bulletin issued by the War Industries Board. It states that priority is being administered generally on iron and steel products, copper and brass products, electrical equipment and the products in which any of these forms an important part. Priority is not being administered at this time on lumber or lumber products, paper or paper products, chemicals, cement, lime, hides, pig tin, tin plates, lime products and other products—the list is too long, the bulletin states, for the giving of complete details. It states that even in the articles mentioned, exceptions will sometimes occur, and recommends that inquiries be addressed to the Priorities Committee of the War Industries Board in respect to any doubtful commodities.

Munitions Patent Board Created by War and Navy Departments

The War and Navy Departments of Washington have established the Munitions Patent Board for the purpose of coördinating the policies of the two departments in patent matters. The membership of the board consists of the Hon. Thomas Ewing, the joint selection of the two departments; Max Thelen, the representative of the War Department, and Pickens Neagle, representing the Navy Department.

The board was formed to consider and adjust patent clauses in contracts, infringement claims, patentability of inventions, compensation for the use of patents, and other miscellaneous questions as to patents which may arise in the two departments. The actions of the board on such matters are subject to the final approval of the Secretary of War and the Secretary of the Navy.

Foreign Demand for American Ready-Built Houses

Interest in American ready-built houses has been expressed in both France and England, according to a report made by John R. Walker, lumber trade commissioner, reported in *Commerce Reports* by the United States Department of Commerce. The report states that manufacturers of such houses who are interested in the European market are requested to send their catalogues to the Bureau of Foreign and Domestic Commerce for transmission to Mr. Walker, so that the latter may be in a better position to answer inquiries.

Labor Department Issues Book Regarding Employment Offices

The bureau of labor statistics, United States Department of Labor, has issued a 100-p. bulletin, No. 241, entitled "Public Employment Offices in the United States." The bulletin is a report of a study made by the United States Bureau of Labor Statistics at the request of a number of organizations throughout the country. It was requested that private as well as public employment agencies throughout the country be studied, but this report covers only the public employment agencies.

The book gives information regarding employment through these public offices, illustrations of employment forms, tabulation of employment headquarters throughout the United States, and other information in tabular form.

Women for State Organizations of Employment Service

Two women, one representative of management and one representative of labor, are to be added to each state advisory board of the United States Employment Service, bringing the total membership of each of these boards from five to seven, and thereby giving women a large share of the responsibility for the administration of the war labor supply program. Hitherto the state advisory boards have been composed of the state director of the Employment Service as chairman, two representatives of management, and two of labor.

Two women are now being added to the original membership of every community labor board, with full voting powers upon all questions coming within the jurisdiction of the board. This changes the personnel of these boards to one man and one woman, each representative of local management, and one man and one woman, each representative of local labor, in addition to one local representative of the Employment Service as chairman.

Ruling Simplifies Export License Procedure

Certain Licenses Will Embody Both Priority Release and Steel Supply Permit

The procedure with respect to export licenses, priority certificates and permits from the Director of Steel Supply for the exportation of commodities has been simplified by a recent ruling (W.T.B.R. 258) of the War Industries and War Trade Boards. It is accomplished by the withdrawal of War Industries Board regulations published July 3, in P. C. form No. 18.

To the application for the license (form X), there should be attached such supplemental information sheets as may be required by the rules and regulations of the War Trade Board in connection with shipments of certain commodities to certain countries and the new supplemental information sheet, form X-26, which was issued by the War Trade Board on Oct. 14. It is announced that applications which have form X-26 attached will not require form X-2.

Priority classification C has been awarded to all articles (on which priorities are issued) which are on the export conservation list of the War Trade Board and covered by export licenses issued on and after Oct. 16. It is stated that the license itself will be evidence that the articles covered by it have been automatically awarded priority classification C. Export licenses, for commodities bearing a higher classification than C must be accompanied by the proper priority certificate and will be forwarded with the export license by the priorities committee without further request from the applicant. Licenses for the exportation of iron and steel especially, or products and manufactures thereof, which are not covered by a specific priority certificate, will in themselves constitute a permit and approval from the Director of Steel Supply for the filling of the orders.

It has been found that manufacturers, have made articles useless for domestic consumption, for specific export orders, before obtaining export licenses, which articles could not be exported under the regulations of the War Trade Board. The notice states that it is essential for the proper conservation of commodities in the United States, that this practice be discontinued, and licenses will be refused to exporters who do not conform to this policy.

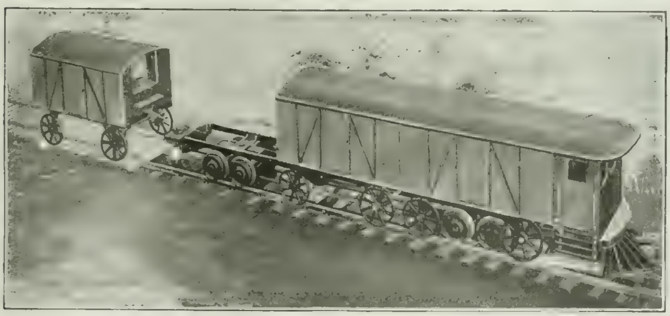
Schedule XP, to which this ruling especially applies, includes pig iron, iron and steel scrap, ingot, billet, fabricated structural steel of various sizes, various classes of plates, and sheets, oil well casing, line pipe, various pipe of cast iron, wrought iron, etc.

Rail Wagon Eliminates Rehandling of Freight

A new method of freight collection, haulage and delivery, to do away with rehandling in transit, is to be tested on lines of the Public Service Ry. in New Jersey, if the recommendations of a committee of manufacturing and operating engineers are carried out. It consists essentially of the use of wagons or vans wide enough to be carried astride special railroad carrier cars. The wagons can thus be loaded by the shipper and unloaded by the consignee without intermediate handling or the provision of warehouse facilities.

The "rail wagon" has a body about 16 x 7 x 7 ft., with a capacity of 5 tons. It can be either horse-drawn or motor-driven. The "carrier car" may be either a self-contained gasoline or electric motor car or a trailer car. Its essential features are a low frame that will pass under the rail wagon when it is astride the track, and a jacking device, operated by the air-brake system, for raising the rail wagons clear of the tracks. For the movement of the rail wagons to and from the railroad a third element of the system has been designed—an "auto-hoss," which carries the wagon in the same manner in which it is carried on the railway.

The system is known as the "Bonner Rail-Wagon System." The statement is made that it has been under development for three years, and that the committee that recommended the tests has pronounced it fundamentally sound. The plan is to test it on a line from Paterson to Hoboken, N. J., and also via the Hudson & Manhattan R.R. into New York City.



RAIL WAGONS ARE CARRIED ASTRIDE SPECIAL CAR FRAMES

Business Notes

J. C. Fitzpatrick, formerly manager of the construction machinery department of Gaston, Williams & Wigmore, Inc., 39 Broadway, New York City, has resigned to accept the position of assistant to the president of the American Condenser & Engineering Corporation, 120 Broadway, New York City.

William S. Cetti, representing the Thomson Meter Co., Brooklyn, N. Y., for several years, has resigned his position and announces that his present address is 221 Eastern Parkway, Brooklyn, N. Y.

The Portland Cement Pipe & Tile Co., Portland, Ore., and The Concrete Pipe Works, Vancouver, Wash., have pooled their interests under the name of the Concrete Pipe Co., with principal offices in the Board of Trade Building, Portland. The Concrete Pipe Works had plants at Vancouver, Tacoma and Walla Walla, Wash., and these plants, together with the Portland plant, will be rearranged and enlarged to meet the increasing demands for concrete culvert, sewer, irrigation and drainage pipe.

Trade Publications

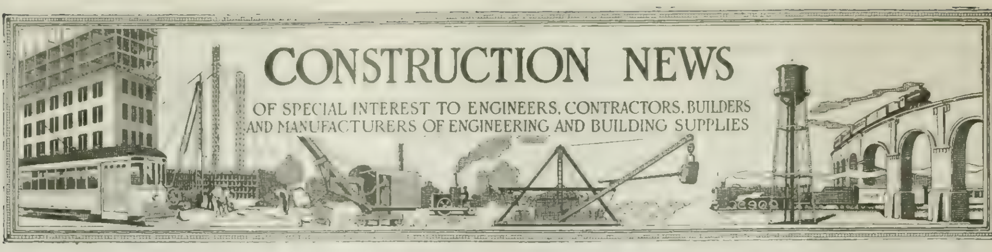
The Beaumont Manufacturing Co., Philadelphia, has issued catalogue 37, giving descriptions, illustrations and dimensions of standard Beaumont gates for controlling the flow of granular material from bunkers. The design of ashpits under boilers and the correct gates to use for this purpose are illustrated.

The White Co., Cleveland, Ohio, has published an 8-p. pamphlet announcing a double reduction gear drive truck. It is illustrated with halftones of the new axle, together with a general description of the truck.

The Armstrong Cork & Insulation Co., Pittsburgh, has published a 37-p. catalogue entitled "Linotile Floors."

Portable conveyors for handling, transferring and stacking freight are shown in a variety of forms and applications in a 48-p. pamphlet, 6 x 9 in., issued by the Brown Portable Conveying Machinery Co., Chicago.

The General Fire Extinguisher Co. has issued the October bulletin of the Grinnell automatic sprinkler. It is a 16-p. pamphlet dealing with hotel equipment, and is called a "special hotel number."

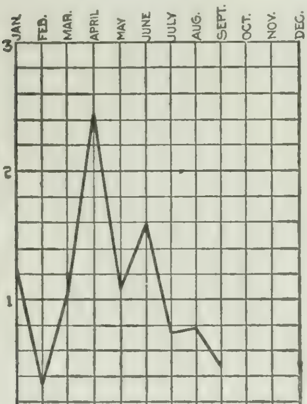


Bridge Business Falls to Unusually Low Levels

Need of Replacement, However, Makes Revival Probable, According to Various Leaders in the Field

A review of bridge contracts let the first nine months of the year, as reported in the construction news section of *Engineering News-Record*, shows not only relatively small totals, but a falling off in the last months to unusually low levels. Business and engineering leaders in the field, however, express the opinion that an improvement in the situation in the first half of 1919 is probable.

In compiling the contracts from all sections of the country, it was found that approximately $4,100,000 worth of concrete contracts were let, $3,000,000 in steel contracts and approximately $3,600,000 worth of miscellaneous contracts. The average of the miscellaneous contracts was about $45,000 each, and that of the steel and concrete combined about $44,000; from which it was assumed that the miscellaneous contracts were about evenly divided between concrete and steel, the wood items being negligible. Dividing the miscellaneous contracts equally between the concrete and steel gives approximately $5,900,000 in concrete work and approximately $4,800,000 in steel work. These figures, however, owing to the present inflation of prices, will probably represent only about two-thirds the volume of business that an equal amount would show before the war, so that, in the case of steel work especially, the volume of business is so small as to be alarming to those making a study of the situation.

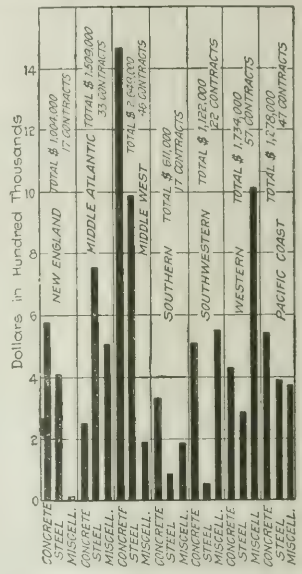


MONTHLY VOLUMES OF BRIDGE WORK

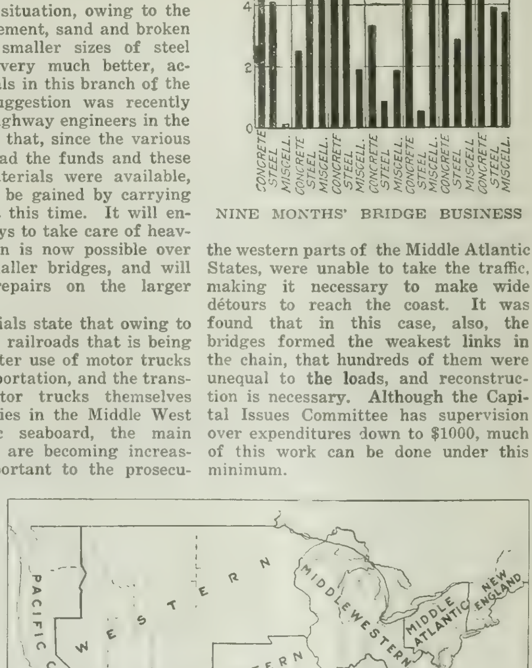
The tremendous war demand for steel, the price of labor and materials soaring to unprecedented levels, and the increasing demand on the railroads for all sorts of transportation, has placed unusually heavy burdens on the railroad bridge business. That the work must be done, however, is evident, since bridges occupy the position of the weak link in a chain in the transportation system.

The highway situation, owing to the availability of cement, sand and broken stone and the smaller sizes of steel reinforcing, is very much better, according to officials in this branch of the industry. A suggestion was recently made by some highway engineers in the cement industry that, since the various municipalities had the funds and these construction materials were available, two ends would be gained by carrying out the work at this time. It will enable the highways to take care of heavier tonnage than is now possible over hundreds of smaller bridges, and will save heavier repairs on the larger bridges later.

Highway officials state that owing to the relief of the railroads that is being effected by greater use of motor trucks in freight transportation, and the transporting of motor trucks themselves from the factories in the Middle West to the Atlantic seaboard, the main highway routes are becoming increasingly more important to the prosecution of the war. When the use of highways for motor trucks was proposed, at the beginning of the war, an investigation was made by the Office of Public Roads, regarding available routes. It was found that, owing to the heavy traffic, the highways, especially in the western parts of the Middle Atlantic States, were unable to take the traffic, making it necessary to make wide détours to reach the coast. It was found that in this case, also, the bridges formed the weakest links in the chain, that hundreds of them were unequal to the loads, and reconstruction is necessary. Although the Capital Issues Committee has supervision over expenditures down to $1000, much of this work can be done under this minimum.



NINE MONTHS' BRIDGE BUSINESS



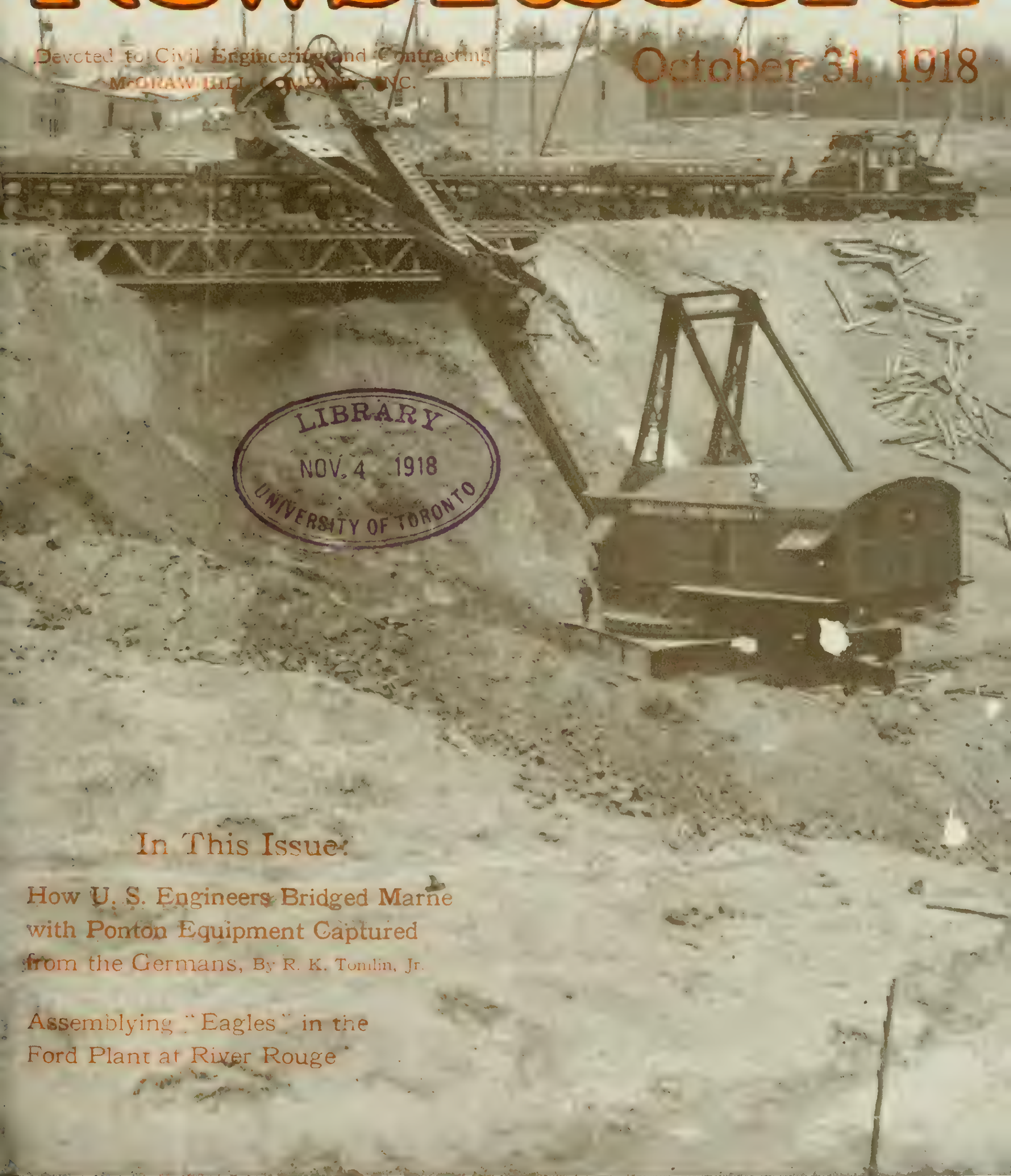
DIVISIONS OF COUNTRY, FOR MAKING COMPARISONS

Engineering News-Record

Devoted to Civil Engineering and Contracting

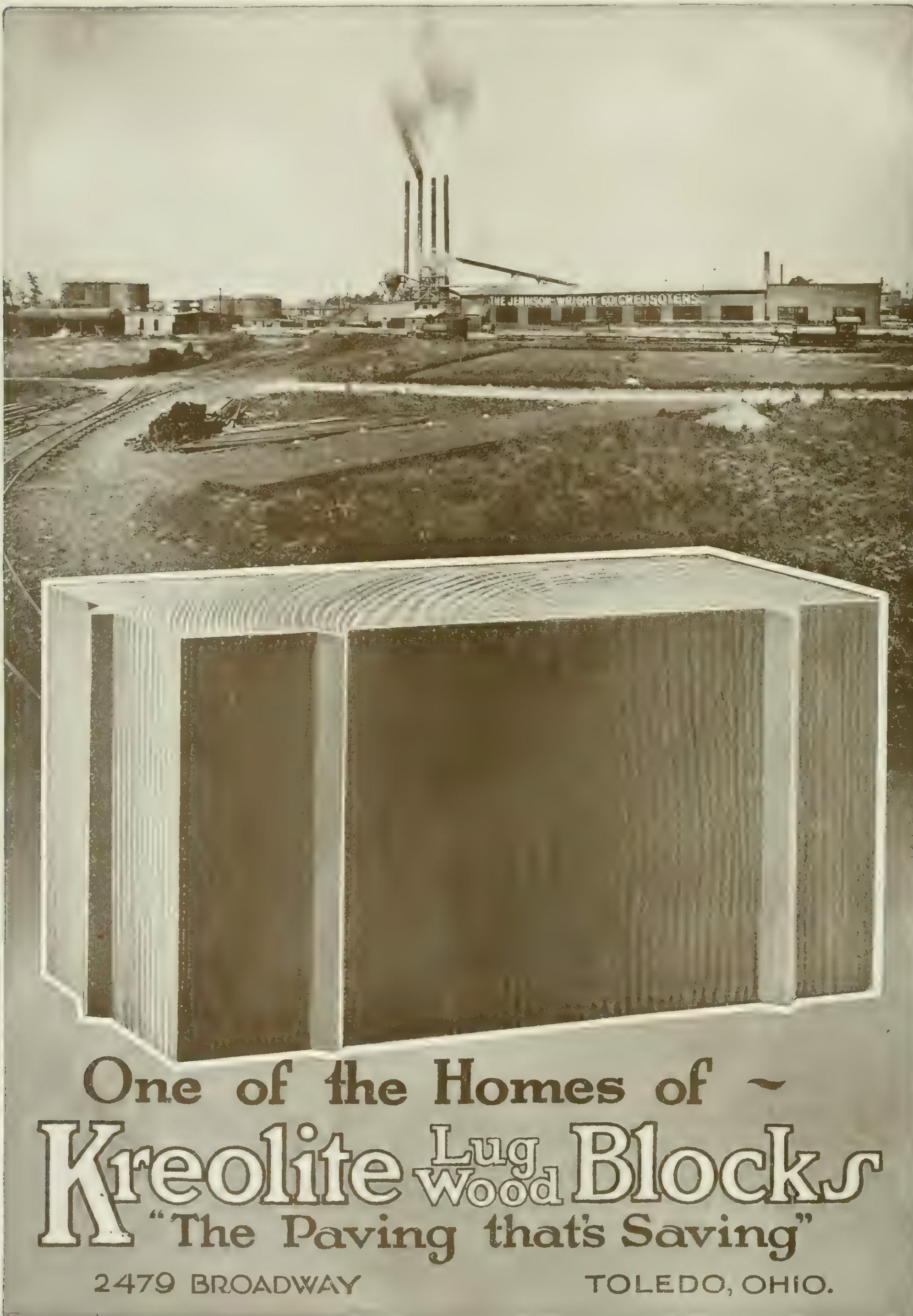
McGRAW-HILL COMPANY, INC.

October 31, 1918



In This Issue:

One of the Mammoth Shovels used in Digging Canal for Rush Hydro-Electric Development at Niagara Falls


THE JENNISON-WRIGHT CO. CREOSOTERS
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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 NEW YORK, THURSDAY, OCTOBER 31, 1918 *Number* 18

Planning For Future Needs

NEW prospects opening each day in the world's rapid progress lay ever-renewed emphasis on the necessity of planning for the morrow and beyond. Such planning, the engineering profession's chief duty, calls for utmost breadth of view. In past months these columns have pointed out time and again the urgent importance of thorough preparation for our country's and the world's war and post-war requirements. Though not more certain, the necessity becomes more obvious as cables, markets and public thought respond to rapidly fluctuating war and end-of-war anticipations. Whatever comes to pass, much planning must be ready for the hands of the doers if there is to be proper continuity of service to the world.

All the Reports Should Be Published

ANOTHER chapter in the history of sewage-treatment projects for Cleveland has been written. The question "Fine Screens or Imhoff Tanks?" discussed editorially in *Engineering News-Record* of Aug. 16, 1917, p. 290, is answered sweepingly in favor of the tanks, as is shown by extracts from Mr. Eddy's report on p. 800, of this issue. Even fine screens followed by activated-sludge treatment are advised against. A service to the engineering profession and to the municipalities of the country would be rendered by the publication in full of Mr. Eddy's report, and of a number of earlier reports dealing with projects for sewage treatment at Cleveland.

Only Washington Knows What is Essential Building

DECENTRALIZATION of the War Industries Board control of building, described on p. 811 of this issue, was a manifest necessity. Once it had been decided that all available building material must be diverted to war use some means had to be provided whereby the prospective builder would be saved the necessity of joining the Washington-bound crowds or of depending on the slender rod of the mails for a decision as to whether what he contemplated was or was not essential. So far as mechanism goes the state Councils of Defense had obvious advantages for agents of the board. They were in existence, were fairly well known and had had experience with the routine of dealing with Washington. Their main deficiency is in their dis-association from the war program. Only those in Washington close to war aims and war programs can decide upon the essentiality of any proposed construction which is not obviously and directly war work. So long as the state bodies refuse licenses to only the obviously unessential, and pass on to Washington the doubtful cases, the system will be effective. If some of them begin to take upon themselves the interpretation of broad questions of essentiality, the War Industries Board will be flooded with appeals and the mediation of the state councils will add to rather than subtract from the difficulties of the new building control.

Repair Economical Under War Conditions

ATTENTION to the repair and reinforcement of bridges and structures, as a means both of economy and of reducing the demand for material and labor for new structures in war time, was the keynote of extended discussions at the Chicago convention of the American Railway Bridge and Building Association. Complementary to this it may be suggested that many abandoned or useless buildings might be wrecked immediately in order to place idle material and equipment in use.

Luxury or Necessity?

WHETHER extensive corporate organizations for the railroads are necessary during the period of Government control seems to have been tacitly answered in the affirmative by the Government in one important case. With the separation of the corporate and operating activities of one of the country's greatest trunk lines the chief engineer and one of the two assistant chief engineers were taken over by the Railroad Administration. The other assistant chief engineer was in France, building railroads, with the commission of colonel. The president of the corporation felt that under the circumstances he simply had to have the colonel as corporate engineer, for the inspection and approval of plans and estimates for improvements and extensions, and for the verification of expenditures in connection with new work, as the costs of the improvements have to be financed by the corporation; and the negotiations that ensued resulted in the honorable release of the colonel from the United States Army. The stockholders doubtless see every reason why this action was necessary. One less in sympathy with the owners could easily assume that they would get their just deserts from the Railroad Administration in the natural

course of events, and that if they desired the luxury of a corporate engineer they must provide him without interfering in any way with war work. There is reason to doubt the wisdom of withdrawing from important duties in France a man who, we are informed, was by no means anxious to be so withdrawn, when so many other capable engineers in lesser positions were to be found on the same railroad; but the action of the Government in recognizing the company's plea for what it considered to be the best protection obtainable shows a commendable desire to be fair to the owners.

Shipbuilding Must Go Forward

WHILE fragmentary and conflicting, the news of its deliberations which the Shipping Board has permitted to go out into press channels during the past week was of such kind as to create anxious expectation and much doubt and uncertainty. Various indeed were the items of news, and none of them of such character as to hearten and stimulate the shipbuilders.

Building wooden ships was to end with the present contracts. Yards were to be closed because they had proved inefficient. Contracts would not be let at present because costs might decrease. Barge contracts were to be cancelled. Reduced steel allotments might be followed by transfers or modifications in steel ship contracts. Each single report was of a kind apt to discourage rather than encourage high-pressure driving of work in the shipyards.

A full clarifying statement from the Board is needed at the earliest possible moment. Subversive changes of policy are in danger of weakening most seriously the intense effort that is being applied to ship production. And just now we are in need of the highest attainable shipbuilding performance.

It would be hard to select a less appropriate time for thrifty speculations as to the possible influence of future cost levels on the shipping policy of today. Shipbuilding must go forward at undiminished speed. Reassurance from the Board concerning the developments at the past week's conference can not come too soon.

Fabrication in the Shipyard

FULLER description of the ship-manufacturing operations in the "Eagle" plant is given on pages 788 to 796 of this issue, supplementing the summarized sketch of the plant and its method printed two weeks ago. As pointed out at that time (page 697), the determining characteristic of the work at River Rouge is the application of factory system to ship construction. It now becomes clearly apparent that a special operating condition made this possible: continuous, full-capacity production of a standardized article.

Service of perfectly definite character was to be performed. Uniform production meant a steady flow of material through all departments, repetitive operations carried on at uniform rate, and standardization throughout. Here is the fundamental distinction between the Eagle plant and the conventional shipyard, where production varies in amount and kind, the flow of material is far from uniform both in direction and in rate, and detail processes are subject to change.

Yet there is an intimate analogy between the two. Considered as shipbuilding machines, they carry out identically the same functions in the same order; their radical dissimilarity in appearance only emphasizes the parallelism. They represent solutions of the same general problem approached from two different sides; the River Rouge plant is a single-purpose machine designed to operate, so to say, at a fixed number of revolutions per minute, while the other is a general-utility device.

Because of its specific service the plant placed a very definite problem before the designer. With operations adapted to fixed routine the consecutive departments could each be planned for definite performance. Laying out a shipyard, on the contrary, where the quantitative duty of no single department is known, is bound to depend on judgment.

Comparison of these two similar and yet different kinds of plant has marked interest in connection with one important development of this year's emergency shipbuilding. Fabricating capacity has proved to be the throttling point in virtually every shipyard; experience showed that berth and erecting capacity are well in excess of shop capacity. Not so in the Eagle plant; there the fabricating shop is easily able to supply the assembly unit under full-capacity operation. This of course is the natural result of designing for a definite plant output. So many ships per week were to be built; the shop had to supply just so much material ready for erection, and consequently required so much fabricating equipment. Proportioning shipyard shops proceeds by less exact methods. Moreover, it is based on operating conditions radically different from those of the present year.

Looking at the fabricating unit more broadly, however, the outstanding feature in any comparison is that the shop of the Eagle plant is a pure service element. Though of impressive size, it is in all respects a subsidiary department, dictating no phase of the assembly or subsequent operations. Placed at one end of the plant, operating under a fixed schedule, and delivering its output of prepared material by direct route, the shop is able to perform its supply function as regularly and unobtrusively as the feeder element of a smoothly working automatic machine. Here again the shipyard exhibits strikingly different conditions, the fabricating shop generally occupying a central position and dominating the yard operation rather than serving it. It is due to this state of affairs and to inadequate capacity that the expedient of bridge-shop fabrication assumed so great an importance in our new shipbuilding industry.

Present-time demands for the ultimate maximum of ship output have transformed the shipyard into a specialized plant operating at full speed. Temporarily every yard is a factory. Many points of equipment and organization have proved weak in this new service. In so far as rearrangement is necessary in order to meet the urgent call for ships, it must be in the direction of closer approximation to the factory type. Quite obviously it is not possible to relocate and rebuild fabricating shops in shipyards to resemble the specialized Eagle shop. Nevertheless, the subject of fabrication receives such remarkable illumination by this shop that the problems of both future and present shipyard service may benefit from its study.

New things are learned in these trying times of war service. Shipbuilding, though an old art, has also brought forth new knowledge. Men of broad outlook in the art acknowledge that within the past year they have learned better methods—learned how to increase yard economy and production. The years to come will show the result. With such a prospect it is not beyond the range of possibility that many problems of the shipyard may be restudied, and that the River Rouge plant may prove a guide to improved shop system.

Reflections on the Epidemic

INFLUENZA and pneumonia are still sweeping the country. Notwithstanding drastic measures of control these twin airborne diseases have spared neither camp nor city. What their death toll would have been under old-time conditions can only be imagined. Even now the U. S. Public Health reports show 21,096 deaths from influenza and 14,788 from pneumonia in 46 of the larger cities of the country between Sept. 7 and Oct. 19. For the period named the epidemic deaths raised the total death rate of these cities to an average of 60.4 per 1000 population on a yearly basis, while in Philadelphia for the week ending Oct. 19 the total death rate was 158.3 or some ten times the normal. In army camps up to Oct. 24 the deaths from the two diseases were 16,174 and the cases had been 296,275 for influenza and 48,328 for pneumonia. There is reason for thankfulness that this wild outbreak now appears to have burned itself out in some places and to have been brought under control in others, though it is to be feared that a large additional sacrifice will yet be recorded.

After so much has been done to protect humanity against epidemics the present outbreak seems at first thought most disheartening. Modern sanitation combined with health work of all kinds—public and private; preventive, protective and curative, and especially immunization—has gone so far in cutting down infectious diseases that a world-wide outbreak like the present one, which if continued for a year would more than decimate the population, is a great shock. This condition is largely due to the fact that until the present epidemic was well under way little had been attempted to prevent the spread of influenza, by controlling either the infected individual or the multitude which might be exposed to infection. In particular, no agent immunizing against influenza, like vaccine or antitoxin, has yet been generally adopted. Moreover, it is and probably ever will be harder to control airborne than food-borne infections.

Smallpox, typhoid fever, cholera, yellow fever, and the bubonic plague have been well-nigh eliminated among progressive peoples; diphtheria is almost in the same class, and so is malaria in many parts of the world; even tuberculosis is being cut down. These conquests are based on scientific research and the application of its teachings, combined with popular education, self-protection and a willingness to be controlled by health authorities.

Heretofore people have been slow to accept and act upon the simple fact that "colds," influenza and pneumonia are rapidly passed from person to person by airborne germs. Consequently persons with severe "colds" —a symptom of air-borne diseases—have at all times mingled freely among other people without question or protest.

The present epidemic has brought a marked change which it is to be hoped is only a beginning of what may hereafter be expected in self-defence and for public protection. To begin with, influenza has been made a reportable disease. Some degree of isolation has been instituted. Nose and throat discharges are disinfected or burned. To reduce infection, widespread efforts have been made to lessen crowding on transportation routes and in places of public assembly. Office, factory and amusement hours have been rearranged to cut down the peak load of transit facilities. Schools, churches, theaters, libraries, saloons, have been closed. Window ventilation of cars and rooms has been required. In scattered instances gauze masks have been worn by civilians, and they have been ordered for general use in army camps. Immunization is being tried among industrial and business groups, in army camps and by individuals.

All the foregoing measures will mark an epoch in both public and private health-protective work.

Aside from the widespread reaction of these epidemics upon all industries, they have a direct interest to engineers in at least one respect—the reduction of peak loads on city transportation systems in order to reduce crowding and infection. Perhaps this reduction through rearrangement of opening and closing hours may yet become permanent.

This and related effects of the present epidemic illustrate anew how much that is normal and seemingly necessary in city life is abnormal to the individual and endangers the public health. Many of the problems of the engineer are due to these normal abnormalities and could be simplified with benefit to all concerned if public opinion were more enlightened and mankind less selfish.

The engineer has provided safe water-supplies to cities and removed the waters after their use and pollution; he has devised ways and means for the sanitary collection and disposal of garbage; he has made smooth streets for ease of use and cleansing; he has expanded cities laterally and skyward and provided speedy, safe and comfortable transportation in both directions; by means of heating, ventilating and cooling systems he has supplied ample quantities of clean air, warmed or cooled according to season, for the teeming population of city buildings. All these and other things he has done to meet the congestion resulting from city growth.

Some of the inevitable abnormalities of city living the engineer cannot ameliorate by mechanical creations or corrections, but he can point the way. Salvation rests with the people, individually and in mass. In the midst of an epidemic like the present the people must submit to drastic interferences with personal habits and liberties for their own and the common good. If they would do more of this at all times the tasks of the engineer would be easier, the health of the people would be better, and epidemics would rapidly diminish in frequency and severity.

Shipbuilding Methods of the "Eagle" Chaser Factory

Hull Erection Divided Among Seven Stations—Extensive Pre-Assembly—Rivets Heated by Electric Current—Launching Platform—Automatic Punching

[This article has been passed by the Chief Censor of the Navy Department]

BUILDING "Eagle" submarine chasers in the Ford factory on River Rouge is essentially a process of taking the ship to the material and men, as described in *Engineering News-Record* of Oct. 17, pages 698 to 702. This process, applied both in the hull erection and in the fitting out, involves skillfully planned detail methods and devices, essential to the success of high-speed "Eagle" building.

Primarily, the revolutionary shipbuilding methods are centered in the assembly shop. This shop represents the equivalent of 21 building berths and in addition the finished-material storage and the pre-assembly shop. It is the key feature of the River Rouge factory. All the hull-erection work is carried on under its roof.

The assembly shop is a steel-frame structure 300 x 1700 ft. in plan, with clearance height of 36 ft. 5 in., except that the ship-assembly bays have a clearance height of 50 ft. 9 in. for 400 ft. at the outgoing end. The plan diagram Fig. 2 indicates the relation of the structure to the shipbuilding operation. In spite of the great width of the building, excellent daylight is obtained throughout its area by ample glazing of sides and roof monitors.

Passing down the length of the building in three separate files, the hulls under construction occupy successively the seven stations indicated on the plan. Each file is separated from the next by a supply- and material-storage bay. All five bays are 51 ft. wide. A narrower lean-to along each side supplements the supply bays (Fig. 3). Bridge cranes span the assembly or working-line bays. Each line bay is served by four 5-ton cranes, one of which is situated in the high part at the outgoing end. There are no bridge cranes in the supply bays, but instead several hand-trolley jib cranes are bracketed to the columns near the incoming end of the building.

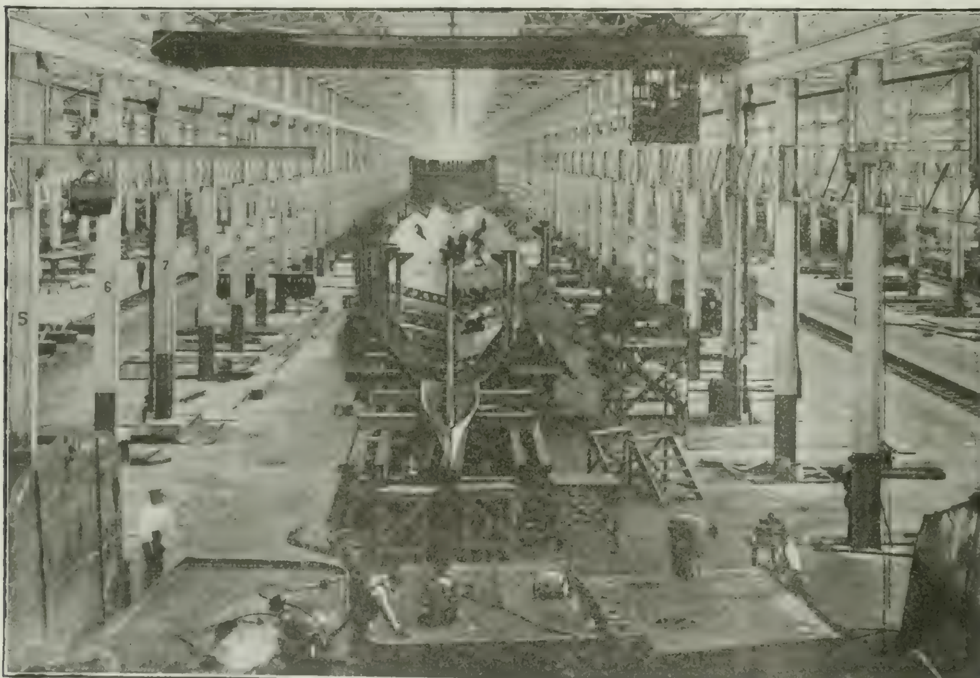


FIG. 1. TIME SAVED IN HULL ERECTION OF "EAGLES" BY PRE-ASSEMBLY OF PARTS

By this arrangement, space is provided alongside each hull-erection station for the material required at that station. Plates and other parts fabricated in the punch shop (at the right, a short distance from the incoming end of the assembly shop) move down the center of one of the supply bays on wheeled trucks running on a track the full length of the bay, and are unloaded directly at the station where required.

When the idea of erecting the hulls in a file of carriages moving along the railway track was conceived, the decision was also reached to use a standard-gage track for this ship support because standard railway

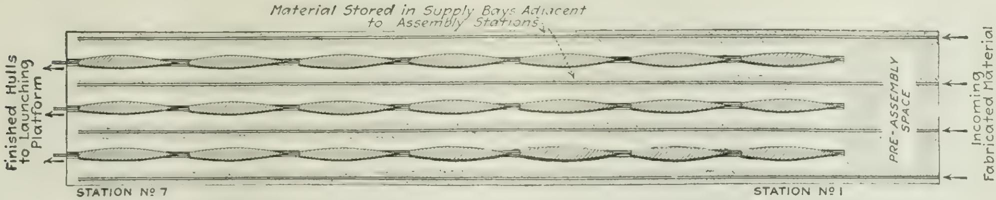


FIG. 2. SEVEN ERECTION STATIONS ON THREE WORKING LINES DETERMINE THE SYSTEM OF ASSEMBLING "EAGLES"

trucks could be used (with springs blocked). Though the wheelbase of 4 ft. 8½ in. is narrow in comparison with the size of the ship, no trouble from lack of stability has been experienced. As the hulls grow, shoring is set against the bottom or the sides, either for temporary support of parts or to hold the ship securely in place. Aside from their wheel support, the trucks are secured against tipping by outrigger shoes attached to the truck bolsters and extending down to within ¼ in. of the rail of a track of 10-ft. gage. This outer track is laid the full length of the working-line bays, on the transfer table and on the launching platform.

The successive carriages of the assembly file are not connected as they would be under a continuous-movement arrangement, but are moved individually when the file is shifted ahead one station. A sketch of the carriage construction, Fig. 4, shows the main or base support of the ship. The wedge keel-blocks in Fig. 7, a relatively late addition, provide for accurately level setting of the keel and any necessary readjustment. A hull carriage comprises 11 sections supported by 12 four-wheeled trucks, but at stations 6 and 7 the two rear sections are taken out and the stern of the ship is supported by shoring from the track and platforms, to give room for placing the shaft bracket and boring the tail-shaft bearings. The weight of the hull at the time of launching is about 250 tons, of which 200 tons are structural material.

Methods of Pre-Assembly of Hull Parts

Organizing the assembly process was a matter of gradually learning by trial how much time the individual operations consume and how they can be allocated most advantageously to the different stations so as to suit the requirements of hull construction. A prominent factor in this development was the evolution of pre-assembly of parts. The large pre-assembly space at the incoming end of the building now has all its skids fully occupied with parts being bolted and riveted up. Riveting is done wholly by air hammers, although a horizontal gap riveter is provided in one of the bays.

Pre-assembly of keel and keelson girder at station 1 constitutes a particularly interesting item of this preparatory work. It is done on horses immediately alongside the first station, as sketched in Fig. 5. When the file of hulls advances, and station 1 is vacated, a hull carriage is brought back from the launching platform (in separate truck sections) by the bridge cranes, and is placed and assembled with its sills and bolsters. Then the finished keel is swung across to position on the keel blocks, ready for the setting of frames.

Until recently, frames, bulkheads, deck sections and tanks were the principal items pre-assembled. As it became increasingly clear that pre-assembly was the key to rapid station work, the subject was taken in hand more boldly. Now the complete stem section, about four frames long, and the stern for a length of about eight frames, are built complete on the skids and set in place as units. A great amount of handling, fitting and bolting is saved, which cuts down the building time and reduces the concentration of men. Furthermore, much riveting is transferred from the stations to the skids. About 15% of the rivets in the ship are driven in the pre-assembly.

One of the special devices developed for facilitating pre-assembly is a frame-assembling gage, shown by the

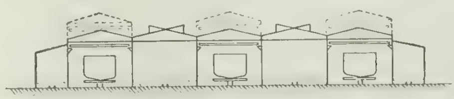


FIG. 3. HULL MATERIAL STORED IN SUPPLY BAYS BETWEEN WORKING-LINE BAYS

drawing in Fig. 7; it can be seen also in the view, Fig. 6. Here the separate floors, brackets and side members of a frame are set in proper position without any measuring or fitting, after the standards of the gage have been adjusted to the correct width of the frame in question by a right-and-left screw in the base. Bolting up and riveting are then carried out quickly and with no uncertainty as to whether the correct shape of frame is obtained. This jig was designed by Superintendent Whiting of the assembly shop.

Organization of the Hull Assembly

Before the various operations involved in the hull erection could be scheduled as to order, and the items allocated to specific stations, many preliminary difficulties had to be overcome. With a new kind of ship and a new shipbuilding procedure the methods of doing some parts of the work had to be developed by actual trial in the shop. Every change in method—and sometimes detail changes in the construction of the ship—influenced other parts of the work as to best order and convenience. The time required for the several elementary operations could not be determined exactly at the start, and therefore an accurate balancing of the several allotments of labor and time to the stations was necessarily a matter of successive approximation.

One kind of difficulty is illustrated by the schedule for station 1. Originally the plan was to complete the entire main frame of the ship here, in order to produce a relatively stiff and robust hull structure before the first move. The early schedules were altered when experience on one or two hulls in the shop showed that this plan of complete frame erection consumed too much

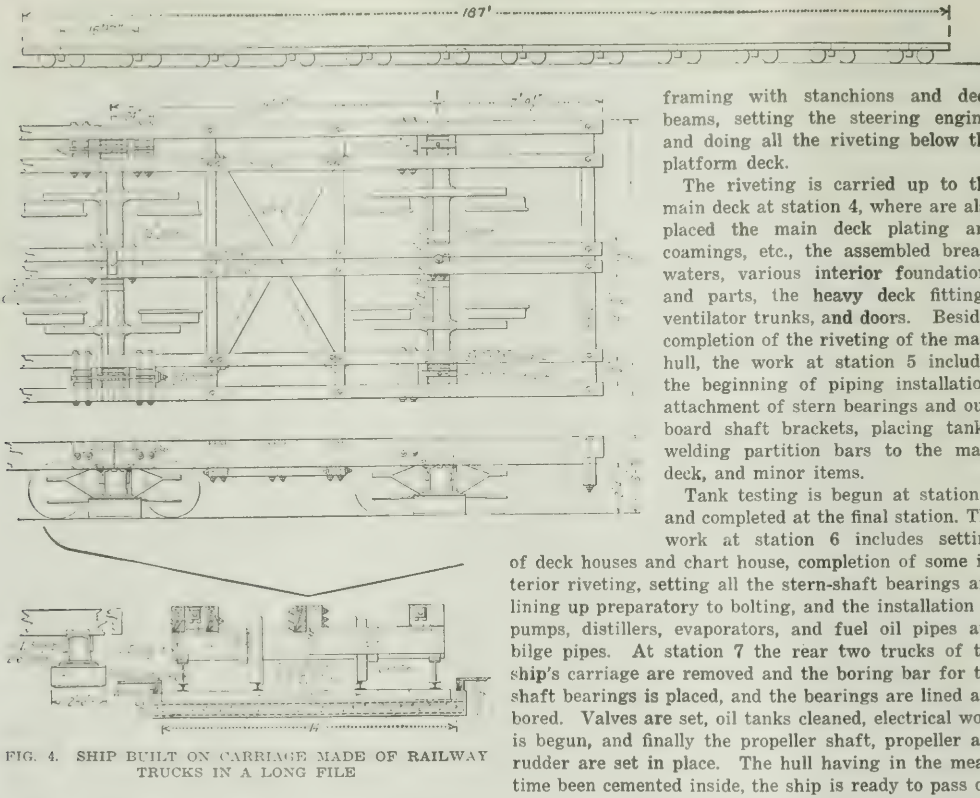


FIG. 4. SHIP BUILT ON CARRIAGE MADE OF RAILWAY TRUCKS IN A LONG FILE

time for one station. Further, it was found that moving the carriage ahead on its track did not disturb the position of the parts perceptibly, even when the framing was not complete.

In the form finally adopted the schedule of operations distributes the total work among the seven stations as nearly as possible in equal shares, except in so far as individual operations like that of boring the shaft bearings and subjecting the hull to hydrostatic test are locally governing factors to disturb the balance.

At station 1, after the truck is made ready for the hull, the assembled keel is slid over from the assembly horses, the keel plate at the after end of this section is set, and then in successive order are placed the two bottom strakes, floors and bulkheads of the after end, the forward athwartship bulkhead, the assembled frames of the main portion of the ship's length, and the lower strake of the sideplating. At station 2 the side keelsons and stringers are bolted up and the assembled boiler foundation and turbine foundation are placed; the bilge strake is set and a number of minor parts are added. Stanchions and platform deck beams are also set at this station.

Riveting begins at station 3 and continues throughout stations 4 and 5, being virtually completed before the ship goes to station 6. At station 3 the largest items of work are setting the unit-assembly bow section and the corresponding stern section, finishing the main framing with stanchions and deck beams, setting the steering engine, and doing all the riveting below the platform deck.

The riveting is carried up to the main deck at station 4, where are also placed the main deck plating and coamings, etc., the assembled breakwaters, various interior foundations and parts, the heavy deck fittings, ventilator trunks, and doors. Besides completion of the riveting of the main hull, the work at station 5 includes the beginning of piping installation, attachment of stern bearings and outboard shaft brackets, placing tanks, welding partition bars to the main deck, and minor items.

Tank testing is begun at station 6 and completed at the final station. The work at station 6 includes setting of deck houses and chart house, completion of some interior riveting, setting all the stern-shaft bearings and lining up preparatory to bolting, and the installation of pumps, distillers, evaporators, and fuel oil pipes and bilge pipes. At station 7 the rear two trucks of the ship's carriage are removed and the boring bar for the shaft bearings is placed, and the bearings are lined and bored. Valves are set, oil tanks cleaned, electrical work is begun, and finally the propeller shaft, propeller and rudder are set in place. The hull having in the meantime been cemented inside, the ship is ready to pass out of the assembly shop and go to the launching platform.

As soon as launched, and while on the way to the fitting-out dock, the ship is inspected in detail, and various minor operations are carried on to get the hull ready for the installation of machinery.

Hulls Checked up by Transit and Level

After experience in hull erection showed that complete assembly of the main framing at station 1 was not possible, it was discovered also that slight changes of position of the hull were likely to occur at all of the stations. A daily check-survey system was therefore established, in order to make sure of maintaining position and alignment. A survey corps checks up level and line of keel and verticality of frames and center line daily, making the rounds of the 21 hulls. Any misadjustment is at once corrected by the wedge keel-blocks and by shores.

Removal of the last two trucks of the carriage at station 7 results in a slight deflection of the stern portion of the ship which is important with respect to the subsequent setting of the turbine reduction gear. Care must be taken to see that the stern does not drop below its position when afloat and ready for the gear installation. The shaft bearings being bored at station 7, the adjustment of the ship to its buoyancy distribution after launching tends to raise the forward end of the shaft and bring the turbine gear foundation slightly

low. In this position of parts the gear is easily adjusted by shimming to correct alignment with the shaft, and all risk is avoided of having the shaft so low as to require cutting down the gear foundation in order to line up the machinery.

About 243,000 rivets, most of them $\frac{1}{2}$-in. and $\frac{5}{8}$-in., are contained in the "Eagle," and of these more than 200,000 must be driven on the hull-erection carriages. For the ultimate rate of production of the plant—one ship a day—it will be necessary to drive more than 20,000 rivets daily at each of nine stations (stations 3 to 5 on three working lines). In view of the magnitude of this daily task, the rivet-handling methods are especially interesting.

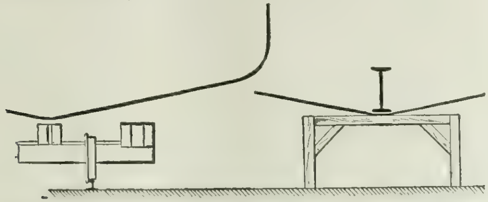


FIG. 5. KEEL ASSEMBLED ON HORSES ALONGSIDE FIRST ERECTION STATION

By far the greater proportion of the rivets are countersunk, with a 60° angle of countersink and with point shaped to $\frac{1}{8}$-in. rise. This "mushroom" point gives greater strength than a flush point, and also makes the driving easier by the use of a slightly cupped rivet set in place of a flat one.

All rivets as received are cleaned of dirt and loose scale in two tumbling barrels set up in a rivet-handling inclosure near the center of each supply bay. From here they are distributed, in bright and clean condition, to their various stations. If used in the heaters in the condition as originally received, scaling would cause constant trouble in the heater.

Electric rivet heaters are among the remarkable innovations in the "Eagle" manufacture. They were designed by E. F. Allison, chief electrician of the Ford Motor Co. Such a heater comprises a simple transformer whose secondary circuit terminates in a jaw having upper and lower contact plates, the upper one spring-mounted, between which the rivet is placed in vertical position. The contact resistance of the large current flowing through the rivet produces the proper riveting heat in about 30 sec.—just time for taking the hot rivet to the ship and returning to the heater for the next. Heating is most rapid at the point, the head brightening up last.

A convenient riveting scaffold is another innovation. It consists of hook-ended hangers (Fig. 9) with laterally projecting bolts, and similarly hook-ended bracket members, which can be placed instantaneously. The hangers are hooked over the top of the shell; extension lengths can be hooked to their lower ends just as easily.

A sharp departure is made from the ordinary shipyard practice of countersinking the plates in the punch shop before they come to the ship. At the "Eagle" plant the countersinking is done on the ship, when the plates are in place. It is combined with the operation of reaming, through the use of a reamer shaped with a countersink taper in its rear portion; a stop on the tool assures correct depth of countersink. One advantage of this procedure is that perfectly true countersinks are obtained, whereas when the countersinking is done in the punch shop the subsequent reaming of holes not perfectly matching shifts the axis of the hole and results in forcing the head to one side of the shaft of the rivet. This gain in rivet quality, and the elimination of such errors as countersinking the wrong side of the plate (which may occur in the case of shop countersinking) are decisive advantages, although the hand countersinking proved to be rather heavy work in the 12-lb. shell plating.

Simplicity of the Hull Construction Work Largely Due to Design

With all frames straight, with no plates except those of the bilge strake requiring to be curved in bending-rolls, with only four furnace plates under the keel (one of these is die-forged in an outside plant and is received at the "Eagle" factory ready shaped), the manufacture is largely reduced to simple punching and assembly work arranged in the manner described. Furnace bending is practically limited to the shaping of the watertight boundary angles of the bulkheads. Only one set of bending-rolls is provided in the punch shop, which is sufficient to take care of the bilge plate. Flanging the frame members and brackets is done cold by two large plate benders.

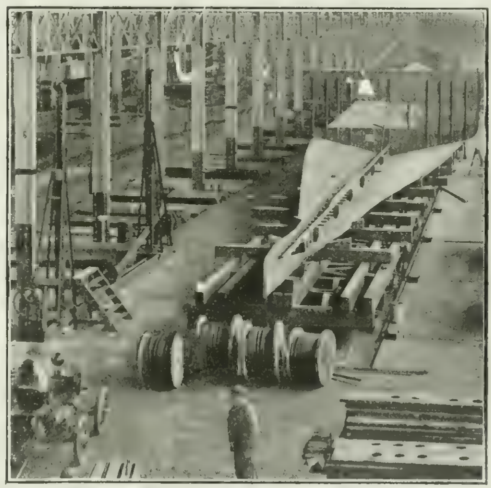


FIG. 6. SPECIAL GAGE FACILITATES RIVETING OF SHIP FRAMES

These elements of simplicity are to be credited to the Navy Department's original design, which, as already stated, was conceived with factory production in view. Notable elements of the design, besides those mentioned and those represented in the frame section, are the use of V-shaped keel plates, the avoidance of forgings and complex plating at stem and stern, straight-line longitudinal shaping so that both bottom and shell plates can be drawn into position directly from the flat, and elimination of joggling by using short, tapered liners, not only at butt-laps but also on the frames, under the out-plates of the shell, these plates being drawn in to

the frames. The boundary angles of water-tight and oil-tight bulkheads are stapled to fit the plating.

Unusually numerous lightening holes in floors, frames, brackets, etc., are called for by the design. They are produced very expeditiously, however, and do not make the shop work less simple. The smaller holes are stamped out while the larger ones are burned out with oxyacetylene flame. Flame welding is also used extensively, chiefly for the corners of bulkhead angles and similar work.

Plates ranging in weight from 6 to 12 lb. per square foot make up the structure of the ship. Stanchions are made of tubes pressed flat at the ends for riveting to angle clips at the floor and deck connections. Making the keel plate part of the shell plating eliminates the necessity for edge-planing as required in ships of ordinary design at the junction of keel and shell plate. A warped surface occurs in the rear portion of the ship's bottom; the shell plating here can be drawn down to the frames without difficulty, however.

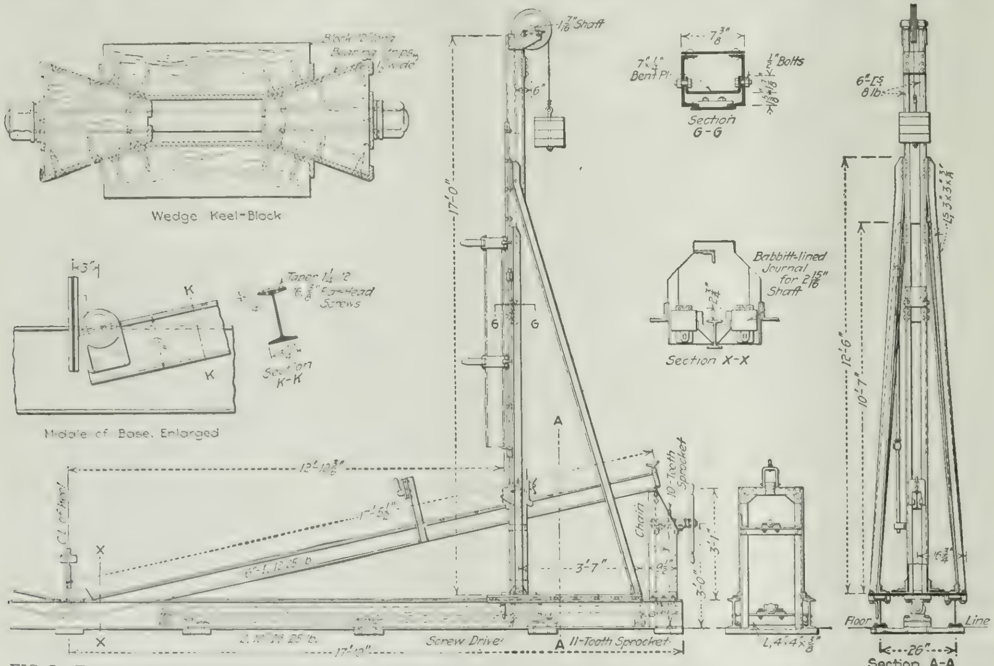


FIG. 7. FRAME ASSEMBLY SIMPLIFIED BY MASTER GAGE ADJUSTABLE TO VARIOUS WIDTHS AND BOTTOM SLOPES

When the designers in the Ford Motor Co.'s ship-drafting force carried out the detailing, and undertook to work out the plating for a maximum amount of multiple punching, they found a considerable gain in accuracy by laying out the plating on the drafting board by graphical projection to a scale of 3 in. to the foot. The results of this process checked against the mold-loft layout, proved to give superior accuracy and furnished a satisfactory basis for fixing the dimensions of plate and laying out the riveting.

In the search for further simplification of manufacture, electric welding of bulkheads, deck houses and other parts not calling for great structural strength is being introduced. The stimulus for the attempt came partly from the successful ship work done in England in electric butt-welding. Recently a complete athwartship bulkhead was made up by welding, and steps were taken to systematize the work for regular application.

"Quasi-arc" welding is used. The joints of the plating are butt-welded, while the boundary and stiffener angles are attached by edge welding and intermediate welding, as sketched. The first intermediate welding tried was like that used in the English experiments, the angle leg in contact with the plate being notched, so as to bring part of the welded toe edge close to the position of the ordinary rivet line. As an improvement on this, elongated holes were punched in the angles, and the edge of the angle along the inside of this hole was welded to the plate.

From the last station of the assembly shop, the completed hull passes out through one of three large steel rolling doors in the end of the building—the largest steel curtains ever used—and, still mounted on its carriage, moves forward for transfer to the launching platform.

This operation is accomplished by a transfer table, which, except for its length, 200 ft., is precisely like those used in locomotive shops. It runs on 11 rails transverse to the axis of the plant, and is carried by two wheels per rail, one of the two being driven from a longitudinal shaft connected to an electric motor at mid-length. The deck carries four rails, two for the hull carriages and two for the outriggers or steadying plates of the carriage. Forward of the transfer table, at its right end, is the launching platform, to which the ship is moved over a short length of approach track.

W. B. Mayo, chief engineer of the Ford Motor Co., is credited with originating the idea of lowering the finished hulls into the water by a vertically moving hydraulic elevator. Carried out with remarkable excellence of detail, the scheme has proved completely successful.

This platform is a steel truss bridge 200 ft. long, supported at the quarter points of its length by two transverse trusses whose ends, 14 ft. out from the bridge trusses, are attached to two vertical 4-in. hanger rods, which are the piston rods of vertical hydraulic cylinders. Concrete pedestals 8 ft. high above water support these cylinders; the deep slot between the two pedestals of each pair, extending to the bottom of the slip under the bridge, gives space for the ends of the cross-frames of the bridge as the lowering proceeds.

In the operating house, on the bank alongside the launching platform, is a duplex high-pressure pump furnishing water at pressures up to 500 lb. A control stand with four pairs of valves provides for independent operation of the eight cylinders, but an ingenious dial indicator directly in front of the control stand shows by four separate hands the position of each pair of pistons and of the center point of the platform. The operator is able to keep the platform level within ¼ in. About 30 minutes' time is required for the complete launch.

Two mechanical safety devices are embodied in the launching platform construction. To take the weight of the empty structure when in its normal (upper) position, a supporting girder is placed under each end, bridging the width of the gap between lateral forward extensions of the abutment pier. This girder can be pulled back out of the way—after the platform is raised an inch or two—by pulling-screws engaging the ends of the girder and a pair of upward-projecting lugs fastened to the back of the abutment. Further, locking bolts pass through links in the eight piston-rod hangers. The pistons cannot be lowered until these bolts are withdrawn. Two hand levers at each pair of cylinders are provided to actuate the bolts.

Systematization in the Fitting-Out Plant

Saving labor and time in the fitting-out operation is accomplished by virtue of the progressive system of layout and working, with little aid from mechanical appliances. The work of installing the machinery and fittings of the ship and placing its many pieces of equipment is broken up into a succession of segregated items, carried out in seven consecutive positions of the ship alongside the 2000-ft. fitting-out dock.

To characterize the arrangement of these operations, the following partial schedule of items performed at its seven stations (stations 9 to 15) is quoted:

Installing boilers, uptake and mounting is the principal piece of work at station 9. The deck over the boilers is riveted, boiler piping and a considerable amount of other interior installation are placed, and anchors and windlass are added to the ship. At station 10 the steam turbine and its reduction gear are set, shafting and the bulk of all the piping are installed, the chief electrical work in the ship is done, and the stack is set. Most of the furring is placed at station 11, and the air test of various compartments is made. At station 12 many

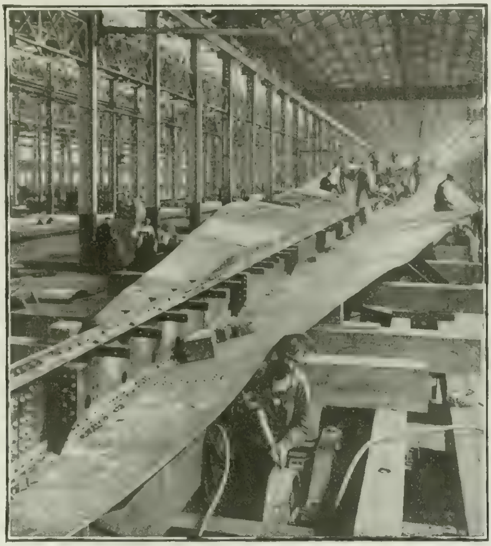


FIG. 8. WORK ON THE FIRST "EAGLE" IN PROGRESS LAST MAY

items of rigging are put in place, from ventilating cowls to masts, spars and davits; fire extinguishers, whistle, plumbing fixtures and radiators are set, and the ice machine is put into the ship. Some electrical work is also done at this station. Other items of equipment and part of the naval installation are set in place at stations 13 and 14. Making the ship ready for sea begins at station 14 with loading the fuel-oil tanks. At station 15 the final items in this part of the work are performed, including raising steam and testing the piping.

Long sheds built on the fitting-out dock, some 20 ft. inshore of its face, supply the materials and equipment in corresponding order. A locomotive crane running on a track on the dock in front of the sheds handles the material into the ship.

Ford factory methods find application in a special rig used at the first of the seven stations, where turbines and boilers are installed in the ship. It serves for assembling the boilers, which arrive as drum-and-tube units without casing. The steel plate and firebrick casing must be built up around the steam element before the boiler is transferred to the ship. For this work an assembly skidway is provided in the shed. It consists of a pair of I-beam rails mounted on low concrete pedestals, and extends about 100 ft. longitudinally

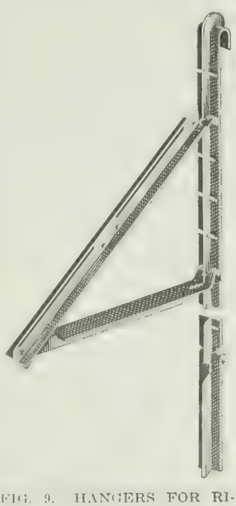


FIG. 9. HANGERS FOR RIVETING SCAFFOLDS

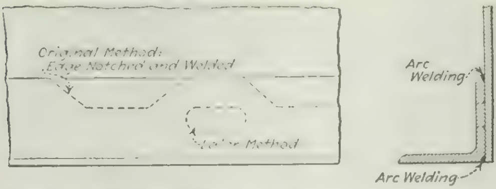


FIG. 10. ELECTRIC WELDING APPLIED TO BULKHEADS AND DECKHOUSES OF "EAGLES"

down the shed, Fig. 13. The boiler casings are built on small flat-wheeled carriages running on the skidway, as sketched.

Starting at the middle of the length of the skidway, the boilers are built up progressively and are shifted step by step toward the ends, going to different workmen for successive operations in the assembly. They reach the ends of the skidway in finished form, and here are run out through a door in the front of the shed by

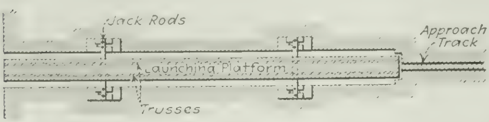


FIG. 11. LAUNCHING PLATFORM SUPPORTED BY EIGHT HYDRAULIC CYLINDERS

means of a transfer table composed of a length of skidway mounted on wheels. With ideal working of the system the two boilers required for a ship are started simultaneously at the middle of the skidway and, several days later, are completed and pass out of the shed at the same time, so that they can be set in the ship during its one-day stay at that station.

Supply of hull material to the "Eagle" plant is provided for by a punch shop that is easily among the largest in the world. As early as two months ago this plant was turning out material at the rate of 160 tons per day. On the basis of completing one "Eagle" daily, the ultimate production of this shop will be about 200 tons, a production that is being approached rapidly. Because the "Eagle" plating is only one-third to one-fourth as thick as that of steel merchant ships, the capacity of the shop in terms of ordinary ship material is 600 to 700 tons per day, or 15,000 to 20,000 tons a month.

Multiple punching is the basis of the shop equipment. When the work in the designing room had demonstrated that a large part of the shell and deck plating of the ship could be multiple-punched, ten machines for the work were fitted up from sheet-metal punch presses of the Ford Motor Co.'s automobile works. Thomas spacing tables were added at the feeding-out side, and the necessary gangs of punches with gag levers were built into the frames.

The shop is a timber-frame building about 100 x 450 ft., its long dimension set across the direction of travel of the material. At its rear, facing the storage yard, a lean-to 60 ft. wide extending all the way across the building provides space for marking out and for a considerable amount of single punching. There is a smaller lean-to on the opposite or forward side of the building.

In the storage yard back of the punch shop the plates are piled flat (not set in racks) and many of them are handled into the shop by hand. Locomotive-crane tracks traverse the yards at right angles to the longitudinal alignment of the plant, to place material in storage from cars, or to assist in handling it into the shop.

In the rear lean-to of the punch shop are installed eight single punches, two plate shears and one circle-cutting shear. Most of the space of this lean-to, however, is devoted to marking the single-punched plates, which is done by center punching through metal templets. These templets are stored in racks alongside the punch table. Material passes forward from here on small hand trucks and roller beds to the punches in the main building.

In the shop itself, the multiple punches dominate the arrangement. There are seven plate multiples, most of them of 72-in. gap. The plates to be punched average about 50 in. in width and usually require a gang of about 24 punches; they are fed through by hand. In addition there are three narrow multiples, eight single punches, one angle shear and punch, one blocking-out press, a horizontal punch for curved angles, two plate benders (flangers), one set of bending-rolls, a pair of small furnaces with bending slabs adjacent, and a row

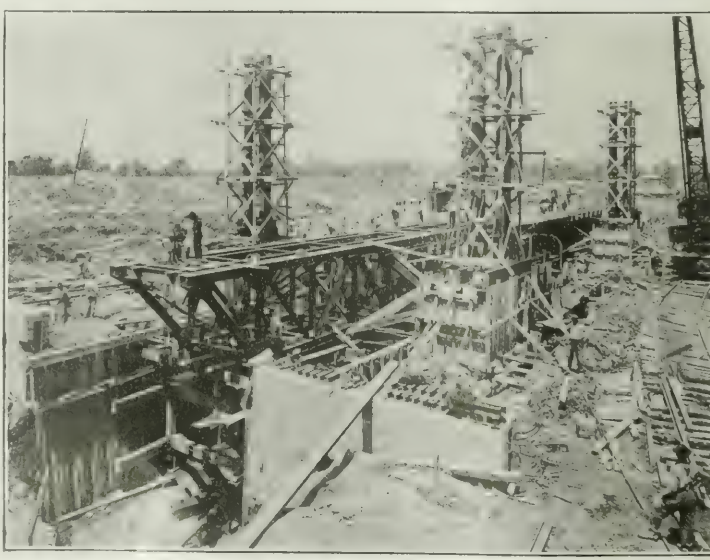


FIG. 12. LAUNCHING PLATFORM AND HYDRAULIC JACKS DURING CONSTRUCTION

of blacksmith forges. In the shed on the outgoing side of the punch shop are two plate-edge shears.

No storage space for finished material is provided at this shop. The outgoing material is handled directly on small railway trucks into the assembly shop, where it is taken down the supply bays to storage adjacent to the station where required for erection.

A New Automatic Spacer

An important improvement is being made in the punching of narrow plates and frames by the use of a special automatic spacer, capable of dealing with plates not ordinarily adapted to multiple-punch work. This ingenious device, originated by Joseph Dorschel, superintendent of the shop, punches plates in which the transverse lines of holes are not exactly at right angles to the longitudinal axis of the plate.

Between the rails of the feeding-out bed of the press is laid a metal pattern over which rides a small carriage attached to the leading end of the plate to be punched. A handle on this carriage serves for pulling the work plate forward through the punch. A transverse row of small vertical plungers or detector fingers is spring-mounted in this carriage, and adapted to enter holes in the pattern. As the work plate is pulled forward, one of these fingers dropping into the hole in the pattern stops the work. At the same time the punch operator sees the end of this finger depressed, and he pulls the corresponding gag lever of the punch, thereby producing a hole in the work plate corresponding in location to that of the pattern. As he does this, the feeder lifts the pulling lever, thereby disengaging the depressed finger, and pulls the work forward until another finger finds a hole in the pattern. By this arrangement, punching of holes irregularly arranged along several longitudinal lines is easily done, with accurate spacing; marking out is eliminated.

Working Force at the "Eagle" Plant

Estimates of operating organization call for a total force of about 11,000 men to operate the "Eagle" plant. The probable ultimate force will include about 9000 men in hull construction, and something more than 1000 in the steam-engineering work. A labor force of about 100 per station of the assembly shop will be required in each shift.

Work is carried on continuously through the 24 hours in three shifts—day shift 7 to 3, evening shift 3 to 11, and night shift 11 to 7. The day-shift force is one-third larger than those of the other two shifts.

Riveters have been the main problem of the "Eagle" plant, as they have of regular shipyards. In the words of William Knudsen, superintendent of the plant: "We know we can punch 200 tons per day, and we know we can erect 200 tons per day; the pinch is in riveting. We are now driving 86,000 rivets per day at the maximum [this was in September.—Editor], and we want to reach 240,000 rivets per day. We are putting on green men at the rate of 10 gangs per day, training them in the assembly riveting for final transfer to riveting on the hulls. An ultimate force of about 500 gangs of riveters is needed."

Considerable help was given to the organization of the plant by the transfer of about 40 skilled ship-

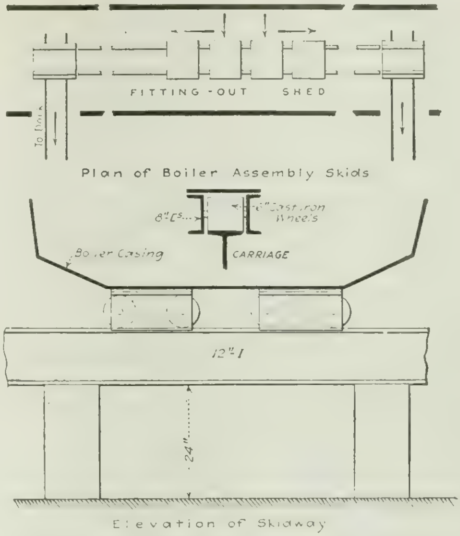


FIG. 13. FORD CONVEYOR-ASSEMBLY SYSTEM IN BOILER SKIDWAY

builders from United States navy yards, to act as instructors and help develop the working organization.

An outstanding feature of the organizing work is that hull construction did not begin until May 1, and that within four months from this time an organization of 6000 had been created and was successfully producing "Eagles." Almost none of the entire force had prior shipyard experience. The building up of this great working force proceeded in spite of the fact that no housing facilities are available locally, and, when construction began, the nearest street-car line was about a mile from the yard. Since that time special provision has been made for transporting men to their work, and recently a street-car line has been extended directly to the plant.

New Water-Power Project in California

A permit recently granted to the Southern California Edison Co. by the California Water Commission paves the way for an improvement to cost approximately $1,000,000. The permit approves the direct diversion and storage in Huntington Lake of the waters of Pitman Creek and the storage of 3781 acre-feet annually in Pitman Creek reservoir for the development of electric power. It is proposed to construct at Pitman Creek reservoir a dam 103 ft. high, 860 ft. long on top and 50 ft. long at the bottom. This structure would be of reinforced concrete, of the multiple-arch type, and the estimated cost of the dam and the conduit line to Huntington Lake would be $855,000. Two plants have already been installed on Big Creek, known as Big Creek Power Plants Nos. 1 and 2, and it is proposed to construct two additional plants below these. The water, after being used in all the plants, is to be returned to the San Joaquin River from the tailrace of Plant No. 4 in Madera County. Construction work is to be completed on or before July 21, 1921.

Does the Engineer Make a Good Railroad Operator?

Views of Men Who Have Run Railroads as to Whether Engineering Training Helps or Hinders in Broader Railroad Work

BY C. W. STARK
Associate Editor, Engineering News-Record

IS ENGINEERING a good training school for the railroad operating executive? Do engineering education and practice tend to develop the essential qualities of the successful transportation man, or do they narrow and so disqualify men for that service, or, finally, do the characteristics of the man govern wholly, irrespective of the training?

Some weeks ago a man high up in the Railroad Administration told the writer that one large trunk line in the East had stood out last winter, in comparison with all other roads, in the way it kept its line open, and that the reason for its success was that it was "run by transportation men and not by engineers"; and, on the other hand, that another large road had failed dismally in the emergency because it was run by engineers. As a personal opinion this charge need not, perhaps, be taken too seriously; but the writer, remembering that there were three engineers on the Railroads' War Board who were summarily dismissed when the Government took the reins, feared that there was a distinct feeling against engineers in the administration, and determined to solicit the views of railroad officials as to whether such a distrust was warranted. The subsequent appointment of engineers to two of the seven regional directorships, and of at least six engineers to important Federal managerships, indicates, happily for our profession, that there is no absolute conviction at Washington that we are unfit; but a summary of the opinions of the officials the writer has interviewed may nevertheless be of interest.

FOUR OUTSTANDING THOUGHTS

Four conclusions stand out as the consensus of opinion of the men interviewed: First, and most important, that the engineering training and point of view are very desirable for the operating executive; second, that almost everything depends on the man, so that it is equally a mistake to promote him solely because he is an engineer or to condemn him for the same reason; third, that there is a danger that close confinement to technical problems may restrict the engineer's vision, examples being seen in the men who, with unimpeachable technical records, have failed utterly when tried on administrative work—computers to the *n*th degree, but not engineers, if engineering means skillful and economical production; fourth—and this seems to fit exactly with Dr. Charles R. Mann's views—that there is considerable opportunity for improvement in engineering education in order to develop in the engineer a better grasp of the human factors—a realization that engineering is not all, or even mainly, technical. And most encouraging was the writer's discovery that the men in the highest positions seemed surest of the value of the engineer's analytical methods in solving and handling transportation problems.

The opinions recorded include those of three railroad presidents, all of whom have served one or more large trunk lines and have played prominent parts in the railroad drama; the Federal manager of about 3000 miles of extremely important lines; a former general manager of an equally large mileage, and several lesser lights whose views are nevertheless highly respected by the writer.

WHEN TO SHIFT TO OPERATION

Executives who had risen from the engineering ranks naturally came to the writer's mind when he considered whose views to solicit. One of these was the president of an Eastern railroad. He began in the maintenance department of another road, was division engineer and then division superintendent. He believed in engineering training as preparation for the responsibilites of railroad operation, thought the engineer's powers of analysis valuable in such work, but felt that most depended on the man. He thought it entirely possible to follow such a course as he had done and qualify for a superintendency without previous transportation experience; but he regarded it as essential that the young engineer keep his eyes and ears open to pick up all the railroad information possible. On the time at which to shift from engineering to operation, be it said, there was not unanimity of opinion. Some thought the engigeering graduate after only a brief sojourn in engineering work should get into operation in a yardmaster's or trainmaster's office; others thought the Pennsylvania's plan of holding him to engineering work until he had reached the post of division engineer gave him ample contact with the problems of keeping trains moving; a majority seemed to doubt the desirability of his remaining in engineering much beyond the division office if he hoped to absorb the fine points of railroading.

The general manager referred to thought that practically everything depended on the man; that the right man would succeed and the wrong one fail, irrespective of whether either or both were engineers. He thought there might be a tendency, because in the pursuit of engineering the engineer is dealing with materials whose performances he computes or forecasts in a coldly scientific way, to fail in dealing with men, because of an attempt to treat them in the same cold-blooded manner. On the other hand this man, who had been chief engineer, was glad he had been trained as an engineer, and thought that training of much service in his present work. In short, his view, like that of others, was that engineering training tends to make narrow men narrower and less useful for large railroad problems, and broad men broader and better fitted to solve them.

FINANCE, BANKING AND BUSINESS IN GENERAL

One of the picturesquely independent thinkers in the railroad world, an engineer president who has remained with his corporation, testified to a faith in engineers that has grown constantly in the forty years of his association with them. Not only railroad operation, but railroad finance, banking and business in general he thinks need the viewpoint, the powers of analysis of the engineer. His confidence in the engineer was the more impressive because he has little faith in the lawyer and

less in the politician as a business administrator. He feels keenly that the Government is now operating the railroads not because the owners were given a fair chance and failed, but because unintelligent regulation denied them that chance.

This man thinks the line of advancement prevalent on the Pennsylvania system affords opportunity for sufficient acquaintance with the problems of operation before promotion to the superintendency. He believes there is some opportunity for improvement in engineering education, and thinks well of the coöperative system at the University of Cincinnati; and yet he doubts whether it is feasible to teach understanding of men at the student age. To use his expression, "You must look out that your layer cake does not turn out to be simply hash." Rather, he favors a broad university course, as contrasted with the technical school course, and afterward, for the would-be railroad official, short periods in a number of different railroad departments.

The Right Man Plus Engineering Training

On the other side of the railroad fence from this president is another engineer—the Federal manager before mentioned—another man of striking personality, whose rise has been rapid. This man has no illusions about engineers. To him it is the man himself who counts for most, and while he decries the prejudice against engineers that once existed on his road, he will not promote a man merely because he is an engineer. But withal he has a deep faith in the value of the college training, and especially the engineering training, as a groundwork for the solving of transportation problems. "When the technical man has a new operating problem to solve," said he, "he sets to work to analyze it and work it through; the man without the education probably will look back in his experience for a similar problem solved, and if he finds no guiding precedent he is in trouble." This executive tries to give his nontechnical operating officials something of the engineering viewpoint by sending to them young engineers with charts and diagrams; the officials, he finds, readily ask the engineers to explain them and show their uses.

This man has well formulated views as to the defects in engineering education, and they accord to a striking degree with Dr. Mann's, though expressed to the writer before the Mann report was published. He believes that the schools should give more care to developing the human side of engineering; that there should be more effective testing and grading of students, and the weeding out of poor prospects. He also believes that far more thought should be given to character study in the building up of the railroad personnel.

Does Engineering Narrow One?

Two engineers who have remained in their engineering departments, although they have evinced much interest in operating matters, were asked their views. One of them, a member of an engineering department that, perhaps because of its size and dignity, has remained more than ordinarily aloof from the transportation department, is a firm believer in the value of the engineering training. He regretted that he had perceived a lack of understanding of operating problems among many of his associates. This opinion was independently concurred in by an operating official—not an engineer—of the same road; and the moral seems to be that every railroad engineer, if he aspires to a high office on his road, must remember that the chief purpose of the railroad is not to build bridges or yards, but to move traffic. The other engineer, connected with a road on which there is a less sharp line of cleavage, thought that environment and attitude governed, and that the young engineer, put where he could learn the purposes of the railroad and encouraged to study them, had an excellent chance to become a successful operating man.

Efforts of the writer to get the views of executives who were not engineers by training were not wholly successful. Several who were approached thought they could contribute nothing to the discussion. Such comment as was elicited was in the main favorable to the engineer. The operating official mentioned in the preceding paragraph, while cognizant of deficiency in some of the engineers he had encountered, thought the fault was mainly in the men, and believed the engineering training ought to be a great help to the operating man. More significant, however, was the brief and crisp statement of one of the most eminent railroad presidents—that, though not an engineer himself, he had chosen an engineer for his chief assistant. And the impression was conveyed that this assistant was not merely a highly capable man who happened to have studied and practiced engineering in his earlier days, but a man whose engineering viewpoint dominated his actions and was a most important fact in his success.

Conclusion

The views of these eight men, who are believed to be fairly representative of successful railroad men, show striking similarity, though they of course bear the impress of the personalities of the men who gave them. In part they are corroborated by opinions of still other railroad men not recorded here. There is general agreement that the engineering training and viewpoint afford an excellent foundation for success in solving the broader railroad problems, and the men highest up seem most aware of the value of such a foundation. In his report on engineering education Dr. Mann says the ultimate aim of engineering education is more intelligent production. *Engineering News-Record* concurs fully in this belief, and in his belief that engineering schools have not recognized this as they should. If individual engineers have failed as producers of transportation the writer ventures the opinion that this proves, not that engineering training tends to disqualify men for the larger railroad work, but merely that these individuals were not, according to the modern definition, good engineers. It is for the profession to realize and prove—with the help of the engineering schools—that *railroad operation* IS *engineering.*

Sioux City Has City Plan Commission

A city planning ordinance was passed recently at Sioux City, Iowa, and a commission of 21 members is being organized. A general review of the situation will be made, but there is no expectation of projects being carried out under the supervision of the commission for some time to come.

U. S. Engineers Bridge Marne With German Equipment

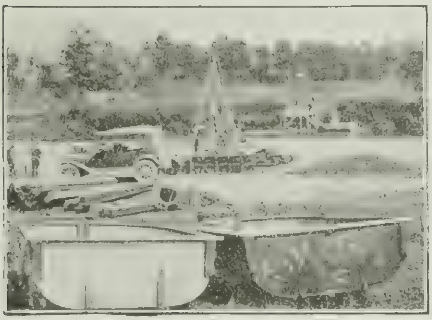
In Van of Advance, Engineers Build Floating and Trestle Structures for Hurried Allied Crossing

By Robert K. Tomlin, Jr.

Working under shell fire and using German ponton equipment captured during the recent Allied advance in the region of the Marne, companies of the —th United States Engineers successfully spanned the historic French river, thereby opening up lines of communication which made possible a substantial drive into enemy territory. This achievement is the first of its kind to be recorded in the annals of the American Expeditionary Forces, and is of particular significance in showing the change in the type of work demanded of engineer troops at the front, following the transition from trench warfare to a war of movement. The following notes are based upon reports submitted to the chief engineer, American Expeditionary Forces, by the commanding officer of the —th Engineers:

Immediately prior to the time when the call came for the crossing of the Marne, all companies of the regiment had been engaged principally on fortification work in a certain divisional area. The construction of fire trenches, wire entanglements, regimental and battalion P.C.'s, dressing stations, signal stations, and the strengthening of farmhouse cellars to resist artillery fire, served as the prelude to the new work of bridge building later accomplished.

It was on the morning of July 15, after a heavy bombardment, that the Germans launched their attack



PILEDRIVER, PONTON SECTIONS AND TRESTLE BENT CAPTURED FROM THE GERMANS

PONTON BRIDGE BUILT WITH GERMAN EQUIPMENT AFTER CROSSING HAD BEEN MADE BY FOOT-BRIDGE SUPPORTED ON CASKS

TRESTLE BRIDGE FOR HEAVY TRAFFIC WAS BUILT TO RELIEVE PONTON STRUCTURE

on this particular divisional front. Although not in direct contact with the enemy at this time, the companies of the —th Engineers, then in various wooded areas back of the front, were not spared by the enemy's artillery fire. In the forward movement which ensued, one company on July 19 advanced with an infantry regiment, and was successful in seizing and salvaging a quantity of German ponton equipment along the north bank of the Marne.

Two days later other companies of the engineers moved up to join the first, and during the night of July 21-22 foot-bridges were built. On July 22 the members of the regiment had the satisfaction of launching the enemy's equipment and completing the ponton structure across the Marne.

Speedy Work on Heavy Trestle Bridge to Replace Ponton Structure

But the work did not stop at this stage. The arrival of two additional companies July 23 was the signal for the beginning of work on a heavy trestle bridge to relieve the traffic which the finished ponton bridge was carrying. Speedy work was done on the trestle bridge construction, for at noon on the day after the two companies arrived at the site vehicles were moving northward across it. With the completion of the trestle bridge, the ponton structure was removed, under cover of night, and reconstructed at a new site where a crossing was urgently needed.

Shifting to new territory, another company of the regiment a few days later reached the River Ourcq, where the enemy, in his retreat, had demolished a crossing. This bridge was speedily rebuilt and placed in service, but an attempt to span the same stream at a second point had to be abandoned because of the intensity of the German artillery fire.

At the end of the month, all but one of the engineer companies were relieved. The unit remaining continued the construction of another trestle bridge and busied itself with the collection of enemy ponton equipment in the neighborhood. About 80 German boats of the types shown in the accompanying pictures were finally obtained.

Spans Exceed 200 Feet

Both of the foot-bridges referred to were hastily constructed by the use of *bidons*, or casks, rigged as floats. In each case the span was about 230 ft. The heavier trestle bridge over the Marne, with a span of 215 ft., was built of any material that could be quickly obtained near at hand. Into this structure went a number of telegraph poles and a quantity of 3 x 9-in. planks which happened to be at a near-by dump.

The accompanying photographs indicate the types of bridge structure employed and show the details of the captured German pontons, which are now serving to transport the men and material of the allied forces across the Marne. An inventory of the bridging material abandoned by the enemy in the divisional area where United States engineer troops were operating shows the following: Enough pontons and ponton equipage for about 30 bays of span, 6 ponton wagons in fair condition, 2 piledrivers, a large quantity of bridge timber and other miscellaneous bridging equipment.

Length of Motor-Truck Stop Varies Inversely as Braked Load

Tests Show That Shortest Stops Are Made By Trucks Having Large Percentage of Load On Rear Wheels

BRAKING tests of motor trucks and automobiles which have been made in Chicago show the advantage of concentrating a large proportion of the load on the braked wheels, which are the rear or driving wheels. Maximum braking effect, it is known, may be obtained by so controlling the brakes as merely to retard the revolution of the wheels. If the wheels are stopped or locked they will slide on the paving, and the resistance due to sliding may be considerably less than that due to braking. In tests made by the engineers of the Nash Motors Co., however, it was assumed that in an emergency most drivers would apply the brakes so hard as to lock the wheels, and the distance was measured from the point where the wheels began to slip to the point of stoppage.

In regard to sliding, it is stated by G. W. Smith, assistant chief engineer, that the coefficient of friction of rubber tires on dry paving is taken usually as 0.6 to 0.7. The tests were made on a concrete road having a thin coating of oily dust, and the coefficient was found to be only 0.475 to 0.530. It is thought probable that an average of 0.5 would apply to all the vehicles in the test, whatever their weight. Mr. Smith explains that the point it was desired to bring out was that the ability to retard a vehicle depends upon the proportion of the total weight of the vehicle which is imposed upon the the tires subject to braking action. Thus, a vehicle having 65% of its total weight on the rear or brake wheels would make a stop proportionately quicker than one made by a vehicle in which this load was only 50 per cent.

With a uniform speed of 20 miles per hour the shortest stops were made by trucks having a relatively high percentage of total weight carried by the rear or

TABLE I. STOPPING TESTS ON MOTOR VEHICLES BY NASH MOTORS COMPANY—SPEED 20 MILES PER HOUR

Vehicle	Paying Load, Lb.	Total Weight, Lb.	Weight on Rear Axle, Lb.	Weight on Front Axle, Lb.	Braked Load, %	Average Length of Stop, Ft.
1-ton truck	1,500	4,740	3,060	1,680	65.0	39.0
1-ton truck	4,000	7,348	5,740	1,608	78.7	36.2
Touring car	.....	3,085	1,575	1,510	51.0	53.7

braked wheels, while the longest stops were made by a touring car with relatively light rear wheel loading. The results are shown in Table I.

Another set of tests was made by L. D. Hemman, superintendent of delivery for "The Fair" department store. Owing to differences in methods of observation it may be noted that the results are not directly comparable with those of the first set, as the percentage of braked weight is not given. The results, however, are shown in Table II. Solid rubber tires were used on all the trucks as follows: 36 x 5-in. dual tires for the 3-ton truck, 36 x 4-in. dual tires for the 2-ton trucks, and 36 x 3-in. single tires for the ½-ton truck. The touring car had 37 x 5-in. pneumatic tires. Mr. Hemman states that these last were inflated to a low pressure, which allowed them to flatten somewhat and thus

give a greater traction surface than if inflated to their full capacity, which, it may be pointed out, would explain the short stop made by this vehicle on the dry pavement.

Skidding of light trucks on wet pavement when the brakes were applied took place in Mr. Hemman's tests, which were made on asphalt paving and with a uniform

TABLE II. STOPPING TESTS ON MOTOR VEHICLES BY L. D. HEMMAN—SPEED 15 MILES PER HOUR

Vehicle	Dry Asphalt Total Weight, Lb.	Dry Asphalt Length of Stop, Ft.	Wet Asphalt Total Weight, Lb.	Wet Asphalt Length of Stop, Ft.
½-ton truck	4,700	23	4,700	61
2-ton truck	8,500	19	8,850	52
2-ton truck			9,000	55
3-ton truck			10,000	48
Touring car	4,600	19½	4,600	73

speed of 15 miles per hour. When the streets were very wet, with a slight coating of sloppy snow, the skidding tendency of the lighter machines was increased so greatly that it was found almost impossible to keep them from turning round completely while stopping. In spite of all care they skidded from the middle of the street to the curb, while the larger trucks would skid only 2 or 3 ft. out of line.

Records of these tests have appeared in publications of the Motor Truck Owners' Association, Chicago, and have been furnished by F. E. Ertsman, executive secretary.

Study Economics of Bridge Repair and Replacement, Urges C. A. Morse

WAR conditions affecting labor, material and the money market make it especially desirable to avoid reconstruction of bridges at this time, according to the views expressed at the annual meeting of the American Railway Bridge and Building Association by C. A. Morse, director of maintenance in the operating division of the United States Railroad Administration, and formerly chief engineer of the Rock Island lines. The following is an abstract of that part of the paper relating to bridge work:

It is possible to extend the life of pile and timber bridges indefinitely by replacing annually the separate parts of the structure. This being the case, it is desirable, under present conditions, to keep these structures in use by such partial renewals, although in ordinary times it is considered wise to renew a structure completely when a certain stage or life is reached.

Large quantities of treated timber, especially creosoted timber, have been used for repair work in recent years, but now it is impossible to get sufficient creosote to fill requirements. On the other hand, to renew bridges entirely with untreated material would result in comparatively short-lived structures. But in making repairs to extend the life by from one to five years untreated material should be used, as it will give the necessary service and is much easier to obtain than treated material.

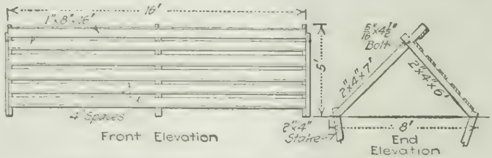
A few years ago railways could borrow money for additions and betterments at 4%, so that it was not economical to spend more than 4% of the cost of renewal in repairs that would extend the life of a structure by one year. And as labor and material cost much less at that time, it did not pay to make very extensive repairs. Now, however, this money costs from 7 to 10%, while labor and material—if they can be had—cost from 50 to 200% more than a few years ago. Therefore, we are warranted in making large expenditures for repairs at this time, especially for repairs that will extend the life of the structure until after the war, when renewals can be made at probably 25% and possibly 50% less cost than at the present time.

Careful inspection and study of each structure should be made. If it can be repaired so as to make it good for, say, four years, for 40 or 50% of what it would cost to renew or replace it, then the repairs should be made if they will extend the life one year for 7%, two years for 8% per year, or three years for 9% per year on the cost of renewal. If this policy is carried out we shall be able to get through 1919 with few, if any, full renewals of pile and trestle bridges, while there will be a great saving in both labor and material.

Steel structures should receive the same careful inspection and study. In the first place, they should be kept well painted, as nothing else gives added life to steel bridges at so little cost. Many structures that are somewhat light can be taken care of by strengthening those on important main lines or by reducing speed of trains on less important lines.

Sand and Snow Fence Protection on Colorado Roads

Four cuts on a state primary road in Colorado over a high divide between Fort Collins and Loveland have in past years blown full of snow several times during the winter. This stretch is through dry sandy land with



SNOW FENCE PROTECTS CUTS ON HIGHWAY

little vegetation to obstruct a full sweep of the wind. This year the road was protected by portable snow fences of the design shown in the accompanying cut.

During one recent winter traffic was stopped five or six times for several days. In fact the road could hardly be opened before another wind again filled the cuts level full. As the cost ran up to several hundred dollars the officials decided to install 77 16-ft. panels to protect all four cuts. The cost per panel amounted to $3.62, including construction and placing. The work was done under the direction of James G. Edwards.

Toronto Has Housing Problem

More than 5000 families in Toronto are in need of "sanitary dwellings that cannot be had, owing to the shortage," says Dr. Thomas J. Hastings, local medical officer of health, and president of the American Medical Health Association, in the monthly bulletin of the Toronto Board of Health. He also estimates that 5000 new houses will be needed yearly after the war. The board has requested Dr. Hastings to make a more extended report on the subject.

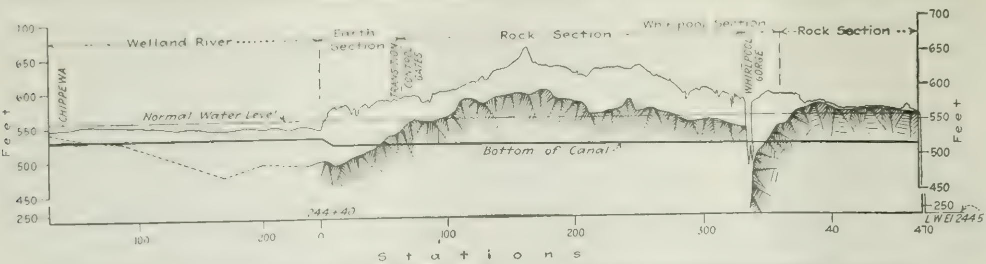
Canada Rushing Huge Niagara Development As War Conservation Measure

World's Largest Electric Shovels Digging 8½-Mile Canal Around Falls and Rapids to 300,000-Horsepower Power House in Heavy Overburden and Rock—Development to Cost $25,000,000

DIGGING partly in fine, wet clay sand, productive of dangerous slides when undrained, and partly in very stable red clay, the two largest electric revolving shovels in the world are stripping the site of the Queenston-Chippewa Canal, most of the flow section of which will be in rock. The canal, which will take water from the Niagara River above the Falls through the Welland River, locally known as Chippewa Creek, and deliver it to a 300,000-hp. power plant below the last rapids, is part of a project to develop 305 ft. net head of the 327-ft. difference in level between Lakes Erie and Ontario. The work is being pushed during the war by the Hydro-Electric Power Commission of Ontario as a conservation measure, made urgent by the great shortage of power, both steam and electric, in the territory served by power from Niagara Falls, and by the fact that none of the plants now in operation at the falls can be made to develop more than two-thirds of the total available head, while the treaty limit of possible diversion from the falls has been nearly reached, making it necessary to utilize the small surplus of available water under the maximum head which physical conditions will permit.

The construction, which is being carried on by forces of the commission, involves the removal, from the Welland River and the artificial section of the canal, of 13,000,000 yd. of earth, which is being taken out by cableway and dredge on the river section and by the big shovels in the dry cut, and 4,000,000 yd. of rock from the canal and forebay, to be removed by the big shovels and by standard railroad shovels. In addition to the power house and the gatehouse, ten concrete arch bridges, three of them carrying railroads, and a reinforced-concrete intake structure requiring extensive coffer-

CANAL FROM WELLAND RIVER TO NIAGARA GORGE BELOW RAPIDS



PROFILE SHOWING DIFFERENT SECTIONS OF CANAL, AND MATERIALS ENCOUNTERED IN EACH

dam work in the Niagara River, are among the structures required.

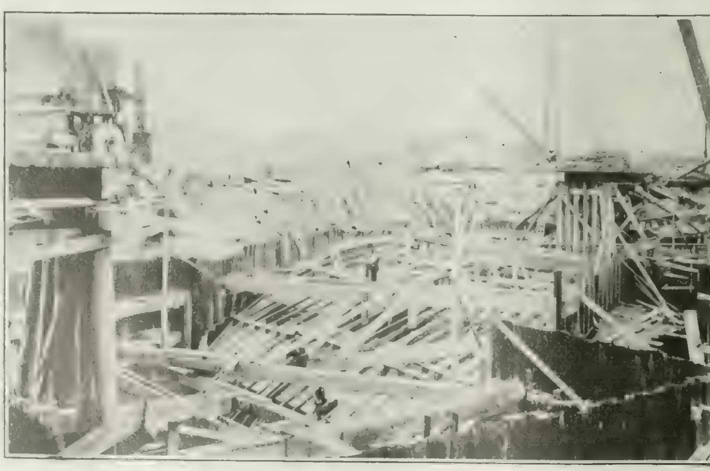
The dredged river channel, with a gradient of 0.63 ft. to the mile and a mean velocity of 2.0 ft. per second, and the canal, with a gradient of 1.1 ft. to the mile and an estimated velocity of 6 to 7 ft. per second, will pass 10,000 sec.-ft. of water. The power house will contain six 52,500-hp. units, and the site itself, as well as the scheme as a whole, is capable of being expanded, by the provision of additional waterways and power-house space, to take the entire quantity of water that can be diverted under the present treaty on the Canadian side, amounting to slightly more than 1,000,000 hp. capacity.

Drawing water from Grass Island pool after a slight fall from Lake Erie, and delivering it back into the Niagara River below the last rapids at a point where the fall to Lake Ontario is but little more than a foot, the general scheme of development is thought to be by far the most favorable of any yet conceived, and will cost, complete, about $25,000,000. The time of completion is conditioned by the excavation, on account of the heavy yardage involved, and the opening up of the work and the method of attack with large shovels was dictated by the character of the overburden, which could not be depended upon to support heavy, concentrated loads. The nature of the soil, which contains a considerable quantity of ground water and is so fine in places as to have the appearance of clay, made the use of large draglines, operating from the tops of the slopes, out of the question. For the same reason it was desirable to carry the heavy excavating equipment right through on the rock surface, to avoid the continuous trouble with soft ground. This required shovels with a great reach, cars on a track 64 ft. above the rock surface having to be loaded at several points. Very large revolving shovels were therefore selected for the work. One has a 90-ft. boom set at 53 deg., with a 58-ft. dipper stick and a 5-yd. dipper. Another has an 80-ft boom set at 45 deg., a 54-ft. dipper stick and an 8-yd. dipper. A third shovel, similar to the second, will soon be installed. After the earth is stripped and the three shovels are put on the rock excavation, all will be equipped with 5-yd. dippers.

The cut is made by starting a pilot near one side of the canal prism with a railroad shovel, loading cars on the ground surface. In this cut are run the loading tracks for the big shovel, which follows the pilot cut on the rock surface. The loading tracks connect with the main line at both ends, giving the shovels run-around service. With 20-yd. air-dump cars in eight- and ten-car trains, the big shovels have been able to load 4000 yd. in an eight-hour day.

The entire line of the canal is to be paralleled by a double-track standard-gage electric trolley railroad 175 ft. west of its center line. Near the middle of the work is a Y from which a double-track railroad runs two miles to the main dump, which is capable of taking 20,000,000 yd. The hauling equipment consists of one hundred and fifty 20-yd. air-dump cars, twelve 600-volt direct-current 50-ton electric locomotives, and seven steam locomotives. The maximum grade on the construction railroad, which, when complete, will contain 40 miles of single track, is 1%, and the haulage equipment is capable of making 10 miles loaded and 20 miles light with 10-car trains at any point on the line.

The trolley wires are offset 7 ft. from the center line of the tracks to permit the loading of dump cars, and in order to pass locomotive cranes, of which there are three 40-ton and two 15-ton machines on the work.

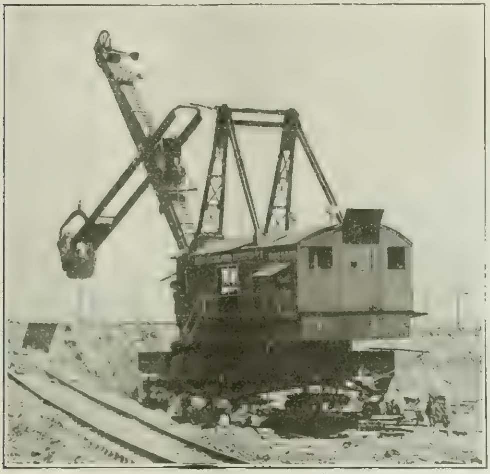


THE BRIDGES WERE BELOW THE ORIGINAL GROUND SURFACE,

The order in which the work was opened up was dictated both by the length of time required for the excavation and by the location of three existing railroad crossings. Two of these are close together, as may be seen from the map, a short distance south of the Whirlpool Gulch, a deep cut which it is believed was once the bed of the Niagara River. Just south of this gulch occurs the heaviest earth cut on the canal, a face of 100 ft. being encountered here for a short distance. The shovel that started in at the south face of this gulch is the one with the 5-yd. dipper rigged to load cars on tracks 64 ft. above grade. It was possible to dispose of the excavation from this shovel to the extent of 1,500,000 yd. in the Whirlpool Gulch itself, making it unnecessary to cross a main-line railroad in order to get to the central dump. Since the short section between the Grand Trunk Ry. crossing and the next crossing south was the location for the Y leading off to the main dump, and since it could therefore be excavated before the railroad crossings were constructed, this point was selected for starting the other large shovel. With the excavation begun in this way, both shovels could be kept busy while the first bridge was being built. The construction railroad will pass under these railroad bridges, and sufficient clearance is provided for the large shovels by taking down the booms. The southerly shovel will be let out in this way and will proceed south, following the construction railroad and the pilot cut for the loading tracks, until the overburden is completely stripped; being helped, in all probability, by the third shovel when it arrives. The loading tracks will then be lowered to the rock surface, a pilot cut will be made by the railroad shovels, as in the earth section, and the shovel now operating at the Whirlpool Gulch will follow through, taking out the rock cut to grade. The other shovels will, on the completion of the earth excavation, turn north to meet it.

North of the Whirlpool Gulch the cut is almost entirely in rock, and there is a large forebay approximately 300 by 1000 ft. to be excavated. This rock will be removed by the railroad shovels, of which there are two of 3½-yd. and one of 2½-yd. capacity. There are also two ⅞-yd. caterpillar revolving shovels on the work.

The forebay excavation was begun when the two large shovels were started, in order to provide rock for track ballast and for concreting. As the heavy end of the rock excavation is near the forebay, and as little stripping had to be done, the main crusher plant was located here. The rock, which is Niagara limestone, will be used as aggregate for all the concrete. A concrete plant located at the lip of the gorge above the power house will be able to concrete the head house and power house by gravity. As these structures will not take more than 18 months to build, it has not been necessary to start them as yet, and no work beyond the clearing of the building site has been undertaken at this point.



ONE OF THE SHOVELS WAS RIGGED TO LOAD CARS ON TRACKS 64 FEET ABOVE GRADE

The remaining portion of the work, the dredging of the Welland River, is being carried on simultaneously by a 3-yd. dipper dredge and a large cableway operating a clamshell bucket. On account of bridges, houses and rough ground the cableway was not able to start within 4400 ft. of the intake, and the work between that point and the Niagara River will be done by the dredge, the material being scowed into the Niagara River. The cableway has an 80-ft. head tower and a 60-ft. tail tower, both traveling on railroad trucks on parallel double tracks. The span is 800 ft., and the rig handles a 3-yd. clam. The head tower on the north bank of the river is set far enough back so that all the excavated material can be disposed of by dumping it on that bank. The total cut in the Welland River is to a depth of 30 ft. below the surface, but at 24 ft. below the surface a limited deposit of quicksand has been struck, which cannot be dug with any type of grab bucket yet tried on the cableway. It will prob-

ably be necessary to remove this quicksand with a dipper dredge.

As might be expected, the early construction of the railroad bridges is essential to the prosecution of the excavation. The first started is the center one, as shown on the drawing. This bridge will let the southern shovel out, and by the time it is finished there will still be sufficient time to construct the Grand Trunk crossing before the second shovel will be ready to come through with the rock cut.

To build these bridges, holes had to be dug in the ground, and steel sheet piling used for cofferdams. As shown in one of the photographs, the crown of the arch in the first bridge built is below the ground surface. This bridge is for an electric railway road from Niagara Falls to St. Catharines, but the loading specified by the electric railway company was as heavy as that for either of the steam railroad bridges.

The railroad bridges each contain about 3500 yd. of concrete, each being a single arch. This excludes the wing walls, which will not be placed until the canal excavation has been completed. Because the bridges are built below the original ground surface, the concreting proved easy. It was only necessary to set up a mixer with a loading hopper on the edge of the excavation and spout the concrete directly to place in the forms. The mixer at the first of these bridges was served by a locomotive crane, material being received on a spur from the Grand Trunk Ry. The excavation was carried out with two derricks, the material being dumped around the cofferdam.

As will be seen from the profile, the first rock excavation available was at the lower end. The forebay excavation was begun by shooting out a 10-ft. lift over the entire area, about 1100 holes being fired at once. About one pound of dynamite to the yard, including that used for springing the holes, was used. Each hole was sprung with five or six sticks and loaded with 15 or 20 sticks, the spacing being 7 ft. each way. Several experiments with blasting caps wired up in various ways were tried in an adjacent open field, to make sure that the loaded holes would be fired simultaneously. The firing was done with a high-amperage but low-voltage current thrown with a single switch. As a result of this blast, about 60,000 yd. was broken fine enough to be handled by the railroad shovels.

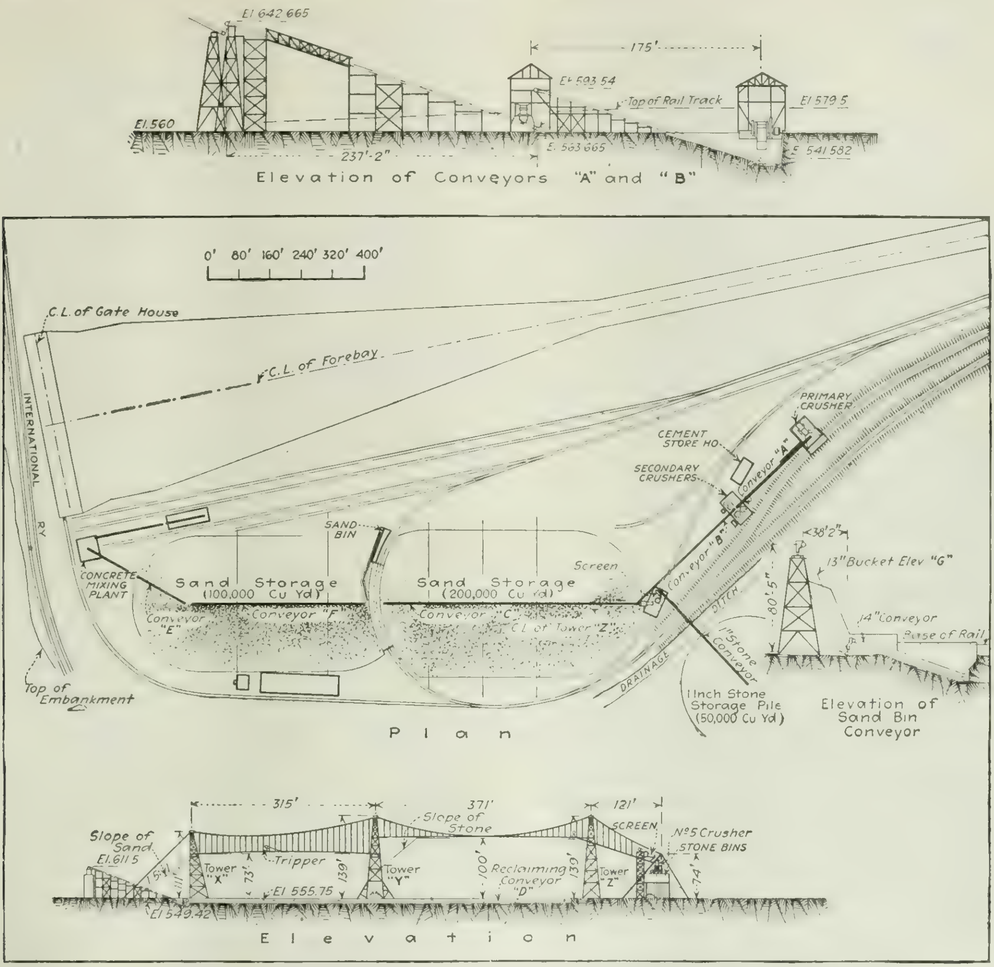
The crusher plant near the forebay receives material by rail in the 20-yd. dump cars. These discharge direct into a large hopper lined with 2½ x 6-in. steel bars laid flat, and feed a 60 x 84-in. jaw crusher operated by a 250-hp. motor. This crusher reduces the stone to 8-in. size and delivers it to a belt which takes it to the top of the secondary crusher house, where it is fed into three gyratory crushers that reduce it to 2-in. size. From these crushers the material passes through a screen which removes dust and oversize aggregate, and is then carried on a suspended belt conveyor over the storage pile. At the end of the storage pile is the bin structure for the receipt of 1-in. stone to be used for reinforced-concrete work. The 1-in. material is obtained by bypassing the oversize aggregate, after it leaves the screen, into a small auxiliary gyratory crusher, which delivers its product directly into the bin mentioned above.

CABLEWAY EXCAVATOR AND NEAR VIEW OF GRAB BUCKET ON WELLAND RIVER SECTION

Under the storage pile is a gallery containing another conveyor for delivering stone to the concrete plant, which it is planned to build as shown in the layout drawing.

The rock-excavation work on the canal itself is carried out in such a way as to produce smooth sides and secure the maximum flow. It is the intention to channel the rock down to the water line in advance of blasting, and to break the rock back below this face so as to allow for a 6-in. lining of concrete throughout the entire flow section. There are 15 duplex channelers cutting to a depth of 20 ft. at one operation on the work, most of them being at present employed around the forebay. The channelers and the tripod drills are operated by compressed air delivered by a 10-in. pipe.

There will be 12 motor-driven compressor units, having a total capacity of 12,000 ft. per minute, on the work. A capacity of 8000 ft. is concentrated at the Whirlpool station in the center of the work now in progress, and the other 4000 ft. is located at Montrose station at the southern end of the line. Six of these machines are now in operation at the first-mentioned station, where one of the main transformer substations for the work is also situated. After-coolers are used on the compressors, and it has not been necessary to employ reheaters, although these may be resorted to in cold weather. At present the loss of pressure in delivery from the central station to the drills in the forebay is about 3 lb. per square inch, the drills taking air at a little more than 100 pounds.



LAYOUT OF CRUSHING, CONVEYING AND CONCRETE MIXING PLANT AT POWER HOUSE

Because plenty of electric power was available, and because shipments of coal are becoming more and more difficult to obtain promptly, electric power was used wherever possible on the work. As stated, the haulage equipment uses 600-volt direct current, transformed by rotary converters at the central stations. The other equipment uses 440-volt alternating current, the lines to the two large electric shovels carrying current at 4000 volts to transformers on the shovels themselves. For the smaller plant units the current is stepped down before being delivered to the machine.

For organization purposes, the work, which is being done entirely by the forces of the Hydro-Electric Power Commission, has been divided into four sections. The first of these includes the deepening of the Welland River. The second is the portion of the main canal from station 0 to station 235, the third is the other half of the main canal from station 235 to the forebay, and the fourth section includes the power house, gatehouse and the forebay itself. Sir Adam Beck is chairman of the commission, for which Frederick A. Gaby is chief engineer, Henry G. Acres hydraulic engineer, T. H. Hogg assistant hydraulic engineer and M. V. Sauer designing engineer. The work is in charge of J. B. Goodwin, works engineer, under whom G. H. Angell is general superintendent and A. C. D. Blanchard field engineer. F. W. Clark is assistant field engineer, R. T. Gent plant engineer, and William Snaith office engineer. C. F. Whitney is resident engineer on divisions 1 and 2, George Lowry on division 3, and W. S. Orr on division 4.

United States Helps Engineers To Employment

Placements of engineers during September by the Division of Engineering, United States Employment Service, in Chicago, number 1658. During the same period 5161 engineers registered their qualifications with the division.

Sewage Sedimentation Advised for Cleveland, Ohio

Considered Far More Effective than Fine Screens—Chlorination at Lake Plants—Filtration at River Plant

SEDIMENTATION in two-story tanks for preliminary treatment at all three of the proposed sewage-works for Cleveland, with disinfection of the tank effluent at the two lake plants, the Easterly and Westerly, and with sprinkling filters for final treatment at the Cuyahoga River or Southerly plant, has been recommended by Harrison P. Eddy, consulting engineer, Boston, Mass., in a report made to Robert Hoffmann, chief engineer, Department of Public Service, Cleveland, Ohio. Earlier proposals for sewage treatment at Cleveland were outlined and discussed editorially in *Engineering News-Record* of Aug. 16 and Dec. 17, 1917, pp. 290, 308, 1085 and 1128.

At the two lake plants the main object of sewage treatment is protection of bathers and the prevention of beach fouling and of nuisance from gas-lifted solids, while the river plant is needed to prevent nuisance from putrefaction. Mr. Eddy's introductory summary of his report, with some condensation, follows.

Results With Fine Screens

It has been proposed to pass the sewage through fine screens having $\frac{1}{16}$ x 2-in. slots, and to disinfect the screened sewage with chlorine. This method will remove the large particles of suspended matter and thus prevent substances which are recognizable as of sewage origin from reaching the lake waters and becoming a source of offense. Much of the finer floating and suspended matter would not be removed by the screens, and, while not recognizable, would still be present in the lake waters. This finer matter has been shown to be even more dangerous than much of the coarser matter, on account of the greater number of bacteria contained in the smaller particles.

Of the suspended matter not removed by the screens, some would be immediately carried away from the submerged outlet by the current either in the direction of the shore or away from it, and the remainder would be deposited upon the bottom of the lake in the vicinity of the outlet pipe, in the form of sludge.

The wave action will tend to disperse these sludge deposits from time to time, and will cause more or less of this matter to be carried along by the bottom or by the surface currents, as the case may be. In this way a great mass of such matter may be carried to the shore at times of relatively high wind. In warm weather gas generated in the sludge deposit will cause great masses of it to rise. These masses will gradually become broken up and portions of them will be carried at times to the shore.

In the process of disinfection it is difficult for the disinfectant to penetrate the particles of suspended matter and kill the bacteria inclosed within them, unless very large proportions of disinfectant are used and prolonged periods of contact provided. Tests made at West 58th St. show that even with as large a quantity of available chlorine as 10 p.p.m. the bacteria within the particles of suspended matter will not be killed in a period of contact as long as 30 min., which is as great as will be provided by passage through the submerged outlet pipe.

Sedimentation Far More Effective Than Screening

Efficient sedimentation will remove approximately nine times as much of the suspended matter in the sewage as fine screens, and thereby remove physically a much greater number of bacteria. More important, however, is the fact that the remaining bacteria are in a position to be reached and destroyed by the disinfectant. Thus, not only can a smaller quantity of disinfectant be used, but the process as a whole, when practically applied, will be much more efficient in the removal of bacteria than the fine-screen disinfection process.

In addition to the greater bacterial efficiency of the sedimentation-disinfection process, it should be noted that the sewage will be deprived of the settling solids, so that sludge deposits, either in the vicinity of the submerged outlet pipe or elsewhere, will not be formed to an appreciable extent. It is also true, in my opinion, that this treatment will remove the larger particles recognizable as of sewage origin, at least as efficiently as fine screening.

Objection has been raised to the installation of two-story tanks, the upper for sedimentation and the lower for sludge digestion, on the ground that offensive odors are likely to be produced by such tanks. Such odors are more likely to escape from sludge drawn before it has become thoroughly digested. This, however, is not likely to happen after the first year, and can be avoided by the adoption of available means of control. If, as I have recommended, the sludge be barged to the lake, there should be no danger of trouble from this source. This is an entirely practical method of sludge disposal, and there is no reason to believe that it cannot be indefinitely continued. There is, however, the remote contingency that Governmental regulation may prevent such disposal at some time in the future, in which case it will be feasible to construct sludge-drying beds within buildings of greenhouse construction, for the purpose of drying the sludge. The dried sludge would then be hauled to the country for fertilizer or used for filling. This method of drying and disposing of the sludge can be carried out without danger of creating seriously objectionable odors.

Relative Costs

An Imhoff-tank disinfection plant at the Westerly site, according to my estimates, will cost about $250,000 more than a fine-screen and disinfection plant, at present prices. Under pre-war conditions this difference would have been about $170,000. The total annual charges, including interest and depreciation, for the Imhoff-tank disinfection plant, will be about $14,000 less than for the fine-screen disinfection plant, at present prices, and $10,000 less at pre-war prices.

According to my estimates, the Imhoff-tank plant for the Easterly District will cost about $425,000 more than a fine-screen plant, at present prices, and $285,000 more

at pre-war prices. The annual charges will be about $32,000 less for the Imhoff-tank disinfection plant than for the fine-screen disinfection plant, at present prices, and $20,000 less at pre-war prices.

In my opinion, the protection of the public health and comfort demands the adoption of the Imhoff-tank disinfection process in preference to the fine-screen disinfection process, in spite of the greater cost of installation.

Remarks on Activated-Sludge Process

The state Department of Health indicated its disapproval of the fine-screen disinfection plant for the Westerly District, on the ground that it will not provide sufficient purification of the sewage. In view of this position the fine-screen disinfection plant was modified to include treatment by the activated-sludge process in case it should be found that screening and disinfection did not provide adequate treatment. Subsequently the state Department of Health approved the fine-screen disinfection plant for the Westerly District, provided the city would agree to construct an activated-sludge plant as supplementary to the fine-screen plant after the latter had been in operation for one entire year, if the state Department of Health should find, upon investigation, that further treatment is necessary. The additional cost of the supplementary plant required for the activated-sludge process, based upon the estimates of 1917, is about $600,000.

While this process will provide for a greater removal of the organic matter than either the fine-screen or the Imhoff-tank process, it will not, in my opinion, produce a materially safer water for bathing and other purposes.

Such improvement as might result from this combination of processes would be obtained at a plant cost of at least $350,000 in excess of that of the Imhoff-tank disinfection process. Furthermore, the protection afforded the bathers would not be as great as that of the Imhoff-tank disinfection process, because the activated-sludge process, as proposed, is to be operated only during the bathing season. In the remainder of the year, when the fine-screen plant is in operation, the suspended matter passing the screen will be discharged through the submerged outlet, and the sludge deposits formed in its vicinity will be in a position to be carried to the bathing waters, except in so far as they may have been dissipated by storms and other conditions.

The foregoing discussion of the activated-sludge process applies solely to the Westerly District problem, as plans for the Easterly District plant have not been presented to the state Department of Health. The conditions, however, are so similar that it is to be expected that the state Department of Health will take like action in this case. The addition of the activated-sludge plant for the Easterly District would involve very large expense.

Effect of Storm Overflows

It is unfortunate that storm sewage must be discharged along the waterfront. This will occur on the average about 1% of the time, or 25 to 30 hours, during the bathing season. Under such conditions bathing should be prohibited, and the superintendents of the bathing beaches should be empowered to require the bathers to come out of the water, and to prevent further bathing until after the danger has passed.

To treat storm overflow discharges so as to remove the suspended matter appears to be a very great undertaking and to involve an almost prohibitive expense. Even to disinfect these discharges would involve large annual cost for disinfectant and labor. A further investigation should be made of this whole problem, to ascertain the number and frequency of discharges, the quantity of storm sewage so discharged, the intensity and duration of rainfall required to cause the overflows to go into action, and the effect of the storm sewage upon the bathing-beach waters. Without such data I am not prepared to advise the disinfection of storm sewage discharges.

Southerly District Prevents Different Problem

The problem of the Southerly District is somewhat different from that of the Westerly and Easterly Districts. The objectionable condition to be remedied is obviously the foul state of the river. This problem is therefore primarily one of public comfort and not of public health.

[After discussing the earlier recommendations for (1) Imhoff tanks and sprinkling filters, with sludge drying in glass-inclosed beds and sludge disposal by filling, and (2) the later recommendation for fine screens and sprinkling filters, with recovery of the sludge for fertilizer, as means of treatment at the Southerly or Cuyahoga River plant, Mr. Eddy concludes that the second plan would be "highly experimental," as regards both filter performance and sludge recovery. He then gives comparative cost estimates for this plant, and also the estimated total and yearly costs for all three plants, and a program for construction, as follows:]

My estimates show that the construction cost of the Imhoff-tank trickling-filter plant, under present conditions, will be about $8000 less than that of the fine-screen trickling-filter sludge-recovery plant, and $4000 less at pre-war prices. The annual charges for the Imhoff-tank trickling-filter plant are estimated to be $12,000 less than for the fine-screen trickling-filter plant under present conditions, and $13,000 less under pre-war conditions.

The estimates of the cost of building the [three] plants which I have recommended, are as follows:

	First Cost		Annual Charges Including Interest and Depreciation	
	Present Prices	Pre-War Prices	Present Prices	Pre-War Prices
Westerly Plant	$750,000	$449,000	$88,500	$57,700
Southerly Plant	1,266,000	844,000	103,000	70,000
Easterly Plant	1,456,000	971,000	156,900	98,800
Total	$3,472,000	$2,264,000	$348,400	$226,500

Program of Construction

The aggregate amount required to build all three plants is in excess of the sum available. It is doubtful that Governmental authority can be obtained for such an expenditure for this purpose, under present conditions. In the circumstances, it seems to me that it is a wise financial policy to provide for doing this work gradually, undertaking now a part which will afford a substantial measure of relief from present objectionable conditions and which can be done for a moderate expenditure, and postponing until after the war the remainder, representing the greatest portion of the expenditure. I therefore recommend that racks, grit chambers, disinfection building and equipment, labora-

tory building and equipment and necessary accessories be built now at the Westerly and Easterly plants, and that at the Southerly plant the racks, grit chambers, Imhoff tanks, sludge-drying beds, laboratory building and accessories be provided at the present time.

These features will all be required by the complete plants. The disinfectant can be liberally applied—as much as 10 or more parts available chlorine per million—to secure a substantial reduction in the number of bacteria. This program will permit of treating the sewage at both the Westerly and Easterly plants, which is preferable to the expenditure of all the money at one plant, as the conditions and requirements are virtually the same in both localities.

The estimates of construction cost and of operating expense, not including fixed charges, of the portions of the plants recommended for immediate installation, are as follows:

	Present Prices	Operating Costs
Westerly Plant	$116,000	$36,200
Southerly Plant	498,600	19,000
Easterly Plant	234,300	72,200
Total	$848,900	$127,400

Highway Reconstructed and Kept Open for War Traffic

Bad Stretches Rebuilt in Two Sections and Connected With Old Bituminous Macadam Surfacing—Special Bond Between the Two Sections Provided

RECONSTRUCTION of a badly damaged bituminous-macadam highway, where no détours were available, without closing the road to the present heavy war traffic, has been accomplished by the New York State Highway Department by the building of concrete slabs in two parallel sections with a longitudinal joint along the center of the road. The work was planned so as to use the smallest amounts of construction materials possible and to keep the highway passable by repairing only those portions which had given way. By this means materials which are now so hard to obtain were conserved. Of the seven miles of road repaired, three miles were reconstructed in 15 stretches, the longest of which was 9600 ft., the second longest 1060 ft., the shortest only 100 ft. The same method of construction was followed on all the stretches.

During the spring of 1918 heavy motor-truck transportation did great damage to the main roads in New York State, as it did in many other states. The principal damage was done as the frost was going out in the spring, when the saturated subgrades were unable to bear the loads put upon them by the increased industrial traffic due to the monopolizing of rail transportation by war business, and by the many Government motor-truck trains going overland to the seaboard.

This destruction was particularly pronounced on those roads of the macadam type which were without beam strength to bridge over the soft places. Hard-surfaced roads having permanent foundations suffered little damage, but those of lighter construction were practically destroyed. Roads which had carried a similar traffic throughout the winter and which would, it is believed, have carried the traffic during the dry summer months, went to pieces during the spring break-up, as predicted by highway officials. Though various means were suggested for keeping traffic off the roads at that time, no practicable solution of the problem was found.

The highway in question, which was reconstructed as noted above, was of the bituminous type, and was on Route 6, between Canandaigua and Geneva, being the main east and west highway through the central portion of the state. It was originally a 6-in. water-bound macadam road. This had been surface treated at various times and had received a bituminous resurface, being built up to an average thickness of about 8 in. It varied in width from 14 to 16 ft. and had a 4-in. crown on the surfacing and a 28-ft. width between ditches. Being one of the roads of heaviest traffic, when the spring break-up came without any let-up of this traffic, but rather with an increase in loading, it became almost impassable in many sections, as is shown in one of the illustrations. Immediate reconstruction became necessary to save the original investment.

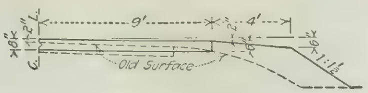
Since there are no parallel roads capable of carrying heavy traffic, détours were out of the question, and how to repair the road without interfering with the traffic

BREAKUP BY HEAVY TRAFFIC AS THE FROST LEFT THE SUBGRADE OF THE HIGHWAY

presented a problem. It was finally decided to build it in two sections, using one-half while the other was being constructed. This arrangement is stated to have worked very well, it being necessary only to locate passing places on the shoulders here and there to insure practically uninterrupted passage. The fact that the new slab was constructed only where needed, and in short stretches, allowed the passage of vehicles on the unbroken sections, and it was only on the longest stretches that special passing places had to be provided.

Designing of the slab was begun as soon as the bad condition of the road became known in the spring, and a half section of the plan finally adopted is shown in the drawing. An average depth of 7 in. was used—8 in. at the center and 6 in. at the edges. As the subgrade is flat, this gives a crown of ¼ in. to the foot, providing for prompt drainage of the water to the side ditches. The position of the slab with reference to the old surface and the new shoulders, together with the various di-

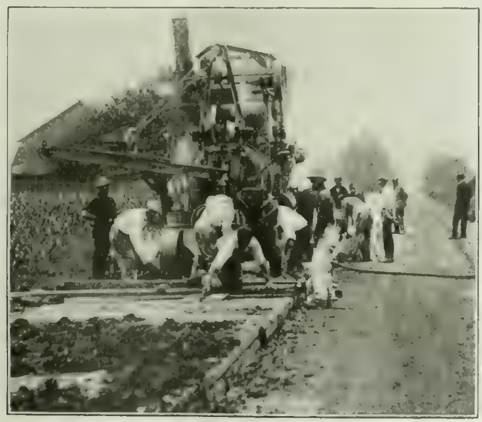
mensions are shown in the section. To bond the two sections of the slab together a V-shaped groove was formed on the inner edge of the first section of slab to be laid, and when the second section was laid care was



POSITION OF CONCRETE SLAB WITH RESPECT TO OLD SURFACING—CROWN REDUCED

taken to tamp the concrete well into the groove so as to get as good a connection as possible. While the designers do not think this will keep the various expansion and heaving forces from forming a hair crack along the central joint, they believe it will prevent the surfaces from getting out of position with respect to each other, and thus prevent the wear which would occur at this point from an uneven surface. The V-shaped bond can be readily seen in one of the photographs.

Early in the season a contract was let for the work which provided that all materials for the job would be furnished by the state, and that, upon order from the contractors, the materials would be shipped to designated sidings by the material company. The contractor's bid



FINISHING INITIAL SLAB—NOTE BOND GROOVE IN EDGE OF SLAB, SQUARE HAND FLOAT AND TEMPLET

covered grading, hauling of materials, construction of the concrete slab, connection of this slab with the old macadam surface and the finishing of the shoulders and ditches while maintaining traffic over the road.

Every effort was made to conserve labor. The rough grading was done entirely by machinery. It consisted of scarifying the old macadam and pulling the material to the sides to reduce the crown, which was too high for a concrete pavement. The scarifying was done by teeth attached to the road machine, which afterward with its blades threw the material to the shoulders. The road machine was hauled by a steam roller, and the labor required was that of two men, one to run the roller and the other to operate the road machine. The scarifying and shaping was carried on for the entire width of the road and when it was completed very little hand grading was necessary to obtain the desired flat subgrade. This force was able to rough-grade about 800 lin.ft. of 15-ft. road per 9-hour day, at an approximate cost of about 3c. per square yard.

When the rough grading was completed the fine grading was done by hand labor. Instead of fine-grading the entire section, the contractors finished only that portion which was to be constructed immediately, while the other half was kept open for traffic. The fine grading was done by the mixer gang, which consisted of a foreman and 16 men. About three hours was required for this gang to fine-grade an 800-ft. stretch which had been rough-graded by means of the road machine and steam roller. This gave an approximate total cost for the scarifying and reshaping of about 6c. per square yard.

The forms for the concrete slab were made of 2-in. plank. The outside form was 2 x 6 in., while the inside form was 2 x 8 in. with a V-shaped piece of wood spiked to it to form the groove. This V-shaped piece was made by sawing a 2 x 2 on the diagonal. Instead of carrying the groove continuously from one end of the plank to the other, it was found more convenient to form it in 6-ft. lengths with a 5-in. space between, thus giving a place to drive the iron rods which held the forms in place. Forms in position and materials delivered ready for concreting are shown in one of the illustrations.

Motor trucks were used to deliver the crushed stone and cement after the forms had been placed, the sand being dumped in advance upon properly leveled spots on the shoulder. The stone was dumped directly upon the subgrade, while the cement was piled as shown in the illustration. Ordinarily, the cement was placed along the middle form, as shown, at proper intervals to be fed into the mixer. The large pile on the stone was being placed for covering up.

Stone for this work was of the No. 2 size and was Niagara limestone from quarries in the vicinity of LeRoy, N. Y. This is a hard, flinty limestone considered of excellent quality. The sand was well-graded Niagara River grit. Cement, sand and stone were mixed in the proportion of 1:1½:3, the usual charge being two bags. Tamping and shaping of the concrete base was accomplished by means of a templet formed by spiking together three 2-in. plank stood on edge, with handles passed through them near the ends. This gave a 6-in. bottom surface, which was cut to the proper crown and shod with sheet iron ⅛ in. thick. The templet may be seen just behind the finisher, in one of the illustrations. In forming the concrete, the templet was used both as a strike and as a tamper, being moved gradually ahead as it was moved up and down, and it was heavy enough to consolidate the concrete without heavy striking, which would affect the grade on the forms.

When the slab had been formed as above, and after sufficient time had been allowed for the concrete to stiffen, it was finished with a large wooden float 18 in. square, as shown in the view mentioned above. After being finished in this manner the surface was broomed crosswise with a coarse wire stable broom to break up the film of mortar on top and give a slightly ribbed surface. This brooming is said to overcome scaling of the surface and it is reported also that it prevents the surface from becoming slippery for a long period of time.

CONSTRUCTION LAYOUT FOR INITIAL SLAB—MATERIALS DELIVERED AND TRAFFIC MAINTAINED

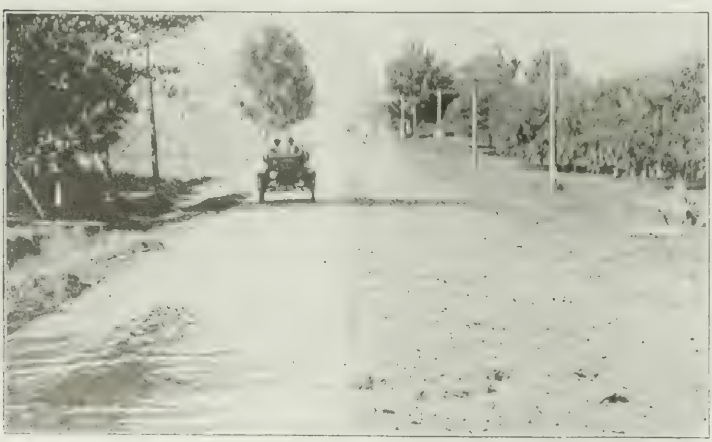
Expansion joints $\frac{3}{8}$ in. thick were placed at intervals of about 30 ft., in such a manner as to stagger on the two sections of the slab. No special clamp was used to install these joints. When it was desired to place a joint, iron pins were driven into the subgrade, and a steel plate, having its upper edge cut to the contour of the surface, was placed against them. The expansion strip, consisting of premolded asphalt, was rested against this plate until the concrete had been placed on both sides of the joint, after which the plate was removed. The width of the slab being only 9 ft., this method was feasible.

Great care was taken to protect the work after it was laid. While the concrete was still wet on the initial section, iron rods $\frac{3}{8}$ in. in diameter and looped at the upper end were forced through to the subgrade. These were placed about 15 ft. apart and were designed to support a wire along the edge of the initial slab to keep traffic from getting upon the other slab before it was sufficiently cured. These iron rods were loosened soon after the concrete had taken its initial set, so that they could be removed when there was no further need for them. When they were removed, the holes which they had formed were grouted with cement grout. The rods with the wire supported by them can be seen in one of the photographs. To protect the concrete from the sun while curing, the usual heavy covering of earth was used and was kept moist for several days. The gang used for laying the concrete slab is shown in Table I.

TABLE I.—CONCRETE GANG AVERAGED 500 FEET PER DAY OF 9 HOURS

1 foreman at $6	$6.00
1 mixer man at $5	5.00
1 fireman at $4.50	4.50
2 form men at $4.50	9.00
3 stone wheelers at $4.50	13.50
2 sand wheelers at $4.50	9.00
4 stone shovelers at $4.50	18.00
2 sand shovelers at $4.50	9.00
4 concrete shovelers at $4.50	18.00
2 cement men at $4.50	9.00
1 finisher at $4.50	4.50
Total	$106.50

The average day's work for the gang was 500 ft., while the greatest day's work was 750 ft., giving a labor cost per cubic yard of approximately $3.30, to which must be added plant rental and the cost of delivering materials upon the work. After sufficient time had been allowed for the concrete slab to set on any stretch, a connection was made with the old bituminous macadam by filling in with the same kind of material. This received an easy taper to the old work at a distance of about 12 ft. The contractor was paid for these connections by the piece. When any section of the base was ready for traffic it was properly cleaned, the



COMPLETED ROAD—ONE SECTION CURVING AND WIRE GUARD LINE IN PLACE

iron rods and guard wire were removed, and the section was opened.

Contract prices for the different parts of the work are given in Table II.

TABLE II.—CONTRACT PRICES

Earth embankment, per cubic yard	$1.00
Scarifying and reshaping, per square yard	0.17
Constructing concrete slab, per cubic yard	5.90
Maintaining traffic, per lineal foot	0.10
Junctions with old pavement, each	15.00

The earth embankment consisted in trimming the shoulders and ditches.

A completed section of the road with a curve banked to take high-speed traffic is shown in an illustration.

All reconstruction work of this character is carried on under the maintenance bureau of the Highway Department, of which F. W. Sarr is head as second deputy commissioner of highways; he works through the division engineers of the various divisions. The work described was carried on under Perry Filkin, division engineer, seventh division, and H. G. Hotchkiss, superintendent of maintenance. A. F. Hinman, the county assistant engineer, was in charge of the work. The contractor was the Greenfield Construction Co., Hornell, N. Y. H. G. McGibbons was superintendent for the contractor.

CURVE SUPERELEVATED FOR HIGH-SPEED TRAFFIC

How the War Industries Board Controls Building

Building Materials Section Passes on All Applications for Proposed Work, Which Come Through State Councils of Defense, and Coöperates With Materials Producers' Committees

CIRCULAR 21, the famous order of the War Industries Board which practically prohibited all but war building in the United States, was issued Sept. 3. Since then every bit of contemplated construction has had to be approved by some Governmental agency which ultimately reports to the War Industries Board. To take care of this new control the Building Materials Section of the board, under the chairmanship of Richard L. Humphrey, has been expanded to a size far beyond what was contemplated when it was organized.

Committees Represent Each Industry

One of the first acts following B. M. Baruch's acceptance of the chairmanship of the War Industries Board was the organization of the Building Materials Section. Rapidly thereafter, War Service Committees were formed under the direction of the section, with a representative in Washington to serve as the point of contact by which the Government requirements are communicated to the industry, and by which the problems of the industry are communicated to the War Industries Board. These War Service Committees are composed of group representatives, each representing a group of manufacturers or producers, so that all the groups represent the entire country. These group representatives are elected or confirmed by a vote of all the producers or manufacturers in the group.

The War Service Committees are bureaus of information as to facts relating to the industry, and they represent the industry in matters which affect the fuel supply, curtailment in operation, prices, and other similar problems that are under consideration by the several agencies of the War Industries Board, or the several Government construction bureaus. When information is desired, the request is communicated to the Washington representative, who in turn communicates with the group representative, and he notifies the rest of the group; in this way an answer is obtained. There are, at the present time, some 36 War Service Committees, and 20 representatives are stationed in Washington.

Materials Section Has Many Functions

The Buildings Materials Section is engaged in the following principal activities: (1) Collation of data as to resources, available stocks and capacity of various manufacturers and producers of building materials; (2) keeping a record of rates of production and delivery on various Government purchases; (3) forming standard specifications and details which serve as a basis for the purchase of various building materials, whereby the greatest conservation of labor, fuel and metals is attainable; (4) regulation of fuel supply for the building materials industry; (5) permits and clearances for building materials required in permissible construction; (6) analysis of cost data, in so far as they relate to prices; (7) handling detailed problems of the various building material industries, in order to enable these industries to meet their problems in the most efficient way.

The section has as members representatives of the War Department, the Navy Department, the Marine Corps, the Emergency Fleet Corporation, the Treasury Department, the United States Railroad Administration (a chairman and a representative of each of seven regional advisers), the Panama Canal Commission, and the United States Housing Corporation.

Frequent meetings are held between these representatives, representatives of other sections of the War Industries Board, and the War Service Committee representing the various building materials industries, to dis-

cuss the various problems relating to building construction. Standards have already been approved for composition roofing, mill work, window screens and doors. building hardware, gypsum plaster and wall board, fiber wall board and lighting fixtures, and there are now under consideration standards for heating and sanitary apparatus, electrical materials, slate and clay roofing, and paints.

How Building May Be Permitted

In accordance with the revisions of circular No. 21 the erection of buildings throughout the country is now possible under the following conditions:

No building operation can be undertaken without a license issued by the War Industries Board. If the building is for Government purposes or is an extension to an industrial plant engaged in work for the Government, the license is issued by the New Facilities Section. If the building is for essential purposes, but not directly contributing to the winning of the war, the license is issued by the Nonwar Construction Section.

Applications for a license for work of the first class must be made to the New Facilities Division if built by the Government, or to this division through the regional adviser of the Resources and Conservation Section of the War Industries Board if the construction is necessary for the winning of the war. If such an application is approved, a license is issued by the New Facilities Division.

Applications for the latter class must be made through the local and state Councils of Defense; if the application is approved, it is forwarded to the Nonwar Construction Section; and if favorable action is taken here, a license is issued. The names and addresses of these several bodies are given in the accompanying table.

Copies of such licenses are sent to the Building Ma-

STATE BODIES WHICH EXERCISE PRELIMINARY CONTROL OVER ALL BUILDING IN THE UNITED STATES

State	Body	Executive Head	Address
Alabama	State Council of Defense	L. M. Hooper, Chairman	State Capitol Montgomery
Alaska	Territorial Council of Defense	John Marshall, Executive Secretary	P. O. Box 1097, Juneau
Arizona	State Council of Defense.	C. E. Adams, Vice-Chairman....	War Work Bldg., Phoenix
Arkansas	State Council of Defense,	Wallace Townsend, Director.........	1104 Boyle Bldg., Little Rock
California	State Council of Defense.	Charles C. Moore, Director.........	Ferry Bldg., San Francisco
Colorado..	State Council of Defense.	D. W. Thomas, Secretary	State Capitol, Denver
Connecticut....	State Council of Defense.	Joseph W. Alsop....	State Capitol, Hartford
Delaware	State Council of Defense	Everett C. Johnson, Director	State Capitol, Dover
District of Columbia	Dist. Council of Defense..	William H. Baldwin, Chairman.........	502 District Bldg., Washington, D. C.
Florida..	State Council of Defense	H. S. Howard, Secretary.........	State Capitol Tallahassee
Georgia	State Council of Defense.	Price Gilbert, Chairman	State Capitol Atlanta
Idaho...	State Council of Defense	Joseph Hansen, Secretary	428 Idaho Bldg., Boise
Illinois	State Council of Defense.	Samuel Insull, Chairman	120 W. Adams St., Chicago
Indiana	State Council of Defense.	John V. Wilson, Secretary......	State House, Indianapolis
Iowa	State Council of Defense	H. J. Metcalf, Executive Secretary	State House, Des Moines
Kansas	State Council of Defense	J. C. Mohler, Secretary	State Capitol, Topeka
Kentucky	State Council of Defense	E. W. Hines, Chairman	Inter-Southern Bldg., Louisville
Louisiana	State Council of Defense	John Marshall, Executive Secretary.	State Capitol, Baton Rouge
Maine	Committee on Public Safety...............	H. P. Gardner, Executive Secretary,	Blaine Mansion, Augusta
Maryland	State Council of Defense	Lynn R. Meekins, Secretary	Union Trust Bldg., Baltimore
Massachusetts.	Committee on Public Safety	Henry B. Endicott, Executive Manager,	State House, Boston
Michigan	War Preparedness Board.	Col. Roy Vandercook, Secretary	State Capitol, Lansing
Minnesota	Committee on Public Safety	H. W. Libby, Secretary	State Capitol, St. Paul
	State Council of Defense	Prof. W. H. Smith, Acting Chairman	Agricultural College
Missouri.......	State Council of Defense.	F. B. Mumford, Chairman.	Columbia
Montana.......	State Council of Defense.	Charles D. Greenfield, Secretary........	State Capitol Helena
Nebraska......	State Council of Defense,	George Coupland, Vice-Chairman....	Bankers Life Bldg., Lincoln
Nevada.......	State Council of Defense.	H. A. Lemmon, Director..........	Reno
New Hampshire..	Committee on Public Safety	John B. Jameson, Chairman.........	State House, Concord
New Jersey	State Council of Defense.	C. H. Anderson, Secretary.. ...	State House, Trenton
New Mexico...	State Council of Defense.	Walter Danburg, General Secretary..	Santa Fe
New York.....	State Council of Defense.	William A. Orr, Secretary.........	State Capitol Albany
North Carolina..	State Council of Defense.	D. H. Hill, Chairman	Raleigh
North Dakota.	State Council of Defense.	Thomas Allan Box, Secretary......	State Capitol, Bismarck
Ohio...	State Council of Defense.	J. L. Morrill, Secretary.........	State House, Columbus
Oklahoma..	State Council of Defense.	C. H. Westfall, Assistant Secretary,	State House Oklahoma City
Oregon	State Council of Defense.	J. K. Kollock, Executive Secretary	311 Corbett Bldg., Portland
Pennsylvania..	State Council of Defense.	Lewis Sadler, Executive Secretary	7th Floor Finance Bldg., Philadelphia
Rhode Island	State Council of Defense	Capt. Geo. H. Webb, Director..........	State House, Providence
South Carolina.	State Council of Defense	Reed Smith, Secretary......	Union National Bank Bldg., Columbia
South Dakota..	State Council of Defense	George W. Wright, Secretary	Huron
Tennessee	State Council of Defense	Major Rutledge Smith, Chairman......	State Capitol, Nashville
Texas	State Council of Defense	Judge J. F. Carl, Secretary......	521 Bedell Bldg., San Antonio
Utah	State Council of Defense	Arch M. Thurman, Secretary.........	State Capitol, Salt Lake City
Vermont......	Committee of Public Safety	Joseph G. Brown, Secretary......	Montpelier
Virginia.......	State Council of Defense	C. R. Keiley, Secretary.........	State Capitol, Richmond
Washington....	State Council of Defense	M. P. Goodner, Director..........	State Capitol, Olympia
West Virginia...	State Council of Defense	Jesse V. Sullivan, Secretary.........	State Capitol, Charleston
Wisconsin.....	State Council of Defense	James B. Borden, Executive Secretary,	State Capitol, Madison
Wyoming	State Council of Defense	Maurice Groshon, Chairman	P. O. Box 115, Cheyenne

terials Section, whence issues upon application a permit by which the desired materials may be obtained. If the work involves the use of a material that by reason of shortage is being allocated, the substitution of some other material is suggested, or if the material requires a priority rating—for example, steel—the application is sent to the Priorities Division for the necessary rating. With this license, the contractor may obtain from the manufacturer or producer the building material required.

Producers' Pledge Is Signed

The building material producers or manufacturers are placed into the honor system by the Priorities Division; they sign the following pledge and must apply for a place on the preference list to obtain preferential treatment as to fuel, transportation and labor:

"The undersigned hereby pledges itself not to use, nor so far as lies within its power permit to be used, any products of its manufacture now in, or which may hereafter come into its possession or control, save (a) for essential uses, as that term has been or may be defined or applied from time to time by the Priorities Division of the War Industries Board, or (b) under permits in writing, signed by or under authority of such Priorities Division; that it will make no sale or delivery of such products to any customer for resale until such customer has filed with it a similar pledge in writing, and that it will use its utmost endeavor to insure that its products shall be distributed solely for essential uses."

The producer or manufacturer in turn obtains the same pledge from his dealers or distributors, or the user, where the material is required in the manufacture of products that are to be offered for sale. Each dealer or distributor must render a monthly statement on the 15th of each month to the manufacturer or producer whose materials he sells, showing the use of the materials sold during the preceding calendar month. The manufacturer or producer in turn submits a similar statement to the Building Materials Section for each calendar month. In the event of the manufacturer or producer, or the distributor or dealer, being unable to determine whether the proposed use is one contributing to the winning of the war, he must make application to the Priorities Division for a ruling on the question.

The War Industries Board holds that in general construction that is not essential to civilian life, or that does not contribute directly or indirectly to the winning of the war, or which may be deferred until after the war, should not proceed at this time. Under the above system, it is thought that no building will be undertaken that is not of this character. The above, however, does not apply to such repairs of and extensions to existing structures as do not exceed $2500, or to work on the farm the total cost of which does not exceed $1000.

Highway Work Under Different System

For the maintenance, reconstruction and construction of streets, pavements and highways, it is necessary to obtain a permit from the United States Highways Council. This council is composed of representatives of the Department of Agriculture, the United States Fuel Administration, the United States Railroad Administration, the War Department, the War Industries Board and representatives from the Capital Issues Committee and the United States Employment Service. It meets on Monday of each week and sits to pass upon various applications for permits for work for municipal, county or state highway construction. Applications must be made to the state highway department and through it to the United States Highways Council; they are then considered by a subcommittee and, if favorably acted upon, are referred for approval to the several representatives of the Government department on the council.

By reason of local congestion and other problems, it has been necessary for the Building Materials Section to establish branch offices in New York and its vicinity, Philadelphia and its vicinity and Norfolk and its vicinity. At these points, the demand for sand, gravel, crushed stone, brick and other building materials has been so great that in order to avoid confusion and to supervise properly the deliveries of these materials, it has been necessary to establish branch offices. In these cases the several Government departments make application to the representative of the branch office, who advises as to the manufacturer or producer with whom the order should be placed.

How Orders Are Allocated

Where a license has been granted for a project, whether it be for war work or nonwar work, application must be made to the Building Materials Section for clearance and, if a price has been established, for allocation. The recommendation as to the manufacturers or producers with whom the order should be placed, and the price to be paid, will be furnished by the Building Materials Section. This order is placed with the nearest available manufacturer or producer, so as to involve the least possible transportation. When the manufacturers or producers nearest to the given point of consumption have received orders for all the material they can furnish the orders are then placed with the nearest manufacturer or producer who can furnish the material. In this way the transportation is reduced to a minimum and an equitable distribution of Government orders is effected among the several manufacturers or producers, and the confusion resulting from placing orders is avoided. When one department purchases without regard to another, it frequently happens that a manufacturer or producer will receive more orders than he can fill, while his neighbor has very little business. The result is that the greatest efficiency in deliveries is impossible.

When the Government demand for materials takes the major part of the available supply, it is necessary to allocate this supply to the several Government departments; in order to obtain an efficient and equitable distribution of the material it is necessary for the Government to fix a price. In establishing fair prices, the Federal Trade Commission makes an investigation of the books of the various manufacturers or producers and renders a report of its findings to the Price-Fixing Committee of the War Industries Board. The Commodity Section, or the Building Materials Section in this case, conducts the preliminary negotiations with the industry and arranges for a hearing of the industry

before the Price Fixing Committee. When the industry gets a hearing the Price-Fixing Committee establishes a price, on the evidence presented by the Federal Trade Commission and by the industry. This price covers the cost of production plus a proper allowance for overhead expenses, including selling expenses and depreciation, and a profit depending on the turnover in the industry.

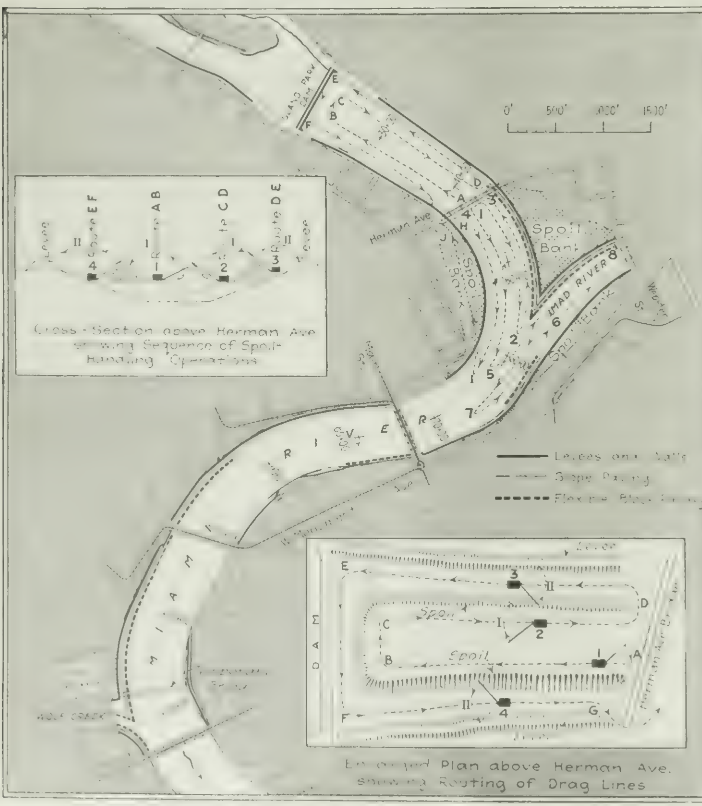
Such prices are generally fixed for both the Government and the public and are subject to review at fixed intervals of about three or four months. Prices have been fixed for the following building materials: Iron and steel, lumber, portland cement, hollow building tile, and, in the metropolitan districts of New York and Philadelphia, the prices for sand, gravel and crushed stone.

Draglines Twice Handle Spoil from Dayton Flood Channel

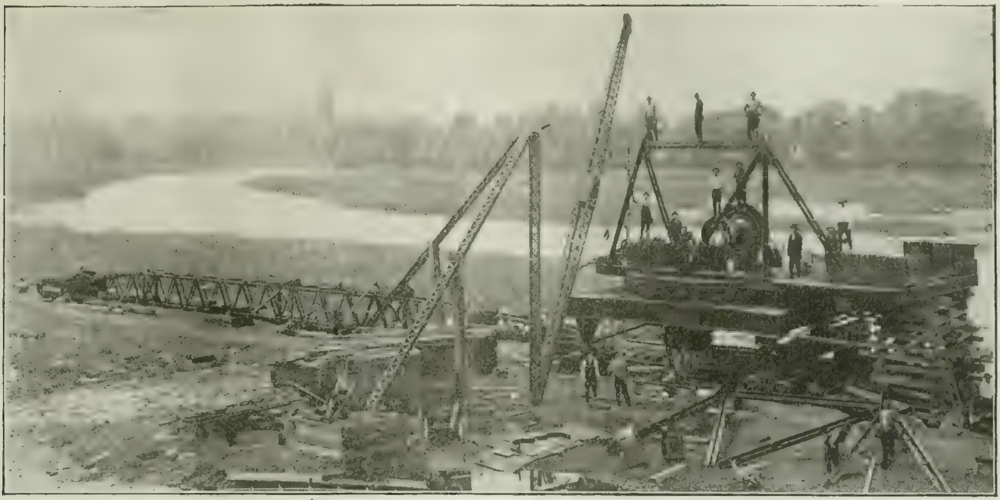
Excavator Mounted on Barge Will Dig Channel and Load to Other Scows Which Will Be Unloaded by Machine Standing on Bank

SEVERAL hundred thousand yards of material will be handled twice by dragline excavators, in improving the channel of the Miami River through Dayton, Ohio. Temporary pools are to be formed in the river by light timber dams, to give flotation for scows. One dragline mounted on a scow will excavate the channel and load onto other scows which will be towed to the spoil bank and there unloaded by a second dragline standing on the bank.

The local protection work at Dayton extends along the Miami River for a length of about eight miles. Of this distance, about five miles of the channel is to be enlarged by dredging. In addition, protection work is required for those portions of the Mad River and Wolf Creek which lie within the city limits. In the five miles of river dredging about 2,000,000 cu.yd. are to be excavated. About one-half of this distance is within a section of the city fully improved with streets and buildings, so that the opportunity for spoiling the material is small. Within the limits of this section there are to be excavated about 900,000 cu.yd.; most of the material is to be transported to spoil banks lying at the intersection of the Mad and Miami Rivers and at the mouth of Wolf Creek. It is for this excavation that dragline excavators are to be used, and a large part of the excavated material will be handled twice. Excavation was begun this summer on the upper section of the Dayton channel improvement shown by the accompanying map. Symbols on this map define the locations of levees and walls, of slope paving and of spoil-disposal areas. Spoil disposal, it will be observed, is largely concentrated in three areas near the confluence of the Mad River with the Miami. Another area near the mouth of Wolf Creek, however, cuts down the haul from a portion of the central section of the channel excavation. Preliminary work, such as assembling and fabricating plant units and getting them installed, is a large part of the first season's task, although first and last a considerable volume of excavation will be accomplished. Broadly speaking, the task involves erecting and installing the excavators, putting



[illegible] DAM FOR SCOW HANDLING OF MATE- [illegible] LINES SHOW DRAGLINE OPERATIONS PRIOR TO SCOW HANDLING

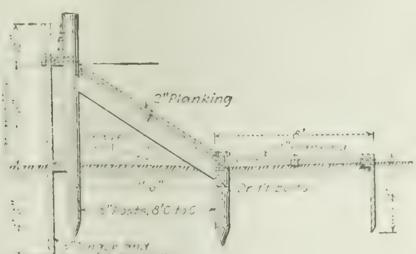


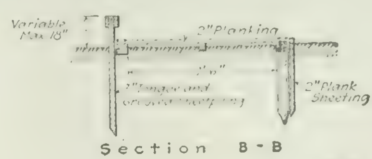
DRAGLINE PARTS MADE FIVE-CAR TRAINLOAD AND REQUIRED DERRICKS FOR ERECTION

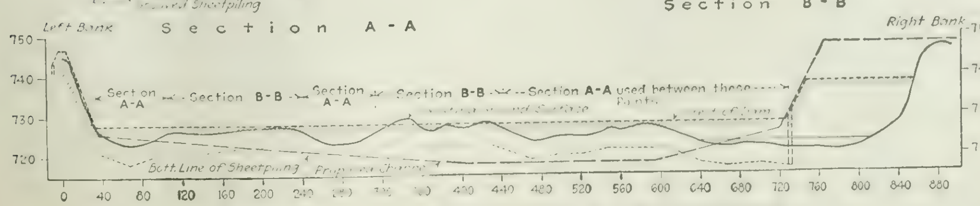
the excavators at work on preliminary channel excavation, building and launching barges and constructing a temporary dam to form the pool. The desirability of carrying the excavation downstream and the availability of sites for erecting the excavators and for building and launching barges, besides the possibility here for considerable channel excavation without barge transportation, determined the start of the work near the Herman Ave. bridge.

Two excavators of the revolving dragline type were installed for the work. Both, at the beginning, were on the regular truck mountings for shifting on track. These are similar machines. As erected for preliminary excavation prior to being mounted on scows, one is fitted with a 125-ft. boom and a 3½-cu.yd. bucket, and one with a 100-ft. boom and a 4½-cu.yd. bucket. Before transportation by scows is begun the 100-ft. boom length will be increased to 135 ft. and the bucket size will be decreased to 3½ cu.yd. Both machines are electrically operated with 250-hp. main motors and 100-hp. swinging motors. Current is brought by a special five-mile transmission line from the plant of the Dayton Light & Power Co., at 6600 volts. Transformers temporarily housed on the bank in the vicinity of the machines reduce the voltage to 2300, at which intensity it is transmitted to a second set of transformers adjacent to each machine, reducing the current to 440 volts for operating the motors. These transformers are moved from time to time by the draglines and motor trucks. It is proposed later to mount them on small scows, for floating them into positions convenient to the work.

One excavator was set up above the Herman Ave. bridge and is digging the channel to the Island Park dam, following generally the route shown by the dotted line, and rehandling the material. The material excavated in this section will practically all be required for enlarging the adjacent levees, and will therefore not have to be transported. The second excavator was erected below the bridge, and, after digging a launching pool for the barge yard, is excavating down stream and into the mouth of the Mad River, handling some of







PILE AND TIMBER DAM IMPOUNDS POOL FOR SCOW FLOTATION

the material twice and a small quantity three times. In digging out the channel under the bridge the two excavators worked together on opposite sides of the bridge, with buckets connected back to back by a 40-ft. piece of cable, and the machines pulled and slacked off alternately, moving the buckets shuttlewise under the bridge. As set for this operation the two draglines are shown in one of the pictures. When the channel work just indicated is completed the draglines will be restationed for scow work, one being mounted on a barge and the other at the spoil bank.

The general procedure of the dragline work prior to the scow handling is indicated by the map and the diagrams. Starting at A above the bridge, dragline No. 790 will proceed along the general route A, B, C, D, E and F to G; it will then have finished the channel above the bridge. The machine will then be transferred around the end of the bridge to H and proceed to I, rehandling into the levee the spoil thrown back from mid-channel by the other dragline working from 4 to 5. From I to J, machine No. 790 will dig a scow channel traversing the spoil bank area.

The operations of dragline No. 790 above the bridge are indicated in detail by the diagram sketches. Note

shown by the pictures. Provided with 24-in. square spuds, it will support the excavator when digging and float it from place to place with the progress of the work. For handling spoil the scows will be 40 x 120 ft. in size. On one side the deck will have a timber bulkhead for the unloading bucket to drag against and to help retain the 400-cu.yd. load.

Sufficient depth of water at all times to float the scows is provided by a pool impounded by a construction dam. This dam is located, as shown by the map, at a point just above the mouth of Wolf Creek, where the channel width is approximately 900 ft., as shown by the cross-section. The dam is a pile-and-timber structure which can readily be removed from the channel when its temporary purpose has been fulfilled.

A 20 x 70-ft. stern paddle wheel, steam-driven tug will be built for towing scows between the point of excavation and the point of unloading.

Channel excavation by the plan outlined calls for skillful coördination of spoil-bank volume and location, scow travel, loading and unloading time, and routing of the excavator doing the digging. The digging unit controls; all other plant units serve. Broadly speaking, the greatest economy is attained when the digging unit

DRAGLINE STARTING CHANNEL EXCAVATION AT HERMAN AVENUE BRIDGE

that these sketches indicate the single dragline in four successive positions, and do not indicate four draglines. In positions 1 and 2 the machine is digging from the channel and casting into the spoil bank; in positions 3 and 4 it is digging from the spoil bank and enlarging the channel, casting into the levees.

Below the bridge dragline No. 729 is following the route indicated by the numerals. Like No. 790 it will rehandle spoil as such work is made necessary by the width of the channel. A small portion of the excavation will be handled three times. Machine No. 729 will finish its work at 8 about the time machine No. 790 arrives at J. Immediately, then, one machine will be barge mounted, the opening in the temporary dam will be closed and scow transportation will begin.

Timber deck scows are being built in a temporary yard on the east bank just below the Herman Ave. bridge. Here a launching pool was dredged, and a lumber yard, tool house and launching ways were provided. The scow for the dragline is 40 x 80 ft. and

is kept operating always at its maximum practicable output. It is estimated that in this upper channel work three scows can be so routed that the digging unit may never be rendered idle by spoil transportation delays. A similar unloading unit will keep the scows cleared of load as fast as they are needed for the digging unit. At the present time the draglines digging and casting into spoil banks are moving from 1000 to 1500 cu.yd. in a 10-hour shift. When the work is arranged for scow handling it is estimated that an output of 1200 cu.yd. per 10-hour shift can be maintained.

Where the excavation is made adjacent to spoil banks, as that portion immediately south from the Herman Ave. bridge, the material is placed directly into the spoil banks by rehandling with the dragline machines, without the use of scows.

The section of the river below Washington St. flows for the most part through land with space available for the disposal of material, without longitudinal transportation. This section of the channel, however, is of

SCOWS BUILT ON RIVER BANK SIDE LAUNCHED INTO POOL

such width that a considerable proportion of the material will need to be handled twice in order that it may be placed in the embankments at the river's edge. These embankments will be of sufficient width to provide roadways 50 ft. wide, and the available material will be sufficient to afford an appreciable amount of filling upon the low lands that are situated outside of the roadways.

The channel improvement is a portion of the flood protection work of the Miami Conservancy District, of which Arthur E. Morgan is the chief engineer, Charles H. Paul is assistant chief engineer and C. H. Locher is construction manager. J. H. Kimball is construction engineer in general charge of the river improvement work of the district. C. A. Bock is division engineer in charge of the channel work at Dayton.

Drifting-Sand Water-Filter Test Results Reported

Large Mechanical Plant at Toronto Operating Without Precoagulation Held to Meet Contract Requirements

TESTS of the drifting-sand mechanical water filtration plant built for the city of Toronto, Ont.,•show that the plant complies with contract requirements as to amount of alum used and bacterial removal, according to a report completed some time ago. The results of the tests have just been made available for publication. The report was made by George G. Nasmith, director of laboratories, Toronto Department of Health, and N. J. Howard, bacteriologist in charge of the filtration plant laboratory.

What a Drifting-Sand Filter Plant Is

The Toronto drifting-sand filter plant was described at length in *Engineering News* of Dec. 21, 1916, p. 566. It has a contract capacity of 60,000,000 Imp. gal. in 24 hours. There is no precoagulation. The name "drifting-sand" is used because the upper part of the sand bed is made to drift across the path of the raw influent water. By this means, to quote a statement in the article already mentioned, based on information from the engineers for the plant, "the bulk of the impurities are swept out, together with a part of the drifting sand—the latter being washed and returned by the constant circulation of the water and sand." An account of the contract letting for this plant was printed in *Engineering News* of Apr. 8, 1915, p. 680, and information regarding the drifting-sand filters in an earlier stage was published in *Engineering News* of June 25, 1914, page 1446.

Five filter units of the plant were tested continuously from Dec. 5, 1917, to Jan. 11, 1918, exclusive of Sundays and holidays. The actual number of testing days was 32. During this period 108 samples of raw unfiltered lake water and a like number of samples of filtered were examined bacterially (agar, 37° C.). The bacterial content of the unfiltered water has never extended beyond 520 per cubic centimeter, and that but once. Of the other 107 samples, only 16 ranged from 50 to 500, and 50 showed 10 bacteria per cubic centimeter or less. B. coli tests with 100-c.c. samples were positive in 106 and negative in two samples of raw water, and positive in 93 and negative in 15 samples of filtered water. Using 0.1-c.c. samples the figures were 106 positive and six negative for raw, and all negative for filtered water. The average amount of water filtered daily was 31,333,333 Imp. gal., and the average amount of alum used was 1.02 gr. per Imperial gallon, as compared with a specification requirement of 1 grain. The lake water during the test is described as representing "at least the average, if not worse than average conditions." The turbidity of the raw water varied from 1 to 115 p.p.m.

and averaged 6.6, while that at the effluent never exceeded one part.

Owing to the impossibility of making chemical determinations on four days, the alum dose for those days was not adjusted to the amount of pollution. Consequently, in the summary of bacterial results given in the report and printed below, the results are given separately for 32 days and for 28 days:

"The total bacteria reduction during the 32-day period was 93.9%. When the bacteria count in the raw water was from 50 to 500 per cubic centimeter, the removal by the filter was 97%, where the specifications call for a removal of 90%. Only once was there a bacteria count of more than 500 per cubic centimeter, in which case the removal was 99.4%.

"Excluding four days' results for the reason specified, the total removal was 93.5% of all the bacteria present. When the bacteria count in the raw water was from 50 to 500 per cubic centimeter the removal was 97.2 per cent.

"The total B. coli removal, inclusive of all results during the 32-day period, was 95.8%. Exclusive of results on the four days previously mentioned, the removal was 98%. This is the removal called for in the specifications.

"The difference of 2.2% in efficiency is probably due to the failures cited above, is of no practical significance, and may well be discarded. That this is true may be seen in the results of the B. coli efficiency of the individual filters. These samples from the individual filters were collected at times when there was no disturbance due to hydro [power] failure or to insufficient amounts of alum.

"In the case of the five filters tested separately, the B. coli removal in all cases exceeded 99 per cent.

"From these results it will be seen that the efficiencies and requirements demanded in the specifications have been attained. The difference of 1/50 gr. of alum per gallon over the one grain per gallon specified may be considered a negligible quantity."

Test to Show Time Effect on Alum Use

After completing the report on the contract tests a series of special tests was made to ascertain the comparative results obtained with alum-treated water after 30-minute contact and a 3-hour sedimendation period. For this purpose two small mechanical filters were used in parallel, operating at a rate of 120,000,000 Imp. gal. per acre daily. From 0.5 to 3.5 gr. of alum per Imperial gallon was used. The report states:

"Throughout the whole series the results were uniform, showing relatively small differences, and also establishing the important point that the time element was not a factor in the purification process. Numerous brands of alum were tried and it was found that the purer the alum the better the results."

In an addendum to the report it is stated that in the near future chlorination will be adopted. In conclusion, Messrs. Nasmith and Howard say:

"The decision we arrived at when the tender for the mechanical plant was first let—'that our former conception of a filtration plant was undergoing a material change; that sterilization of the water was the vital thing from the public health standpoint, but that a filter was essential to clean the water, keep sand and dirt out of the water-supply, and thereby prevent the wear and tear of machinery, valves, taps, etc., as well as prepare the water for efficient sterilization; and that for a great portion of the year only a fraction of a grain of alum in conjunction with a slight amount of chlorine would be essential for filtration, thereby resulting in a great saving in the cost of operating'— has been generally confirmed as a sound one, not only by ourselves, but by sanitarians in civilian and army work the world over."

Concrete Replaces Steel at Gas Plant

CONCRETE staves used, owing to the shortage in and high cost of steel, in place of steel plates for the 8-ft. shells of a 200-hp. gas producer and scrubber, have proved satisfactory in about 12 months' service.

Tongued and grooved staves 24 x 10 in., 2½ in. thick, are reinforced with wire netting and a waterproofing compound is used in the concrete. While the staves are

GAS PRODUCER HAS SHELL BUILT OF CONCRETE STAVES

flat, the tongue-and-groove joints permit their being built up into a circular shell, which is bound with steel hoops. Cement that is fireproof and waterproof seals the joints. To protect the concrete from the intense heat, a 3-in. space between the staves and the interior firebrick lining is filled with "Sil-o-cell" powder. This filling is also to serve for closing any small checks or cracks, thus preventing entrance of air or escape of gas. Any large cracks could be closed with cement.

The apparatus is at Syracuse, N. Y., at the plant of the Syracuse Industrial Gas Co., which has patents covering the construction.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

St. Paul Society Appeals for Workers

Activities in engineering societies are lagging because many of the "live" pushers are finding such pressing emergency needs elsewhere. An appeal to those who must take up the home problems that are crying for solution is made in the October *Bulletin* of the St. Paul Society of Engineers:

"The usual activities of St. Paul must go on. Every variation from the normal life of the people means a congestion, a lessening in the efficiency of the machinery. The feverish activity in war work has caused the neglect of many things which are very necessary. It is the duty of those of us who stay at home to see that the work is carried on. This is a most difficult time for the St. Paul Society of Engineers. Some of our best workers are gone. Some of our other workers are occupied in war work, but a lot of us are not really busy with anything but our own private affairs.

"The St. Paul Society of Engineers needs your intelligent coöperation. It needs some actual work done by each of you to help hold the society together. There will be no special glory in doing this work. If you want glory you had better go where the bullets are flying, but if you want to do your duty here at home help wherever you can. Get in and work. Don't make excuses when you are asked to do something. Your society needs you!"

Along the same line is an editorial comment in the *Bulletin* of the Illinois Society of Architects, for the architects' societies apparently have the same difficulties in commanding active workers. Here are the views from a sister profession:

"The big problem confronting the executive officers of all architectural societies and other professional organizations is how to secure the loyal support and coöperation of the individual members of the societies. It is undoubtedly true that the majority of members of all technical and professional organizations view their membership in the same way as they view a university degree. They look upon membership in a professional body not as a commission to work with their professional brothers to better conditions, but as a mark of distinction similar to that conferred by a university degree. There is always evidenced on the part of a large number of the more prominent members of all societies a 'holier than thou' attitude and a too little regard for the viewpoint of others."

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

The United States Engineer Officer Who Located the Mexican Railway

Sir—My attention has been called to a letter in your issue of Sept. 19, p. 552, which speaks of the life and service of Capt. Andrew Talcott, and I wish to express not only my interest but also my deep gratification.

I was myself one of the party working on the original survey for the Mexican Ry. in 1858, and under his direction ran the first transit line over the mountain side in the Maltrata Pass. He was an engineer well worthy to be remembered. W. R. Eastman.

Albany, N. Y.

Compensation of Engineers

Sir—I have always been of the opinion that one reason for the failure of engineers to obtain proper recognition in the business and commercial world is that, as a class, they signally fail to show any ability in handling their own personal interests.

I refer particularly to the compensation engineers are receiving, especially from the Federal Government at this time. One of the first war moves was to decide that a civilian could not receive the commission of major in the Engineering Corps until he had reached the age of 45. A dry goods clerk or a barber who had reached the age of 35 would be commissioned major in the Quartermaster's Corps or some other branch of the Army, but a rank discrimination was made against engineers right at the very beginning.

I notice that the Government is asking for a number of mechanical engineers, to whom they are willing to pay the salary of $2000 a year. Naturally, they will expect these men to be of mature age and experience. If they were not, they would be already in the Army under the provisions of the draft law. They will also expect these men to be college graduates and men who have handled large industries, and for all this they are going to expect the men to work from 10 to 16 hours a day for $2000 a year. This is less than the Government itself is paying the average locomotive engineer and conductor on the trains that it is operating. In the shipyards, at the present time, the Government is hiring men as machinists who, in times of peace, will be employed as helpers or common laborers, and these men, for nine hours' work, are drawing 9½ hours' pay at 80c. an hour, or $7.60 a day—practically $197.50 a month, or $2370 a year.

Our engineering societies talk a good deal about compensation for engineers, but the societies as a whole seem to be as impractical as the average engineer when it comes to the matter of compensation for services.

It seems to me that the engineering societies ought to go to Washington and arrange a scale for the payment for professional services. They may object to this on the ground that they would thus be getting into the same class as the labor unions. Perhaps it is more desirable to say that you belong to a profession and remain on a high professional basis and starve to death, than it is to belong to a labor union and have your personal affairs conducted in a business-like manner.

City Engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Pretense of a Tool Record Reduces Loss of Tools by Workmen

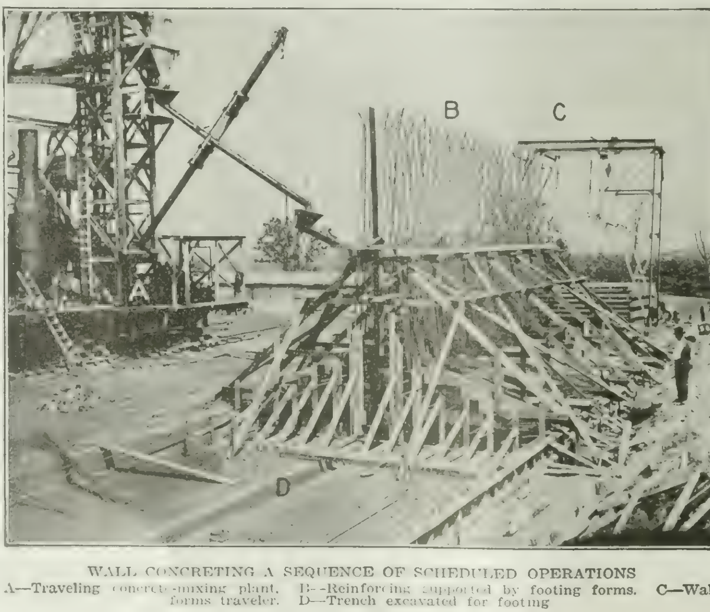
"FOR its moral effect on the workmen," says a successful construction superintendent, "make a bluff at a tool record." Experience has shown that on construction work a complete accountability record for small tools is of doubtful economy. For example, the loss of shovels which is prevented by having an inventory system and tool account complete enough to check all losses is not ordinarily sufficient to warrant the accounting expense. A great error, however, is to accept this as an excuse for keeping no records. A record of some sort should be kept, and notice that it is kept should be made conspicuous. The idea is to impress the workmen with the feeling that the property of the contractor is being carefully safeguarded. Local conditions will determine the manner of keeping the record, so that specific directions are of small utility. A few hints are, however, possible. Brand every small tool as soon as it comes from the dealer. Transfer no tools from foreman to foreman or from job to job, except through the tool room. Make a memorandum charge against the foreman or the superintendent for tools issued, and credit him with tools returned. Where possible, furnish the workmen with tool checks and require them to put up a check for every tool delivered to them. A system of following through all or any of the checks named may not be practicable, and it is not essential to obtaining results, for if there are signs that records are being kept the foreman will not know how accurate these may be and will hesitate to "borrow" or "lose" tools, for fear that the records may show their misdeeds. In these days of high cost and scarcity of material, taking such precautions is especially desirable.

C. S. H.

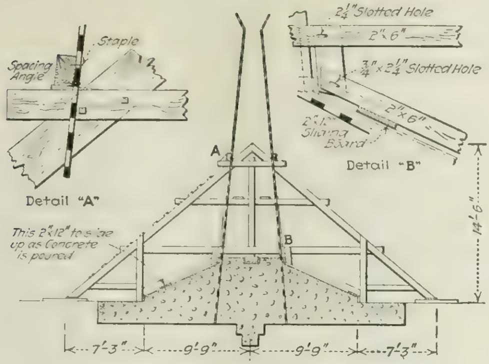
Other Articles of Interest to Contractors In This Issue:

Superframe on Footing Form Supports Thirty-Foot Wall Bars

REINFORCING bars for the 25-ft. partition wall of the St. Paul, Minn., new high-service reservoir were held upright and to accurate spacing, while the footing was concreted around their lower ends, by a light framework carried on the footing form. The processes of constructing the wall, as indicated by the view, are: (1) Excavating and shaping the footing trench; (2) setting forms and concreting footings; (3) concreting wall in sections between forms supported by a carriage straddling the wall. The details of the footing forms and bar supporting frame are shown by the drawing. In concreting the footing the inclined top surface on each side of the wall was formed by a single board, C, which, starting at the lowest point, was slid up as the concreting progressed. The mixer plant on a track parallel with the wall moved ahead concreting the footing, and then retraced its journey, concreting the body of the wall. The con-



WALL CONCRETING A SEQUENCE OF SCHEDULED OPERATIONS
A—Traveling concrete-mixing plant. B—Reinforcing supported by footing forms. C—Wall forms traveler. D—Trench excavated for footing



SUPERFRAME ON FOOTING FORM SUPPORTS REINFORCING RODS

tractors for the reservoir were the George J. Grant Construction Co., St. Paul, Minn.

Electric Lights in Operator's Cab Show Location of Cableway Bucket

AN indicator board containing 24 numbered electric lights, set up in front of the hoist runner on the cableway on the Queenston-Chippewa power development at Niagara Falls, tells the hoist runner where the bucket is at any moment. The lights on the indicator are lit through a circuit closed by a contact, on the haulage drum, which is made and broken with every revolution of the drum. The lights thus show the progress of and the distance in feet traveled by the bucket out across the river and back again to the dump. The numbers under the lights show the hoist operator the exact digging position of the bucket, and prevent him from making a hole in the river bottom, which would lower the efficiency of loading. The indicator also makes accurate and rapid night work possible.

The device was rigged up on the job under the direction of G. H. Angell, general superintendent. The Hydro-Electric Power Commission of Ontario is doing this work with its own forces. The work is described on p. 801.

Save Air-Hose Breakage by Using 45-Degree Taps on Manifolds

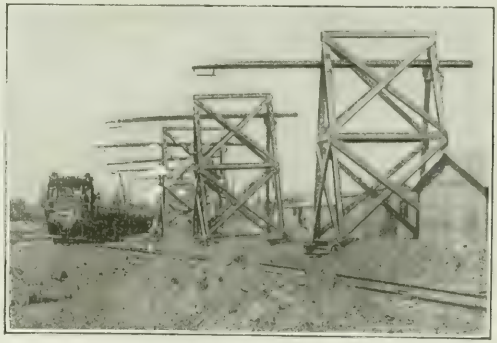
MANIFOLDS for compressed-air service in the Seattle North Pacific shipyard are made up in the shop at that yard with taps leading downward at an angle of 45 degrees, instead of at right angles to the standpipe as usual. This allows the hose to lead off downward without bending stress at the connection, and so greatly prolongs its life. The manifolds are usually made with 16 taps set in four rows of four each, 90 degrees apart. The diameter of the casting is made larger than that of the air main serving it, so the full volume is available for the taps. A globe valve is always put in with the manifold.

A pair of these manifolds is used to afford a flexible connection between the compressed-air lines aboard a ship lying at the outfitting pier, and a 4-in. lateral of the yard system. From the yard manifold 16 hoses are led, with ample length to allow for tide variations, to a similar manifold projecting over the ship rail.

Easily Adjusted Towers Support Offset Trolley Wires on Dump

HOW they keep the trolley wires away from the track center line, out of the way of shovels and locomotive cranes, move them around at will to follow the shifting tracks on a dump, and move the supports themselves with a minimum of difficulty, on the Queenston-Chippewa hydro-electric development (described on p. 801) is shown in the photograph.

The wires are supported on sliding arms carried by double A-frame towers mounted on wheels. The tracks under these towers are standard-gage, and the towers can be rolled on the main track like a hand car, and pulled anywhere on the work. They are mounted on planks at the side of the track when used in supporting the trolley wires, and are rolled forward as the dump moves out and the track is shifted. The arms which carry the trolley wires are movable by means of a sleeve nut and screw operated by a sprocket chain. This latter movement permits a very accurate and rapid final adjustment of the trolley wire. The scheme was devised by G. H. Angell, general superintendent, who has immediate charge of the construction work.



TOWERS ON WHEELS MAKE SHIFTING OF TROLLEY EASY

The offset trolley pole on the 50-ton electric locomotive is plainly shown in the photograph. As mentioned in the article referred to, the work is being done by forces of the Hydro-Electric Power Commission of Ontario.

Forestry Units' Methods in Use Here Before War

Similarity between the timber-handling methods of the American forestry units in France, as described by R. K. Tomlin, Jr., in the issue of Sept. 26, p. 566, and those in vogue in parts of this country, are pointed out by a correspondent. He states that the 35% incline operated by a donkey engine is an exact counterpart of the plant used by the contractor who some years ago built the large timber trestles on the western end of the Clinch Valley division of the Norfolk & Western Ry.; also that the sawmill illustrated on p. 568 is one of a number built at Buffalo and transported for use overseas.

NEWS OF THE WEEK

New York, October 31, 1918

Roads Burn Up in Minnesota Forest Fire

Peat Surfaces Formed from the Nearby Soil Are Destroyed—Great Loss of Life Caused Thereby

(From St. Paul Correspondent of Engineering News-Record)

Burning of the surfaces of many Minnesota highways was one of the peculiar incidents of the recent fire. The roads were built of peat dug from the ditches in obtaining drainage, and having dried out, were combustible. Great loss of life is said to have been caused on account of their becoming impassable.

The fire, which ranks as one of the greatest of forest fires in point of loss of life and property, comes next in this respect to the Michetive fire in New Brunswick in 1830. In the New Brunswick fire, from 1800 to 2000 lives were lost, while in this one, which occurred on Oct. 12 last, 1000 lives are reported to have been lost. The property damage is estimated at from $30,000,000 to $50,000,000.

Instead of being one large fire, this consisted of a number of separate fires, which were fanned by a wind of some 60 miles an hour. Thus several distinct areas are covered by this great disaster. In the main, these areas are long and narrow, which is explained by the high velocity of the wind driving them ahead, instead of allowing them to spread laterally. One of the fires started at Floodwood and ran east through Brookstown to Cloquet; another started some two miles farther north, extending eastward to Duluth. There was heavy loss of life in both of these areas. A third started near Lawler and swept southeasterly to Moose Lake. It was in this area that the greatest loss of life occurred. Other strips were burned over between these areas, and although they were not large, great damage was done to property, especially to peat farm lands.

Among the large property losses, that of the railroad companies was very great. It consisted of damage to culverts, depots, tie supplies, cars and burned-out peat roadbeds. According to newspaper reports, the losses of the Great Northern and Northern Pacific Railway companies was in the neighborhood of $500,000. The state also lost heavily in damage to its highways. Besides having the peat surfaces burned off, wooden bridges and culverts were destroyed. This prevented many people from escaping by means of automobiles, and added greatly to the loss of life. Many accidents are said to have oc-

(Concluded on page 825)

All Engineer Commissions Are Now Controlled By the General Staff

Candidates Must Make Application to Local Offices of New Personnel Branch, Which Procures All Army Officers

(Washington Correspondence)

Control of the procurement of officers for all the army's staff corps and departments is now centralized in the Personnel Branch of the General Staff, and separate recruiting endeavors of individual staff corps have been discontinued. This means that the Chief of Engineers must no longer be addressed in relation to prospective commissions in the Corps of Engineers, nor the Chief of Ordnance or the Quartermaster General for commissions in their respective corps. All staff commissions must now clear through the Chief of Staff. Line commissions—that is, in the infantry, artillery and cavalry—continue to fall under the order of Aug. 14, which requires induction into the service as privates of all candidates for line commissions within the draft ages of 18 to 45.

The new plan specifically applies to the Quartermaster Corps, Ordnance Department, Sanitary Corps, Engineer Corps, Military Intelligence Division, Motor Transport Corps, Construction Division, Department of Military Aëronautics, Bureau of Aircraft Production, Signal Corps, Chemical Warfare Service and Adjutant General's Department. It is intended to make regular announcements in the public press of the requirements in each of these branches of the service. When announcement is made of a need for

SITUATION OF LOCAL MILITARY TRAINING CAMPS' ASSOCIATION OFFICES.

City	Address
New York City	19 W. 44th St.
Boston, Mass.	Room 330, 84 State St.
Philadelphia, Pa.	117 Commercial Trust Bldg.
Atlanta, Ga.	78 S. Pryor St.
Chicago, Ill.	Consumers Building
Cleveland, Ohio	37 Wade Bldg.
St. Paul, Minn.	1013 Pioneer Bldg.
Dallas, Texas	120 Interurban Bldg.
Kansas City, Mo.	New England National Bank Bldg.
Portland, Ore.	Corbett Bldg.
San Francisco, Cal.	1020 Mills Bldg.
Los Angeles, Cal.	Van Nuys Bldg., 210 W. 7th St.
Washington, D. C.	War Service [illegible] State, War and Navy Bldg.

which the civilian considers himself in every way qualified, he will communicate with the nearest office of the Military Training Camps' Association and there obtain complete information on how to apply. If found qualified, he will receive a standard application for commission in the United States Army, which he will need to fill out carefully and return to the Military Training Camps' Association office. These offices are located as given in the accompanying table.

Later, he will be interviewed and examined. In case the requirement which attracted him has already been filled or his qualifications make him more suitable for some other service, his application may be transferred or held, properly classified and available for use, in a deferred file. A civilian who considers himself qualified for service as a commissioned officer in any branch of the Army may, if he desires, make application through the nearest Military Training Camps' Association office in advance of any definite statement of a need for men with his particular qualifications. If found on interview and examination to be generally qualified to be an officer, he will be recommended as an available candidate for a commission, and his application will be forwarded to the Personnel Branch, General Staff, and there classified and either applied to a current need or held pending the development of future needs.

In no case, under the new procedure, is it desirable to travel or write to Washington, since all recruiting for civilians to be commissioned in the specified staff corps will be managed by the district headquarters of the Recruiting Subsection and the offices of the Military Training Camps' Association.

How Rules Affect Engineer Commissions

Engineering News-Record has been informed that the cases of all candidates for engineer commissions who have already been examined by the board which traveled over the country the past summer will be taken care of by the Corps of Engineers, but that others who made application for commissions, following the call for officers between the ages of 32 and 42, but who have not yet come before the board, must renew their applications under the new rules set forth in the beginning of this article.

There is still need for engineer officers in the United States Army. According to present rules, applications will be considered from any qualified engineer except those who are in Class 1A of the draft, or who would be in that class except for deferred rating

on account of industry, occupation or employment. These latter men must be inducted into the service as privates before they can be considered for officers. Other successful candidates will be commissioned and sent to officers' training camps with the pay and privileges of their rank. If there found unsuited for the service they will be given honorable discharges from the Army. Class 1A men, on the contrary, who as privates or noncommissioned officers are assigned to the training camps, must, if unsuccessful, return to their previous rank.

Shipyard Contract Canceled by Shipping Board

New Alameda Yard Out of Program—Ship Work to Be Concentrated—Barge Contracts Revoked

Announcement was made by Chairman Hurley of the United States Shipping Board Oct. 29 that the contract awarded to the new Alameda, Cal., yard of the Bethlehem Shipbuilding Co. has been cancelled. The yard has been constructing a plant with six shipways, to build 12,000-ton transports, but the Shipping Board now finds that the utilization of cargo ships and other large vessels for troop transport, and the increase in ship production, have made further transport-building facilities unnecessary. Present provisions for ships, it is stated, will meet all demands for Army movements under the present plan contemplating placing more than 4,000,000 men in France by June. There are 104 shipways in the United States capable of building vessels of the transport type, the Shipping Board states.

Further concentration of shipbuilding facilities is in prospect. The Shipping Board has made it clear that there will be no further extension of shipbuilding facilities, except possibly to build more concrete yards or more ways in the existing concrete shipyards. However, the least efficient wood shipyards and several steel shipyards that have not performed very efficiently are to be eliminated. As stated by Charles Piez, vice-president of the Emergency Fleet Corporation, in a press statement issued last Friday, revision of the entire shipbuilding program is in prospect, because of the great burden of expense of the present shipbuilding program and because the existing program does not fully meet the needs of the war.

Contracts for 50 wooden barges and 50 composite tugs designed for use in the New England coal trade have been canceled by the Shipping Board. No work had been started on these vessels.

Reduction in the amount of steel taken by the shipyards was announced by Director General Charles M. Schwab early in the week. The present allotment of 50,000 tons per week is stated to be more than is needed under the present labor-shortage conditions, and it is to be reduced by 10,000 to 15,000 tons.

Want Engineers as Sanitary Corps Officers

Enlarged Army Program Results in Call for Water-Supply and Municipal Men

For the purpose of meeting the requirements of a considerably enlarged program of service, both in the Army camps in this country and with the American forces overseas, the sanitary engineering section of the Sanitary Corps is in need of a number of officers of the following types:

Sanitary engineers of broad training and experience in water-supply and its purification, sewerage and sewage disposal, and other engineering activities related to public health; engineers with practical experience in drainage and mosquito-control operations; epidemiologists with good training in preventive medicine and qualified to institute and administer practical measures for the prevention or control of contagious disease; municipal health officers or sanitary inspectors with sound training in the fundamentals of sanitation, and with records of successful experience in handling men and in the sanitation of closely occupied areas, such as cities and industrial communities; water chemists and bacteriologists skilled in field and laboratory examination of water and with practical experience in water and sewage problems. The present and prospective work of this section will require the services of both commissioned and noncommissioned officers, and of a relatively small number of privates.

The program for which these men are needed comprehends several principal divisions:

1. A camp sanitary engineer is appointed in practically every Army camp in this country, or is to be appointed where not already supplied, to be on the staff of the camp surgeon, for advice and counsel with respect to all those phases of camp life in which either the physical structure of the camp or engineering operations connected with some camp activity have a bearing on the health and comfort of the command. In addition to these general duties, the camp sanitary engineers are specifically charged with the inspection and supervision of the operation of the camp water-purification and sewage-disposal plants, in much the same fashion as the operation of municipal plants of like nature is supervised by the engineering division of a good state health department.

2. In many of the camps, permanent labor detachments have been formed for the purpose of instituting and carrying into effective operation practical measures for the elimination of mosquitoes and flies, the proper disposal of manure, rubbish and other camp wastes, and the general sanitary improvement of the camp site. These detachments and their work in the camps are in charge of specially qualified officers of the sanitary corps, many of whom have seen active service in the sanitation of Cuba and the Canal Zone. It is the intention to extend this service to other camps not as yet covered, as rapidly as officers and facilities therefor are made available.

3. In many of the camps the services of officers classed as epidemiologists are required for special work in connection with the prevention or control of epidemic and contagious diseases. This work is not only investigational in character, but is more especially concerned with practical measures of prevention. It is the intention that this form of service in the camps shall be greatly extended.

4. Much of the practical work of sanitation of the areas in France occupied by the American Expeditionary Forces is accomplished through the agency or under the direction of the so-called "sanitary squads" (equivalent to the "sanitary sections" of the British service). Each of these small organizations consists of four noncommissioned officers and 22 specially selected privates, including, wherever possible, a carpenter or two, a bricklayer, at least two chauffeurs, concrete men, a pipe fitter, a plumber, an entomologist if one is available, an engineer, and several good "handy men," all of whom have received some training in the principles and practice of field sanitation. The squad is under the command of an officer of the Sanitary Corps, who directs all its operations and is responsible for its maintenance. A considerable number of these squads are to be organized in the near future, proportionate to the enlargement of the Army.

5. With each company of the water-supply regiments sent abroad by the Engineer Department, and with each Army division overseas, one Sanitary Corps officer is required for field inspection of water supplies.

A Reconstruction Plebiscite

Votes in favor of the Illinois $60,000,000 good-roads bond issue and the Chicago traction ordinance for an adequate system of rapid transit are urged by the Chicago *Tribune* in the platform printed daily for more than a month at the head of its editorial page. Both of the projects will provide extensive work and employment during the reconstruction period after the war. The public will vote on them on Nov. 5. The road project was discussed editorially and described, with a map, in *Engineering News-Record* Oct. 24, pp. 740 and 777.

American Society Leases Fifty-Seventh Street Property

The American Society of Civil Engineers has made arrangements to lease its property at 220 West 57th St., New York, to the Ajax Rubber Co., for $18,000 per year. This property was used as the headquarters of the society previous to the removal of the offices to the Engineering Societies' Building at 33 West 39th St. The 57th St. property had previously been given over to the use of the Food Administration.

Heavy Cantilever Girders Hauled by Teams

Fifty-six Horses Required to Pull Them—Special Trucks Used for the Work

Hauling cantilever girders weighing 73 tons on special trucks by means of 56 horses arranged in four-horse teams is being accomplished in transporting the girders from the boats at the waterfront to the Park Ave. viaduct near the Grand Central Terminal, New York. The girders are 136 ft. long and about 12 ft. deep at the supports. Because of their length and shape, many problems had to be solved in their transfer from the boats to the site. Missing the iron work street openings was impossible in many cases and considerable breakage resulted. A description of the viaduct was given in *Engineering News-Record* of July 11, p. 81.

Several routes for the transportation of these girders were considered, but it was finally found that the only street where they could be turned into Fourth Ave., which is a continuation of Park Ave. below 34th St., was at 23rd St., and the girders were therefore delivered at the pier on East River at 23rd St. This gave only one right-angle turn at 23rd St. and Fourth Ave., and, for the girders for the east side of the viaduct, one transfer crosswise of Park Ave. at 37th St., necessitated by the fact that no driveway exists on Fourth Ave. between 33rd and 34th Streets.

Two large trucks connected with a reach and 54-ft. centers were used as the running gear. The wheels for these trucks were made of cast steel with a tire width of 14 in. and a tire thickness of 3½ in., were placed 7½ ft. centers and 9 ft. out to out of the axles. Heavy bolsters were supported by these, upon which the girders were placed flat in such a manner as to distribute the load equally between the two trucks. To prevent bending of the girders they were trussed by means of wooden bents supporting two ⅞-in. cables attached to the ends of the girders and tightened up with turnbuckles. The trucks with a girder in place are shown in an accompanying illustration. Another illustration shows the 14 four-horse teams starting up a grade between 32nd and 34th Sts. The entire outfit covered a distance of 1½ blocks.


Photos by Edwin Levick, New York

GIRDERS ON TRUCKS TRUSSED WITH CABLES

It was found that the heavy concentrations upon the wheels, amounting to nearly 20 tons including the running gear, had no respect for iron gratings and manholes in the streets. Where it was impossible to miss these they were generally broken down, and it was necessary for the public service companies to have repair gangs in attendance to repair them at once. Damage was also done to the street railway iron work and it is reported that the yokes supporting the rails and grooves for the underground trolley system were broken in many cases.

Upon arriving at 23rd St. and Fourth Ave., special maneuvering had to be used to turn the corner. The method followed was entirely to pass Fourth Ave. until the tail of the girder was at the far curb line. The teams were then turned around, and their cable fastened to the head end of the girder. By pulling back with the front axle cramped the load was backed southward into Fourth Ave. until it was headed north. Considerable trouble was experienced in performing this operation, and severe damage was done to one of the corner buildings.

Little trouble was experienced in hauling the girders up Fourth Ave., with the exception that in some places the wheels sank into the asphalt block pavement and broke up the surface. In the case of one girder which accidentally ran over the curb at 32nd St., damage was done to the curb and sidewalk, the curb being forced down into the ground until even with the surface of the pavement and the sidewalk crushed and cut off as if with a knife. On the grade between 32nd and 35th Sts., it was necessary to use a 90-hp. motor hoisting engine to aid the horses.

Inasmuch as it was necessary to bring all the girders up the west side of Fourth Ave., and transfer those which were to go into the east side of the viaduct, at 37th St., special operations were necessary for this purpose. It was necessary to dismantle the parking at each side of the street to give clearance for passage of the girders which were pulled laterally to the other side. To accomplish the lateral transfer, the trucks were jacked up and the wheels placed in a cradle, made of large timbers about 12 ft. long and 3 ft. wide and shod with ⅝-in. sheet steel. Special grooves to fit the wheels were formed in the timbers. A track consisting of five steel rails attached to timbers was used as a track on which the cradles were rolled lengthwise of 35th St., the rollers being of solid steel, 12 in number and 2¾-in. in diameter.

HORSES STARTING UP GRADE WITH GIRDER, THIRTY-SECOND STREET

In making the transfer the teams were removed and a motor truck was attached to a block and tackle snubbed into a manhole, and after the jacking had been done the movement was accomplished in 15 min. Having transferred them, they were jacked down and the teams proceeded to pull them to the site. Upon arriving at the head of the grade, running down to the Grand Central Terminal, the teams were again taken off and hoisting engines on the job working with cables were used both to pull the girders down the grade and keep them from proceeding too fast.

Arriving at the site they were hosited into place by two large gallows-frames having steel caps consisting of two 20-in. I-beams from which were supported large five-sheave blocks.

The viaduct is being erected by the Terry & Tench Co. of New York, and the hauling was sublet to the Thomas McLarnon Trucking Co. of New York.

Minnesota Forest Fire

(Concluded from page 822)

curred, as people were retreating from the fire in the inky darkness caused by the smoke, through falls into these burned bridges and culverts.

Previous to this fire, and since 1893, the State of Minnesota has had five large forest fires; the Virginia fire in 1893, the Hinckley fire in 1894; the Chisholm and Grand Marais fires in 1908 and the Beaudette fire in 1910. Following the last named, the state appropriated money and established a State Forest Service. This was organized in 1911, W. T. Cox being obtained from the United States Forestry Service to take charge.

The original appropriation was $75,000 per year, but this had been subsequently cut down in 1915 to $40,000 and raised again in 1917 to $50,000, when the State Forester requested $150,000 as the minimum amount with which he could give the most meager service. To the smallness of these sums the present great disaster is laid by many. The value of the Forest Service is said to have been very well shown by this fire, the rangers and patrolmen working hard and at great risk.

The entire town of Cloquet, which has five of the largest sawmills in the world, and which is believed to have turned out more lumber than any other town in the world, was burned over, and the only thing that saved the inhabitants was the energetic work of the rangers who gave the alarm, and in an hour and a half arranged for the transportation of 8000 persons by means of automobiles and Northern Pacific trains to places of safety. The residential section of the town on one side of the river was burned entirely, while the mills on the other side were left unharmed. The people in the towns of Floodwood and Salina were also saved by the work of the rangers.

C. M. Babcock, state highway commissioner, J. H. Mullen, chief engineer, and J. T. Ellison, bridge engineer, are taking energetic means to repair the highways which have been destroyed. The cost to the state in putting out the fire and making repairs is estimated at more than $200,000.

The foregoing information is taken from an interview with W. T. Cox, state forester, who had just returned from the burned district.

Motor Truck Association of America Meets

Discusses Traffic Segregation and Various Desirable Changes in Present System

Segregation of traffic, as instituted by a recent order of the police commissioner of the City of New York and referred to editorially in *Engineering News-Record* of Sept. 12, was the subject discussed at a meeting of the Motor Truck Association of America, Oct. 23. It was brought out in the discussion that the truck mileage of some firms has been increased as much as 80% by this new ruling. The conditions on the Manhattan Bridge produced by the special segregation order made operative recently was also discussed. In opening the meeting, the secretary, T. D. Pratt, who had the chair in the absence of the president, stated that its purpose was to give an opportunity for an exchange of ideas and for asking questions.

Captain O'Connor of the city traffic department, in addressing the meeting, stated that he was without authority to say what changes were contemplated in the present rules by the department. He said that the system is now working satisfactorily from the point of view of the traffic department, but that there are individual cases of inconvenience which regulations may correct. The original idea was not to have the ordinance rigidly enforced to the inconvenience of business men, but was to keep the long-haul north-and-south traffic on certain streets. Policemen have orders not to arrest drivers who are on the wrong streets, nor to issue summonses for them, unless they repeatedly and flagrantly violate the rules.

It developed in the discussion that the rule was not being enforced reasonably in all cases, and that various patrolmen on the precinct squads interpreted it variously. This was particularly so with reference to trucks having deliveries along an entire street which is open to passenger traffic only. A patrolman at one corner will ask the driver where he is going, and the driver will answer, "Three blocks up." The officer will permit him to proceed, but when he comes to the next block, the patrolman there will force him to turn off and go to the next traffic street, up that, and over the block above, to arrive at his destination.

The inconvenience caused by the columns of the elevated railways on heavy traffic streets was also brought out. The trouble is occasioned by the inability of the trucks to dodge in and out among the columns, and this makes it advisable, according to the members, to use other streets for heavy traffic thoroughfares.

Conditions on the Manhattan Bridge were discussed by Nathan Mallouf of the Motor Haulage Co. The new regulations put into effect recently, which require all heavy traffic to go to the right, leaving the central portion of the drive for passenger vehicles only, has in some cases increased the period of time needed by trucks for crossing the bridge from 12 to 50 min. or even an hour. Twenty-five to 30 minutes is the minimum time for a truck to make the trip at present, according to Mr. Mallouf. This is due to the mixing of slow horse-drawn vehicles with the motor trucks, with no chance for passing. Various means of eliminating the interference were suggested.

Assurance was given that changes would be made in the traffic regulations in the near future, and the secretary was authorized to write a letter to the Police Commissioner setting forth the recommendations of the association.

Engineering Societies

Calendar

Annual Meetings

CITY MANAGERS' ASSOCIATION; Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

The Florida Engineering Society will hold its annual meeting at Jacksonville, Jan. 6, 1919.

The International Concrete Ship Association elected the following officers at the first annual meeting of the association, which was held in New York City: President, Victor C. Coxhead; vice-president, Russell B. Smith; secretary, H. F. Cuntz, 7 East 42nd St., New York City.

The Cornell Society of Civil Engineers elected the following officers at the annual meeting held Oct. 15: President, E. J. Moore, vice-president and chief engineer of the Turner Construction Co.; first vice-president, Charles S. Rindsfoos, secretary of the Jarrett-Chambers Co.; corresponding secretary and treasurer, E. A. Truran.

The Association of Russian Engineers for the Relief of Russia has been organized in New York City, as announced Oct. 28 by C. H. Ozols, president of the association. The organization comprises a group of Russian technical engineers, who were sent to

America by the former Russian Government to study American industrial methods, and who found it impossible to complete their work under the Bolshevist régime. The association plans to do all in its power to assist in interpreting American methods, institutions and characteristics to the Russian people, according to Mr. Ozols.

Personal Notes

CHARLES D. WEIRBACH, sanitary engineer, United States Shipping Board, and previously city engineer of Allentown, Penn., has been commissioned in the Quartermaster Corps as a captain and assigned to duty as assistant to the chief of the Construction Division. Captain Weirbach was city engineer of Allentown for 12 years and resigned in February to become sanitary engineer on the staff of Admiral Bowles of the Emergency Fleet Corporation. In this capacity Captain Weirbach had charge of the sanitation and health service of the fabricated shipyards of the American International Shipbuilding Corporation at Hog Island and the Merchant Shipbuilding Corporation at Bristol, Penn., and until recently of the Submarine Boat Corporation at Newark, N. J.

E. E. HOWARD, of Harrington, Howard & Ash, consulting engineers, Kansas City, has been commissioned in the Corps of Engineers with the rank of captain and has been temporarily assigned to duty at Fort Benjamin Harrison.

GEORGE W. HAND, valuation engineer, Chicago & North Western Ry., has been appointed corporate engineer. Valuation work will be handled in various departments, part by the operating department and part by the corporate officials.

PROF. CHARLES H. DOW, mechanical drawing department, Mechanics Art High School, St. Paul, has become an instructor in the Students' Army Training Corps, University of Minnesota, in charge of field engineering and mapmaking.

ALBERT B. GIDLEY, Marshfield, Ore., previously of the firm of Moon & Gidley, contractors of that city, has been commissioned as a captain in the Corps of Engineers.

F. C. PURCELL, assistant valuation engineer, Chicago & Eastern Illinois R.R., has received a commission as first lieutenant in Company A, Third Provisional Battalion, Engineers, Miscellaneous Personnel.

J. B. LIPPINCOTT, Los Angeles, who was previously on the engineering staff of the Los Angeles aqueduct and is now engineer for Hampton & Co., has been assigned to the Neville Island housing project, near Pittsburgh, in connection with the building of 3500 brick houses for employees of the Government ordnance plant.

W. JOCELYN E. DALE, chief engineer of power installations, Matahambre Copper Mines, Cuba, has been appointed superintendent of power, with offices at Minas de Santa Lucia, Pinar del Rio, Cuba.

E. PAUL FORD, previously city engineer of East San Diego, Cal., and engineer for the San Diego Securities Co., has been commissioned as first lieutenant and assigned to duty with the 403rd Engineers, at Fort Douglas, Utah.

J. F. DRUAR, consulting engineer, St. Paul, has been commissioned in the Corps of Engineers as a captain and assigned to duty at Camp Dodge, Iowa.

F. RINGER, formerly chief engineer of the Missouri, Kansas & Texas Ry., has been appointed chief engineer for the corporation.

J. H. A. BRAHTZ, consulting engineer, St. Paul, has been appointed instructor in mechanics, Students' Army Training Corps, University of Minnesota. Mr. Brahtz will, however, continue his practice.

SAMUEL H. LEA, Portsmouth, Va., has become field engineer for the Hill & Ferguson Co. on the Paradise Creek housing project near that city.

MAJ. HENRY S. SPACKMAN has been promoted to the rank of lieutenant-colonel, assigned to duty in the Corps of Engineers.

R. W. HAWLEY, hydraulic engineer of the California State Railroad Commission, has been commissioned as a captain in the Corps of Engineers and assigned to duty at Fort Douglas, Utah.

CAPT. C. R. FORBES, Corps of Engineers, previously professor of mining engineering, Rollo School of Mines, Missouri, has been promoted to the rank of major and is now stationed at Camp Shelby.

C. V. JOHNSON, chief engineer of James Gosselin, Ltd., engineers and contractors, Quebec, Canada, has resigned to become associated with The Foundation Co., Ltd., Montreal.

GEORGE BAKER, assistant city engineer, Dayton, Ohio, has been commissioned as a first lieutenant, Corps of Engineers.

H. C. WESTOVER, engineer for the Board of Education, St. Joseph, Mo., has been commissioned as a captain in the Corps of Engineers.

Obituary

MAJ. ALEXANDER P. CRONKHITE, 203rd Engineers, son of Major General A. Cronkhite, was killed at Camp Lewis, Washington, Oct. 25, by an accidental shot in pistol practice. He was graduated from West Point in 1915, and until recently was instructor at the Engineer Officers' Training School, Camp A. A. Humphreys, Virginia.

CHESTER P. SIEMS, head of the Siems-Carey Railway & Canal Co., died at his home in New York City Oct. 23, in his thirty-fourth year. He was born at St. Paul and was graduated from Yale in 1907, after which he entered the engineering department of the Spokane, Portland & Seattle Ry. In 1908 Mr. Siems joined his father in forming the firm of Siems & Co., for carrying out large construction programs for the Great Northern and the Northern Pacific Ry. In 1911 the firm was converted into the Siems-Carey Co., and Mr. Siems was elected president. In February, 1912, the Marsh-Siems-Carey-Smith Co. and the Siems-Carey, Ltd., both construction companies, were launched, and carried out contracts for the Chicago, Milwaukee & St. Paul, Grand Trunk, and the Canadian Pacific Rys. Mr. Siems in 1916 established the Siems-Carey Railway & Canal Co. It had a contract for 2000 miles of railroad construction in China, against which protest was made by the Japanese Government and it was postponed.

WALTER JAMES, who was consulting engineer for the Kern County Land Co. of California for 46 years, died in Los Angeles Oct. 13 at the age of 82. Mr. James went to Bakersfield, Cal., in 1872, and became engineer for Haggin & Carr, who were the predecessors of the Kern County Land Co., during the period of canal construction in Kern County.

KENNETH BERTRAND TURNER, assistant professor of theoretical and experimental hydraulics, college of civil engineering, Cornell University, died at Oswego, N. Y., Oct. 21, at the age of 36. He was graduated with the degree of civil engineer from Cornell in 1903, obtaining his master's degree in 1905. After two years' service on the United States lake survey, he became a member of the faculty of the College of Civil Engineering. He did much research work in hydraulics.

DANIEL BARTON ROGAN, maintenance engineer, Port Commission, New Orleans, La., died in that city Oct. 10. At the time of his death he was chairman of the committee of mechanical progress of the Louisiana Planters Association.

News of Engineering Industries

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

War Service Committees Aiding Washington

Transmit Government Requirements to Industries and Coöperate with War Board

War service committees, representing various industries, are acting as a channel of communication between the Government and those industries. The committees were formed under the direction of the building material section of the War Industries Board, as outlined on p. 811 of this issue, and are composed of representatives of the producers in the fields covered by the committees. Each committee has a chairman, a secretary and a Washington representative. The powers of the secretary and Washington representative in most cases are centered in one man. A tabulation of the committees, with the names of the secretaries and Washington representatives or chairmen, is shown herewith.

Quartermaster General Compiling List of Bidders

The office of the Quartermaster General is compiling a list of bidders on all articles purchased by the Quartermaster Corps. It is stated that the list is for the purpose of maintaining a closer relationship between the manufacturing and business concerns of the country and the procurement division of the office of the Quartermaster General.

The list is composed of names of companies doing or bidding on work for the Quartermaster General's office, or for the quartermaster depots throughout the country, and the names of those manufacturers and companies which make application for a place on the list will be added. It is expected that when the work is completed there will be at the disposal of the procurement officers of the office of the Quartermaster General a list of firms which produce all of the articles and materials needed by the corps. It will enable the procurement officers to keep in close contact with the manufacturers in connection with proposed purchases and requirements, without interfering with the present method of advertising and publicity, for Quartermaster Corps purchases.

Time-Recording Device for Motor Trucks

The time-recording device for motor trucks, an article on and illustration of which appeared in *Engineering News-Record* of Oct. 10, p. 694, is manufactured by the Service Recording Co., East 105th St. and Quincy Ave., Cleveland, Ohio.

Industrial War Service Committees

Name of Committee	Secretary, Washington Representative or Chairman	Address
Architectural Terra Cotta	[illegible] A. Mills, Washington Representative	729 15th St., N. W., Washington, D. C.
Automatic Sprinklers	Henry B. Cross, Sec. and Washington Representative	821 Munsey Bldg., Washintgon, D. C.
Brick	R. D. T. Hollowell, Sec. and Washington Representative	20 McLean Bldg., 1517 H St., N. W. Washington, D. C.
Building Hardware	Hartwell A. Taylor, Sec. and Washington Representative	1218 New York Ave., Washington, D. C.
Building Stone	Chas. T. Vandeveer, Sec. and Washington Representative	626 Colorado Bldg., Washington, D. C.
Cast Iron Boilers and Radiators	Frederick W. Herendeen, Chairman	Geneva, N. Y.
Cement Concrete Pipe	A. M. Hirsh, Chairman	Lock Joint Pipe Co., Ampere, N. J.
Clay Roofing Tile	J. K. Webster, Sec. and Washington Representative	615 Union Trust Bldg., Washington, D. C.
Clay Sewer Pipe	Geo. H. Tefft, Sec. and Washington Representative	311-312 Homer Bldg., 13th and G Streets, Washington, D. C.
Composition Roofing	Stewart F. Berry, Sec. and Washington Representative	510 Munsey Bldg., Washington, D. C.
Concrete Reinforcement	A. E. Lindau, Sec. and Treasurer	Mutual Life Bldg., Buffalo, N. Y.
Door Hangers and Track	W. P. Benson, Chairman	Sterling, Ill.
Electrical Materials	J. C. Dallam, Chairman	General Elec. Co., 1 River Road, Schenectady, N. Y.
Elevators	J. H. Van Alstyne, Sec.	Otis Elevator Co., New York, N. Y.
Fiber Wall Board	Carl G. Whattler, Washington Representative	Raleigh Hotel, Washington, D. C.
Gypsum and Gypsum Products	V. G. Marani, Washington Representative	415 Woodward Bldg., Washington, D. C.
Hollow Building Tile	E. R. Sturtevant, Sec.	631 Pennsylvania Ave., Washington, D. C.
Illuminating Glassware	James Lewis, Sec.	Consolidated Lamp and Glass Co. Coropolis, Penn.
Lighting Fixtures	Wm. Horn, Sec.	427 N. Broad St., Philadelphia, Penn.
Lime	Henry M. Camp, Sec. and Washington Representative	Riggs Building, Washington, D.C.
Metal Corner Beads	F. E. Sagendorph, Sec. and Washington Representative	301 Colorado Bldg., Washington, D. C.
Metal Lath	Zenas W. Carter, Chairman and Washington Representative	925 Woodward Bldg., Washington D. C.
Millwork	Geo. J. Osgood, Sec. and Treas.	228 Munsey Bldg., Washington, D. C.
Mineral Aggregate	E. Guy Sutton, Sec. and Washington Representative	104 District National Bank Bldg., Washington, D. C.
Plate Glass	Charles W. Brown, Chairman	Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Penn.
Plumbing Supplies	George Herth, Jr., Washington Representative	Southern Bldg., 15th and H Streets N.W., Washington, D. C.
Portland Cement	H. I. Todd, Washington Representative	427 Colorado Bldg., Washington, D. C.
Sand Lime Brick	Allen Walton, Sec.	Hummelstown Brownstone Co., Waltonville, Penn.
Steel Sash	V. F. Dewey, Chairman	Detroit Steel Products Co., Detroit Mich.
Slate	Arch. M. Jones, Sec. and Washington Representative	711 13th St., N. W., Washington, D. C.
Tiling	F. W. Walker, Chairman	Beaver Falls Art Tile Co., Beaver Falls, Penn.
Weather Strips	Jos. R. McCarger, Chairman	American Metal Weather Strip Co., Grand Rapids, Mich.
Window Glass	C. Ellsworth Parker, Washington Representative	301 Star Bldg., Washington, D.C
Wire Class and Ribbed Glass	Walter Cox, Chairman	Pennsylvania Wire Glass Co., 914 Pennsylvania Bldg., Philadelphia, Penn.
Wire Screen Doors and Windows	Jas. B. Henderson, Sec. and Treas.	1319 W St., N. W., Washington, D. C.

Structural Steel Contracts Sixty Per Cent. of Shop Capacity

The secretary of the Bridge Builders' and Structural Society announces that during September 60 per cent. of the entire capacity of the bridge and structural shops of the country was contracted for.

Announcements from the Emergency Fleet Corporation state that the shortage of labor was restricting the shipbuilding activities to such an extent that, for a certain period, from 10,000 to 15,000 tons of steel allotted to shipyards would be released each week for other war industries. The 50,000 tons a week assigned to shipbuilding, it was said, proved to be beyond the needs of the plants.

Time Limit Proposed for Suits on Commandeered Property

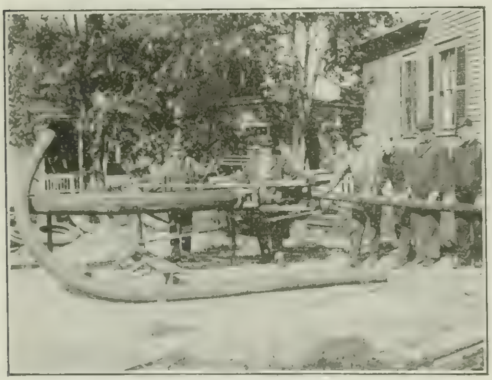
The War Department has recently sent to Congress a recommendation for the enactment of a special statute of limitation reducing from six years to four months the time in which dissatisfied owners of plants commandeered by the Government may resort to the courts for adjustment of claims. The bill covers engineering or shipbuilding plants, shipyards, vessels, mines or any other property seized for Government use.

The Washington representative of the National Federation of Building Industries, in bringing this matter to the attention of the various industries concerned, states that "there seems to

be little reason for their forcing immediate action on all cases of this character. The existence of the war offers no reason for shortening the time for bringing suit. On the contrary, it is a reason for extending it." He points out that various laws extending the time limit were passed during the Civil War and cites the recent soldiers and sailors' relief act. He concludes that Congress should either leave the existing six-year limitation as it is now or, if it is going to enact a shorter time, should make it effective at the end of the war and for longer than four months.

Reducing Cost of Bending Pipe

In an effort to reduce the cost of bending pipes from 4 to 6 in. in diameter, the machine shown in the attached illustration was designed to perform these operations on the pipe without resorting to heat. The manufacturers state that in a recent test made in Massachusetts a 6-in. pipe was bent to a 90° turn by six laborers working but 9½ min. The makers point to the difference in cost between this and the usual charge made by the average pipe bending companies. The machine is known as the Model C Hercules "Wonder" pipe-bending machine, and is manufactured by the American Pipe Bending Machine Co., Boston, Mass.



MACHINE BENDS PIPE WITHOUT USE OF HEAT

Manufacturer Is Chief of Procurement Division, Ordnance Corps

Lieut. Col. Robert P. Lamont, formerly president of the American Steel Foundries Co. of Chicago, has been appointed chief of the procurement division of the Army Ordnance Department. Immediately prior to this appointment, Lieutenant Colonel Lamont was head of the raw materials section of the Procurement Division, having been commissioned in the Ordnance Department Feb. 4, 1918. He succeeds Brig. Gen. Samuel McRoberts, who in civil life was executive manager of the National City Bank of New York, and is assigned to France to take up work with the army abroad.

"Conserve Condenser Tubes," Is War Board's Warning

A shortage of condenser tubes and repair materials, due to the heavy requirements of the Navy and the Emergency Fleet for nonferrous condenser tubes, has become such as to call forth a warning from the War Industries Board. The board emphasizes the seriousness of the situation to all the industries using condensers, and urges upon them the necessity of conserving their condenser tubes.

Convention To Represent 300 Industries Planned

A convention representing 300 industries, and which will probably bring together 3000 delegates, for the purpose of promoting productivity, both during and after the war, has been planned by the Chamber of Commerce of the United States. The convention will be held at Atlantic City December 4, 5 and 6.

According to D. A. Skinner, assistant secretary of the Chamber of Commerce of the United States, the National Chamber of Commerce has been organizing the industries of the entire country at the instance of the War Industries Board. The chamber issued calls to specific lines of industries to meet in Washington, where they are organized under the head of the War Service Commission, and they are being classified under various Federal departments to work with them directly in bringing about wider activties.

Reconstruction and a centralized scheme of organization are among the subjects to be considered.

Motors and Vehicle Division Places $130,000,000 Order

An order amounting to approximately $130,000,000 for vehicles of various kinds, principally motor-driven, has been placed by the motors and vehicle division of the office of the Director of Purchase and Storage to supply the recently-organized Motor Transport Corps. It is stated that the order is the largest ever given by the Government for such equipment.

The order includes more than 1600 motor trucks of from 1½-ton to 3½-ton capacity, more than 10,500 chassis of 1½-ton to 5-ton capacity, and more than 3600 trailers. Nearly 10,000 passenger automobiles were ordered, and more than 18,000 motorcycles and 25,000 bicycles.

BUSINESS NOTES

C. C. Stedman, formerly general manager of the Cook Motor Co., has been appointed standardization engineer for the Allied Construction Machinery Corporation. He will undertake the standardization of the lines, construction and material-handling machinery made by the manufacturers associated in the Allied Machinery Corporation for export trade.

Edgar P. Kable, formerly assistant secretary of the York Water Co., York, Penn., has been elected general manager of the company. Mr. Kable is an active member of the American Water-Works Association and the Pennsylvania Water-Works Association. The York Water Co. is one of the oldest water companies in Pennsylvania and was one of the first to use mechanical filters.

The H. W. Clark Co., manufacturer of the Clark meter box, Mattoon, Ill., is erecting a modern fire-resistive plant to replace the one destroyed by a tornado last year.

Roland S. Fend & Co., 122 South Michigan Ave., Chicago, Ill., have been appointed Chicago managers of the National Equipment Corporation, Philadelphia.

TRADE PUBLICATIONS

The Yarnall-Waring Co., Chestnut Hill, Philadelphia, has issued a loose-leaf catalogue, "Engineering Devices for the Power Plant, Yarway Products." The pages contain line cuts, half tones and descriptive specifications of the various devices made by the company.

The Carbolineum Wood Preserving Co., 34 Greene St., New York, has issued circular No. 87, on the value of timber preservation; it shows the method of application of "Protexol" as a wood preservative.

The Jeffrey Mfg. Co., Columbus, O., has published bulletin No. 246, illustrated with half tones, showing the uses of the Jeffrey pit-car loader in coal mines. It is stated that the bulletin will be sent on request.

The Barrett Co. has issued a new booklet, "Tarvia for Private Estates." It is illustrated by half tones from views of private estates wherein walks and roadways have been treated with Tarvia.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
November 7, 1918

Steel Framing for Chicago Church

I AM ONE OF MANY MILLIONS

I am part of the roof over your head.

Born twelve years ago, I have successfully passed through the uncertain period of infancy and early youth, and have each year grown stronger and better. I have multiplied rapidly and today with millions of my brothers, I am proving my worth through enviable service on America's greatest industrial plants.

I am proof positive of the principle of the survival of the fittest. No effort or expense has been spared to make me the perfect roof I am today. I am the product of twelve years of experience—twelve years of enlightened effort based upon genuine faith and the skill of a trained staff of engineering experts.

I guarantee to you *SERVICE. I Stand Upon My Record* and the record of millions of my brothers. I am

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, NOVEMBER 7, 1918 — Number 19

Adequate Forest Supervision Necessary

FOREST fires are so common that ordinarily they cause little comment. When, however, a disaster occurs of the magnitude of that in Minnesota, reported in *Engineering News-Record* of Oct. 31, p. 822, and further described of p. 841 of this issue, entailing large loss in both life and property, the whole country is aroused and adequate measures to prevent a repetition are proposed. Too often the subject is soon forgotten, and legislatures continue to practice false economy. Such procedure has now cost the State of Minnesota the loss of a thousand lives and untold property damage. In our present needs losses of this character, to say nothing of the loss of life, are particularly deplorable, and Minnesota's experience should serve notice upon legislatures that provision must be made for adequate supervision of forest areas.

Let the Public Be Heard On Reconstruction Bills

RADICAL differences between the two reconstruction bills now before the Senate concern the country's interests deeply. Shall the people be heard on the choice of method? Shall men from business and private life share in the all-important work of preparing for the nation's restoration to peace conditions? Hearings on the bills are essential to bring these questions to an issue. All who take an interest in the problems facing us should write to members of the House and the Senate, urging that public hearings be arranged before either of the bills is acted on in committee.

Can the Company's Officers Escape the Responsibility?

WHENEVER a big railroad wreck, fire or similar disaster causes great loss of life, especially within the confines of a large city, it is the fashion for the authorities to start several investigations, vowing the while that dire punishment will be visited upon the men higher up who were responsible for the conditions that made the disaster possible. Verbal fireworks fill the newspapers for a time, but in the end the worst that befalls the men higher up is a few sleepless nights. The chances for immunity in the case of the recent Brooklyn Rapid Transit wreck seem less than usual. A strike was on, and it was a substitute motorman who hurled the train against the concrete wall. Now, in spite of public clamor to the contrary, it is inevitable that operation will be less safe during a strike than in normal times; if the company is not in all cases to capitulate without a fight, and trains are to be run at all, they must be run by men less qualified than the regular crews. Where the line should be drawn has never been determined. But the cause of this particular strike was the failure of the company to abide by the ruling of the War Labor Board and reinstate 29 discharged employees. Instead, the company had referred the question to an association of the employees, which, however, had all the earmarks of being controlled by the company. For this reason the officers of the company are likely to have much trouble to explain away their responsibility for the disaster.

A Worthy Memorial to an Engineer

IT IS rare nowadays for any recognition to be given to the engineer responsible for a piece of creative work. We have come to class the design and building of great dams and huge machines and long-span bridges with the routine operations of a factory. It is especially worth while to record, therefore, an instance of a contrary sort. In the Yosemite Valley, in California, the Government has recently completed a hydro-electric plant, trifling in size, as such plants go nowadays, but of especial interest in view of its location in this National Park. On Sept. 7 this plant was dedicated, with appropriate ceremonies, as a monument to the memory of the late Henry Floy, consulting electrical engineer of New York City, who made the preliminary studies which resulted in the Congressional appropriation for its construction. In an address at the ceremony of dedication, Stephen T. Mather, Director of the National Park Service, paid a tribute to the patriotic spirit of Mr. Floy, who prepared the preliminary studies for the plant as a matter of public service, for nominal compensataion, and made an argument in its favor before the House Appropriations Committee. His death occurred shortly afterward, and the final design and supervision of the construction were carried out by Galloway & Markwart of San Francisco.

Joint Discussion of a National Problem

MORE than narrow technical interest appears in a joint meeting of the civil and mechanical engineering societies which is to be held within two weeks for the discussion of steel conservation. It is a piece of real coöperation for the societies to come together in a unified technical discussion. Clearly the centripetal forces of the times are making themselves manifest. Evidences multiply that engineers are drifting toward a common center. If this process of aggregation continues, it is inevitable that in time a definite

group will crystallize out, an engineering profession. In the present instance, more than coöperation is to be seen, however. The joint meeting will discuss a subject that is vital to the nation's industrial life—vital, certainly, in the extreme conditions of the moment, and in all probability also during the times of change lying ahead of us. Service to the community is represented in such a discussion, if it be rightly conducted.

Maximum Capacity of Motor Trucks

WHAT limit shall be set to the load capacity of motor trucks to be used upon the public highways? This question must be settled in the near future, if healthy progress is not to be retarded. While highways previously considered satisfactory are breaking down under the strain of heavy loading, and highway engineers are looking forward with apprehension to their behavior during the trying condition of the coming winter, and while there are mutterings here and there among legislators indicating action to regulate the use of trucks, this problem, still unsolved, becomes more urgent every day. As was pointed out in our issue of Aug. 8, p. 253, the only satisfactory method of determining what maximum load should be is discussion and concerted action of those most interested in its solution. With the winter legislative sessions pending, there is danger that legislative will take ill-advised action, before those who are qualified to settle this matter have had time to establish the proper working load.

A Way To Preserve Equipment Values

CONTRACTORS are notoriously wasteful of machinery value. Abuse in operation, neglect of prompt repairs, and careless storage of idle units, make up each year a loss in plant value which amounts to a heavy tax on public works. Needless deterioration of construction plant due to careless winter storage is perhaps the largest item in this aggregate. It exists because contractors widely have not divorced themselves from the old habit of considering the job as the life of the equipment.

In the days past, when most construction operations were performed by hand, men were hired for the job and let go when the job was finished. Then also the few and simple machines used were bought for the individual job and charged into the cost of that job. The job period thus came to be considered the period of service of equipment as well as of men. Each succeeding year's contracts meant a new working organization and in large measure a new outfit of machines and tools. Little inducement existed under such conditions to preserve equipment. Why operate and maintain a machine in a manner to extend its life? It would be sure to last through the job, and then its usefulness would be ended. Let the tail go with the hide!

Always a mistake, war has made this policy a vital error. Equipment prices are high. New production is limited, as metals are being commandeered for war. War construction is consuming the permitted output to the exclusion from the market of the ordinary purchaser. This winter the need is greatest for laying up equipment in such manner that deterioration will be reduced to a minimum.

Timely Words on Shipping

QUICK realization of the influence which its actions reported last week would exert on our high-pressure shipbuilding is evident in the Shipping Board's statements printed in the news columns of this issue (page 867. What Chairman Hurley and Mr. Schwab say to the yard workers is timely indeed. It brings much-needed reassurance.

But the statements go beyond this. They lay down a shipping policy for the country—or the first clause of that policy. We are to build a fleet of three thousand merchant ships. This declaration is vital to all the great development lying before us and dependent on the growth of a world commerce.

No men can speak today with more authority or with a stronger voice of conviction on the shipbuilding question than can Mr. Hurley and Mr. Schwab. They have studied intimately our maritime needs and our ability to meet those needs. They have wrestled with every one of the problems involved, and have dealt with each man in the long line from shipwright to merchant. Their plans are based on knowledge and enterprise. Support for these plans will not be wanting when the question comes to an issue.

New Views on Licensing Prevail

ON a number of occasions we have thought that the question of licensing engineers has been finally disposed of. But it will not down.

Recently we have heard eminent and conservative engineers, formerly opposed to licensing, declare themselves in favor of it. They have come to believe that the resulting legal status will help in the development of a professional consciousness and also in impressing the importance of the profession upon the public.

Engineering News and *Engineering Record* both opposed licensing on the several occasions when the question was at issue in New York State and in Pennsylvania. The purpose of those promoting the bills was to prevent the incompetent from engaging in the practice of engineering. Any feasible measure, however, would fail so surely in accomplishing that object that it was futile on that ground to pass it. Therefore we urged, and in that were giving voice to the views of thinking members of the profession throughout the country, that there be, instead, strict examination of the plans and construction of engineering work, holding that such examination and not licensing would attain the desired end.

Now the argument has changed, and the drift toward licensing is strong. The arguments, in our judgment, are valid. The profession may not be made measureably better by licensing, but it will have a definite status before the law and in the mind of the public because of the statutory recognition. The public will feel that the engineer occupies a more important place, while discipline by a board of examiners would secure wide publicity and have a favorable reaction. Moreover, with a legally constituted and protected body, it is conceivable that the legislature would call upon it for advice on legislation affecting engineering work, just as the county medical societies—having a legal status, it is

true, only because all their members are licensed—are consulted by boards of health. And the scheme works also the other way; the medical societies do not hesitate to urge new or revised regulations on the health boards.

In addition to this external influence, there would be manifest advantages from the standpoint of professional organization. All engineers would be licensed merely as engineers, and there would thus be a tendency to break down the regrettable lines between the different spcialties. The law would also tend to force the organization of the profession along state lines and by creating solidarity on local issues build up that strong influence which our past national organizations through technical societies have only begun to develop. In other words, the internal effect of licensing would be in the very direction that is now indicated for professional reorganization.

Licensing with those arguments in his favor—particularly in these days—is certain to make rapid headway.

The Railroad and the Banking Type of Mind

A FRIENDLY critic has protested against our citation of the railroads as an evidence of the failure of the banking type of mind in running the industries of the country (see editorial on the Development Committee of the American Society of Civil Engineers, in *Engineering News-Record* of Oct. 10, 1918, p. 651). He pointed out that our railroad system has led the world in extent, in development of the country, in efficiency and in low freight rates. We do not believe that many, if any other, readers of the *Engineering News-Record* have failed similarly to catch the significance of our remark about the railroads. Had we been referring to what might be called technical engineering excellence, our word would have been different. But we were discussing the railroads as a whole, as part of the industrial scheme, and as such having an economic and a social bearing. Looked at from that standpoint, we do not hesitate to repeat the original statement.

Here was, and is, an agency with daily influence on the life of every member of the community, performing a service essential to the nation's life. Yet it has few friends among the people at large; more now than formerly, however, due to the number of those whose pity has been excited at the railroads' plight. The first of the railroads' plagues was the type of management—manipulation, it would better be called—which regarded the properties not as carriers but as media for stock-jobbing operations. Consolidations, with the addition of water, and reconsolidations, with still more water, were the order of the day; while those operating the properties danced riotously over their territories waving insolently the flag of "The Public Be Damned." Rebates, car-withholding tyrannies, all manner of schemes were worked to aid the favored few, while the purchasing methods honeycombed the organization with rottenness. Then came the day for the people to have their say, and one national and 48 state commissions began to bedevil the carriers. What the stock jobbers and the grafters had failed to do, the people in their vengeance helped to complete. The public at large, which under intelligent management of the properties would have been the railroads' best friend, had been alienated. As a result we have had the drift into bankruptcy which has been railroad history during the past decade. Instances need not be cited. Each one can supply them from his own neighborhood. Probably the mention of the New Haven will furnish sufficient nausea to carry the right impression.

And that *débacle* we attribute to the banking type of mind, that type of mind that places personal profit ahead of all other considerations. The engineering type of mind, we hold, would have analyzed the purpose of the railroads—would have seen that service to the public at large, and not to any private interest, was the prime object, would have erected that as the railroads' ideal and builded a machine for its attainment.

To our minds, the situation is as an open book. If the railroad plight is not a failure, we do not know the meaning of the term.

Prepare Now for Winter Snow Difficulties

WHAT are city, highway and railway authorities doing to meet approaching problems of snow removal? Last winter the conditions were specially severe. Have the experiences and lessons been turned to account, or shall we be unprepared when this annual problem again confronts us?

Formerly the main reliance has been placed on shovel gangs and teams or trucks, but in severe storm and cold the efficiency of this method is low. Labor shortage was a difficulty last winter, and will be a greater difficulty next winter. So serious were the conditions of snowfall and labor in Chicago that the city had to urge householders to clear not only the sidewalks but also the streets opposite their property in order to permit the passage of fire apparatus as well as of wagons for distributing supplies. Difficulties in delivering coal and food were a menace to public welfare in several cities.

Some mechanical devices for clearing snow were devised and tried. Have these been perfected and put in readiness? The importance of motor truck traffic led some highway engineers and superintendents to keep the roads open and to break through heavy drifts immediately after the storms. The enormous development of this traffic for military and commercial purposes makes such work a still more pressing necessity during the coming winter. Railways were troubled specially by complete or partial blocking of terminals, with the strange results that at some large passenger terminals neither main line nor suburban traffic could be operated for 24 hours or more. The weakness of the shovel-gang system in such cases was very evident.

Preparation for the emergency may include the study of conditions, appropriation of funds, organization of forces, supply of tools and equipment, agreement with farmers along the roads, investigations and construction of special apparatus, and consideration of means of disposal.

It may be asked again: What are city, highway and railway authorities doing or planning to meet the snow removal problems of the coming winter?

TEMPORARY TRESTLE CARRIES NEW AMERICAN-BUILT RAILROAD CUTOFF OVER HIGHWAY

American-Built Railroad Cutoff Will Relieve Traffic Congestion in France

On New Double-Track Line for Expeditionary Forces, 5¾ Miles Long, Construction Plant Is Speeding Up Work—Big Embankment the Chief Feature—Bridge Half a Mile Long Spans Important River

By Robert K. Tomlin, Jr.
Photographs by Engineering News-Record

OF SECONDARY importance is the fact that a distance of five miles will be saved by the new standard-gage double-track railroad cutoff line which engineers of the American Expeditionary Forces are building in central France. Its chief value will be realized in the by-passing of traffic around a certain city where existing French railroad lines converge, and where the yards at the present time are choked with freight cars, on American Army service, going to or returning from the advance section—to say nothing of the freight and passenger trains which must be run for civil, rather than military, purposes. The new line, which will probably be completed and in operation by the time these notes appear in print, offers a through route for eastbound and westbound traffic passing through the intermediate section of the Army, and cuts out a loop around which all trains must now pass, and which, under conditions of freight haulage which is increasing in volume every week, has been the cause of serious congestion and delay. This job involves the building of a line about 5¾ miles long, requiring a large yardage of embankment and the spanning of a river by a timber and steel bridge 2200 ft. in length.

Judged by many of the projects upon which American engineers are engaged in France, this railroad cutoff is being built with the aid of a large amount of construction plant almost entirely American-made. At least, that was the situation when I tramped over the line late in July, although when the job was in its early stages, hand-labor methods were much more in evidence, I was told. Fills amounting to a total of 414,000 cu.yd., cuts aggregating 160,000 cu.yd., the 2200-ft. bridge referred to, and several smaller crossings of canals and highways, are the main features of the work, which is being carried out under the direction of the section engineer of the Intermediate Section East, A.E.F., a lieutenant-colonel of engineers of wide railroad experience. It may be well to explain that in the Army nomenclature the title "section engineer" is one which carries with it much greater responsibilities than are associated with the work of a "section engineer" of an American railroad. In the present case, the engineer of the intermediate section is in charge not only of the railroad cutoff, but of many other projects, including two 20,000-bed hospitals, veritable cities in themselves.

Starting at the west end of the cutoff, where the new line connects with an existing double-track line of an important French railroad, it was necessary to build an overhead crossing to carry one track of the new route across the old tracks, and avoid the conflicting operating movements of a level junction of two double-track railroads. The bridge over the French track (see cut above) is made with 50-ft. lattice steel girders obtained from England. The abutments consist of clusters of timber piles. The clear span of the bridge is 36 feet.

All of the work at the extreme west end of the cutoff

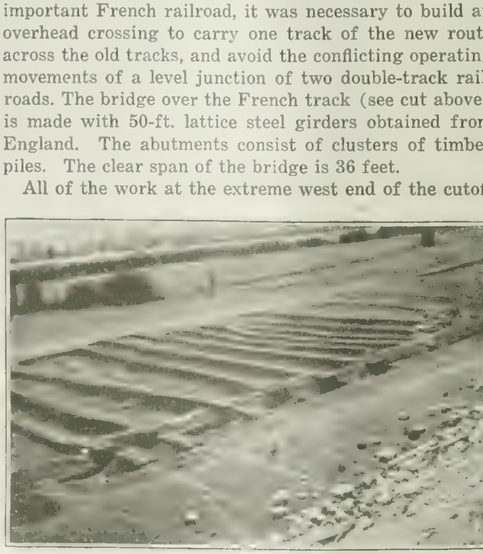
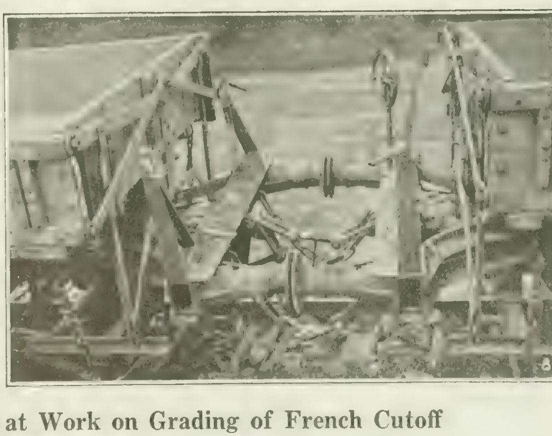


FIG. 1. TRENCHES FORMED BY CHINESE LABORERS TAKING OUT FILL FOR EMBANKMENT



American-Made Equipment at Work on Grading of French Cutoff

Fig. 2—Steam shovel at work on cut. Fig. 3—Excavated material handled by side-dump cars. Fig. 4—Caterpillar tractor hauls elevating grader for embankment work. Fig. 5—Character of material in main cut—Note in foreground air drill and reflector for illumination at night—In background steam-shovel boom. Fig. 6—Shovel with 2½-yard dipper works three shifts, aided by light from portable reflectors. Fig. 7—One of the smaller steam shovels is mounted on caterpillar treads. Fig. 8—American-built side-dump cars are fitted with French buffers

FIG. 9. WHERE THE LINE CROSSES A FRENCH CANAL

was fill, and a total of 113,000 cu.yd. was placed there, principally by hand-labor methods. The maximum height of this fill is about 30 ft. A force of Chinese laborers, the so-called Annamites, was employed in forming the base of this embankment. They worked with pick, shovel and wheelbarrow, borrowing earth alongside the right-of-way by a system of long, narrow, trench-like borrowpits, as shown in Fig. 1.

The material is a clay, overlying rock at a slight depth, which accounts for the large number and the shallowness of the trenches worked by the Chinese. In fact, coming upon this borrow work without knowing the reason for it, one might almost mistake it for a scheme of fortifications rather than excavation for a railway embankment.

At the time the fill from these borrow trenches was made no timber was available for a trestle from which to dump the excavated earth. The construction scheme followed was, first, to place a broad base layer of fill, and upon it build up a narrow earth core carrying a single line of track. On this track loaded cars were run out and dumped to build out the embankment to its proper width. As the work proceeded the construction track was jacked up and the core raised until the top reached grade. On the later stages of this fill American negro labor battalions were used.

For double track, the roadbed widths are 34 ft. in cuts and 30 ft. in fills. The single-track sections are 22 ft. wide for cuts and 18 ft. for fills. The rail is American-made, 80 lb. per yard. The maximum grade is 0.7% and the curvature 5 degrees.

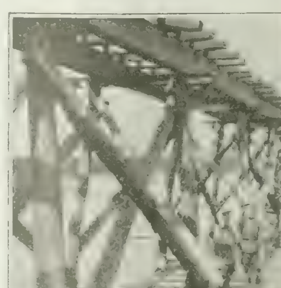
At a point near the middle of the first fill there is a highway which had to be kept open. As the work progressed more supplies and plant began to arrive, and when some timber posts and stringers were delivered they were employed to form the trestle crossing shown in the headpiece of this article.

One of the first cuts on the line is situated east of the crossing of the French railroad. Here one of the four steam shovels used on the job is operating. A good idea of the character of the digging is shown in Fig. 2. Much of the excavation is now handled by hand-dump cars, as shown in Fig. 3; there were about 60 of these cars on the job at the time of my visit, in addition to several 35-ton American-made and two 65-ton Belgian locomotives. In the early days boiler water for both steam shovels and locomotives had to be hauled to the job over roads in tanks from a canal, but now a pipe line and pump have been installed. One of the smaller steam shovels, which has a $\frac{5}{8}$-yd. dipper, is mounted on caterpillar treads, as shown in Fig. 7.

The largest continuous cut is about half a mile long and involves about 85,000 cu.yd. Here the material is largely limestone rock, requiring a considerable amount of drilling and shooting. For the upper part of this material, which is blocky, hand drilling is generally resorted to, as a machine drill often sticks. Lower in the cut, however, the blast holes were put down with light tripod drills (Fig. 5) running on air supplied by portable, gasoline-driven compressors, each compressor having a capacity for operating two drills. The material was taken out and loaded into cars by a 70-ton shovel with a $2\frac{1}{2}$-yd. dipper, as shown in Fig. 6. On this cut the steam shovel has been worked continuously in three shifts; during the night operations illumination is supplied by lights (Figs. 5 and 6) set up at a number of points where excavation and car loading are in progress. The rock excavation on the entire cutoff job has required about 40 tons of explosives.

Following the line eastward one reaches the next important feature, a crossing over a French canal, effected by 50-ft. latticed girders and timber trestle bents, as shown in Fig. 9.

The most impressive part of the job, however, is the 190,000-cu.yd. fill shown in Fig. 10. This is, in fact, the key to the entire construction, for its completion will determine the date upon which the new cutoff can be opened to traffic. This fill is being made with material from the cuts west of it and also from large



FIGS. 10 AND 11. FILL WHICH, WHEN COMPLETED, WILL CONTAIN 190,000 CUBIC YARDS, AND TRESTLE FROM WHICH SIDE-DUMP CARS DISCHARGE TO FORM IT

FIGS. 12 AND 13. SUBSTRUCTURE FOR HALF-MILE RIVER-BRIDGE—1700 PILES HAVE BEEN DRIVEN. FIG. 14—STEAM-HAMMER PILEDRIVER ON END OF BRIDGE IS MOUNTED ON STANDARD-GAGE FLAT-CAR

borrow areas which are being worked with 300 horses and slip-and-wheel scrapers, in addition to elevating graders hauled by caterpillar tractors. This latter equipment is shown in Fig. 4.

At this writing, the principal effort of the construction forces is being concentrated on this big fill. The construction scheme is so clearly shown in Figs. 10 and 11 that no description is needed. It should be noted, however, that all of the timber for the long trestle from which cars dump was furnished by American forestry regiments operating here in France.

This fill is in the valley close to the river which is crossed further on by the new cutoff; to guard against a washout during flood periods the upstream surface of the embankment is faced off with rock, while the core is the earth obtained from the borrowpits nearby. The photo indicates very clearly the two classes of material entering into the embankment.

Before the new double-track cutoff joins the main line tracks of a French railroad at its eastern end it crosses a large river. The type of construction adopted was a trestle bridge consisting of 89 timber spans of 14 ft. each, and 16 steel spans of 50 ft. each, resulting in a total length of almost ½ mile (Fig. 12). Piles for this structure (Fig. 13), most of them 50 ft. or more in length, were furnished by the forestry forces of the American Expeditionary Forces.

The driving was done by two steam-hammer rigs, operating from either side of the river. The American-made piledriver shown in Fig. 14 has leads carried by a steel-truss cantilever extension arm, the whole rig being mounted upon a standard-gage flat-car.

In the entire bridge there are about 1700 piles, the main clusters forming the pier foundations containing 43, and the trestle bents 10 each. The work of pile-driving for the bridge substructure proceeded in two shifts per day. Throughout this work there has been little rain and the river has shrunk to only a fraction of its normal width. Fig. 12 shows the river bottom uncovered and allowing the use of an ordinary land pile-driver of the steam-hammer type on the western end of the bridge.

Eastward from the bridge the last section of the cutoff is a 40,000-yd. fill. Of this amount about 15,000 yd. was placed by negro battalions with wheel-barrows, while the remainder was delivered by cars that ran on 60-cm. track and were loaded at a borrowpit by a steam shovel.

One detail of the dump cars used for hauling material from the heavier cuts on the line is shown in Fig. 8. It will be noted that this American-made equipment, which is of standard gage, has been fitted with the type of buffers which are universally employed on the rolling stock of all French railroads.

In the delivery of piles to the job motor trucks played an important part. About 400 of the 50-ft. piles were transported a distance of 70 miles by American-made trucks from which the bodies had been removed and to which trailers were attached to support the rear ends of the long lengths of timber.

The new railroad cutoff line in the Intermediate Section East of the American Expeditionary Forces is notable in that it represents a very marked transition from the hand-labor methods which have, from the beginning, been so prevalent here in France. At very few places over here can one see collected on a single project so comparatively large an assortment of American construction plant as is in operation at this site.

War Demands Conservation of Construction Plant by Careful Winter Storage

Proper Housing Prevents Loss, Theft, Rust and Rot—Procedures Simple and Inexpensive—Measures To Be Taken for Variety of Equipment Reviewed

BY C. S. HILL
Associate Editor Engineering News-Record

WAR demands the conservation of construction plant. Contractors cannot replace equipment next spring with the ease of last spring. They will pay more for every machine which they buy. As the Government's call for metal for war work becomes insistent, and as war construction here and abroad commandeers a still greater volume of the permitted factory output, the scarcity and the price of all plant employed by contractors will increase. Second-hand equipment, already scarce and costing more than did new equipment a year ago, will fetch even higher prices and be more difficult to obtain six months hence. Existing equipment must be conserved!

TIME-HONORED PRACTICE RIGIDLY FOLLOWED IN STORING DUMP CARS

For years loss, theft, rust and rot of improperly stored equipment have exacted every winter an enormous toll of plant value. Examine the views reproduced herewith. They were taken last winter. They can be duplicated any winter anywhere in the northern United States. Carelessness in conserving expensive equipment could not easily be carried farther than is depicted by some of these illustrations. All contractors do not abuse their equipment in this manner. No contractor need do it. Preparing and housing plant for winter storage is not a difficult task. The processes are all simple. It takes less time to prepare a machine to endure the cold and damp of winter than it does to repair, when spring work begins, the damage of frost and moisture to a machine which has been left unprotected.

Put equipment in good repair as it is stored. Do not store a car with loose hinges and a warped floor; tighten the hinges and level up the floor. If the wood draft sill of a steam shovel has been partly burned out, replace it. Replace worn scraper bits and runners and dulled dipper teeth. Sharpen and rehandle tools which need these attentions. Put the whole machine structurally in shape for immediate use—then *paint* the machine. Paint is a gilt-edge investment.

Some wise contractors keep blacksmiths at work during the winter sharpening tools and doing other repair work. A handy mechanic, one who can turn his hand to a variety of tasks, will earn his pay twice over doing odd jobs of repair work on machinery laid up for the season.

One picture shows a locomotive crane laid up for the winter. Its power and size and endurance appear to deceive many contractors into the belief that heavy equipment, like steam shovels, dragline excavators and locomotive crane excavators, will safely resist rust and rot and frost when smaller machines will not. This is a great error. No type of equipment should be more carefully laid up. These big machines represent a large investment; they must ordinarily be laid up out of doors.

Select for storage a place which permits the free run-off of rain and melting snow. Select a situation also which the wind will keep swept clear of snowdrifts. It costs something to run a steam shovel out of its pocket in the pit onto clear high ground, but it costs more to let it stand under winter drifts and in a spring pond.

Lay up the boiler while it is warm. With the boiler almost full of water, pour in three to five gallons of heavy oil. The oil will float to the top. Then drain the boiler. As the water recedes a coating of oil will be left on the sheets and tubes. This procedure will take care of the inside of the boiler. To protect the outside, thoroughly clean the sheets and the firebox, removing all corrosion and scale. Then paint the firebox and sheets; the paint will burn off when the boiler is fired up in the spring, but during the intervening months it will have protected the steel from corrosion. Cover the top of the stack; this is a simple precaution which is often neglected. Finally, open all flanges in

BOARDS ACROSS CAB OPENINGS KEEP THE COWS OUT OF DINKY LOCOMOTIVE

the steam piping so as to insure thorough drainage; the flange packing will be lost, but almost invariably new packing must be put in every spring anyway, so the loss is not worth considering.

Instead of painting sheets and firebox some contractors swab them with oil. They also clean and oil the tubes. Rust is the enemy that has to be guarded against; it is as insidious as the Hun, and no chances can be taken with safety.

CABLEWAY HOIST SNUGLY HOUSED AND CARRIAGE AND FALL MADE FAST FOR WINTER

Repaint all the painted parts of the engine. Cover all the bright parts with grease. Remove the packing from the piston and valve stems and paint the rods and stems with heavy oil and white lead. Unless so protected, rods and stems will pit; these pits do not look serious but they roughen the rods enough to cut the packing rapidly. It is much cheaper to paint the rods in the autumn and clean them in the spring than it is to renew the packing at frequent intervals during the working season. Oil the cylinder and the valve seats thoroughly. Do this even if it is necessary to remove the steam-chest cover and destroy the gaskets. Some makers of steam shovel engines place in the steam-chest covers plugs through which the parts can be flooded with oil.

If the machine is motor-operated and the cabin has been well closed in, it is sufficient ordinarily to cover the motor closely with heavy, tarred canvas. The best thing, however, to do with any motor on any machine which has to be stored out of doors is to remove it and store it in a tight, dry room. Similarly, cover with canvas the boom engine after preparing it otherwise as described for the main engine; or this engine may be tightly boxed in with boards after the boom has been lowered.

Gears and cables should be slushed with grease and all grease cups should be filled and then turned down so as to cover and protect the bearings. Cable should be unrove and wound on the drum.

Unship the dipper and handle and lay it on blocking so that it clears the ground. Paint the dipper handle and slush the rack with grease. Lower the boom onto a horse or blocking, paint it and cover in the boom engine as previously described. Close the cabin and board up the front end. Paint the cabin and frame.

All small tools, picks, chains, hose, etc., should be cleaned and locked in a box inside the cabin. It is not a bad plan to remove the journal brasses and store them in the same manner. It is not only rust and rot which have to be guarded against, but also theft.

Small machines like concrete mixers, trench excavators, air compressors, pumps and hoists should invariably be housed in when laid up for the winter. This does not mean necessarily that the machine must be put into a storehouse, but that it should be inclosed by some form of weatherproof housing or covering. One contractor in Chicago who owns three trench excavators has a concrete house, with a concrete floor, in which he locks his machines. Another runs his machine up on timbers and boards it in tightly, all except the ladder, which is lowered and left sticking out. A third has a large tarpaulin with which he covers the whole machine. These practices exemplify the three possible methods of housing, in the order of their excellence. The least excellent is the tarpaulin cover; it should not be employed if one of the other methods is practicable.

Trench excavators are small machines only in a comparative sense, and they are expensive machines and so warrant care in preparing them for storage. At the end of the season clean and paint all parts of the machine which were originally painted. Cover all the bright parts heavily with grease. Remove drive and conveyor belts, roll them up, tie and store in a dry place. Also remove all engine parts, such as carbureter and magneto or injectors, pump, steam gage and governor, grease them thoroughly and store them in a box. Oil the cylinders and valves and grease the gears, racks, etc. Lower the ladder and rest it on a horse on the ground. This takes the strain off the hoisting machanism and helps to preserve it. Finally, inclose the machine in a weather-tight housing.

MIXER ROOFED BY THE SKY AND WRAPPED IN SNOW, LIKE THE FLOWERS, AWAITS SPRING

Hoists should be housed. Clean the grease from all

TARPAULINS KEEP THE SNOW OFF PUMPS AS LONG AS THE WIND DOESN'T BLOW

painted parts and repaint; slush the shafting, winch heads and all bright parts with heavy oil; drain the cylinders and leave the cylinder cocks open. Empty the boilers; it is well to run a light fire for a few minutes to dry the head and tubes. Swab the inside of tubes with a heavy oil. Finally, cover the entire machine with a tarpaulin. Electric hoists should receive the same general preparation as steam hoists. The motor should be either removed and stored in a well protected place, which is really the only proper way, or, if this cannot be done, it should be covered with heavy tarred canvas.

When compressors are not in service or are placed in storage the complete drainage of all the water and steam spaces should not be forgotten; otherwise, cracked cylinders and heads and split pipes and tubes will result from freezing. All lubricating oil should be drained off. All lubricators and other small brass fittings should be removed and boxed to prevent breakage or loss by theft. The compressors should be covered with tarpaulin or waterproof paper to keep out dust and water. If they are to be out of service for any length of time, the steam, exhaust and water piping should be disconnected to avoid any possible chance for water to leak in. If the compressors are belt driven, the belts should be removed and stored in a dry place.

Drills are about the most roughly handled expensive tool which the contractor uses. Packing for shipment and preparation for storage of drills are woefully defective.

When packing them for shipment care should be taken to see that the feed piston of stoping drills or the main piston of reciprocating drills are securely fastened so that they cannot run out of the drills. It is almost impossible to bend these, when they are run into the drill their full length, but if they are fully extended they are very liable to become bent in handling and shipment. All finished parts should be slushed with some compound not easily washed off with water. Do not use excelsior for packing the parts, as it is difficult to clean off. All holes extending into the interior mechanism should be plugged with wood so that grit and dirt will not be introduced into the drill. When putting steam reciprocating drills in storage particular care should be taken to blow them out thoroughly with compressed air, or if this is not available remove the packing in the lower head. If this is not done the piston rod will become badly rusted and pitted where the wet packing remains against it for a long time.

Scrapers and graders are a class of tool which it is ordinarily assumed needs no preparation for winter. They both require and repay attention. Clean and paint drag and Fresno scrapers. Wheel scrapers should be freshly greased and nuts and bolts tightened up. Paint the whole machine. If the whole machine is not painted, at least cover the bottom of the pan with some rust preventive; ordinary red lead and tallow make a good mixture. Take off the tongues; preferably stack them on end; if stored horizontally place a support at the middle, or else the timber will sag and take a permanent set. Clean elevating graders thoroughly and paint them. Oil all bearings. Remove rubber belts and store in a clean, dry shelter. Take off and box the brass oil cups to prevent theft.

It is sinful to lay up a locomotive out of doors, but conditions frequently make it necessary to do so. Then, above all things select a place which will be as free as possible from snow and water. Wash out the engine

CARELESSLY ARRANGED DRAPERY CONCEALS CRANE MECHANISM FROM PASSING GLANCES

boiler, and then refill it and pour in about 5 gal. of black oil. Draw off the water slowly. Oil the washout plugs before they are replaced and leave the blow-off valves open. Clean the flues, dump the grate, clean out the ash box and paint with heavy black oil both flue sheets and firebox. Clean the smoke box, especially around the bottom of the front flue sheet.

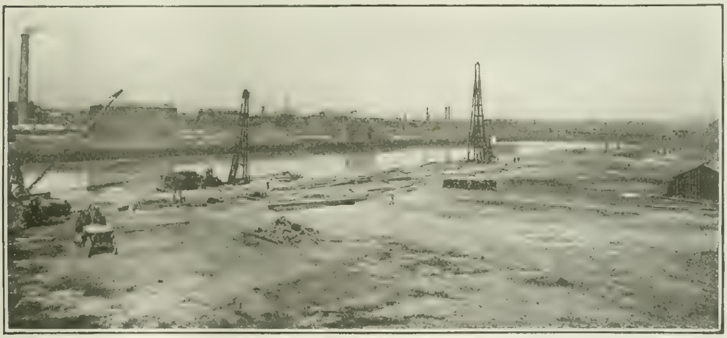
Cover the stack with a board and bolt the board down with a rod running down through the stack to a cleat. Drain the tank and take the drain cock out. Remove all fittings and box them and store the box safely. Take off the steam-chest covers and oil the valves. Remove the cylinder heads and shove them as far ahead as they will go and then oil the cylinder. If the main rods are left on, wire them tight to the yoke so that the main pin will clear the back end of the rod. If the rods are taken off, lay them on the run boards, cleat them down and cover them with a board. Paint all the bright parts thickly with white lead. Board up the cab, including the windows.

Dump cars are made to endure a rough life, but they are not properly stored by rolling them down the embankment, as one of the pictures shows.

New Lake Shipyard Has Side-Launching Ways Under Cover

Ships Built at Ferguson Yard Fabricated in Company's Shop Two Miles Away—Berths Covered with Cantilever Roof and Served by Semi-Gantry Crane

ALL assembling and ship erection in the new shipyard of the Ferguson Steel & Iron Co., Buffalo, N. Y., is to be done under cover in a shop 125 ft. wide and 800 ft. long, covering the berths. The plant lies along the Buffalo River, into which the completed boats will be side-launched. At present four small boats, all Navy tugs, are on the stocks, and most of the shops, buildings, tracks and offices of the new plant are complete. The erecting shop over the berths has only just been begun, but the ships under way will be inclosed by the time cold weather sets in. As the site of the yard was open country on a poorly bulkheaded river last June, the speed with which the operation has been carried out is considered no small part of its distinction.



SITE OF THE FERGUSON SHIPYARD AT BUFFALO IN JUNE WHEN WORK WAS FIRST STARTING

The Ferguson company has conducted a warehousing and structural-steel business in Buffalo since 1913, and has rapidly increased its plant, until at present it covers some 28 acres and is capable of turning out about 2500 tons of structural material a month. Early this year it obtained contracts for fabricating and erecting Navy tugs and New York State Barge Canal barges, and determined to build on the Buffalo River, some two miles from its main plant, a shipyard at which it could not only erect the ships at present contracted for, but which would be a permanent shipbuilding plant. In order to guarantee prosecution of work throughout the severe Buffalo winter, it was decided to inclose the shipways, a procedure unique in lake shipbuilding practice. Future plans include the erection of a fabricating shop in the shipyard, but for the present, at least, all fabrication is to be done at the company's main plant.

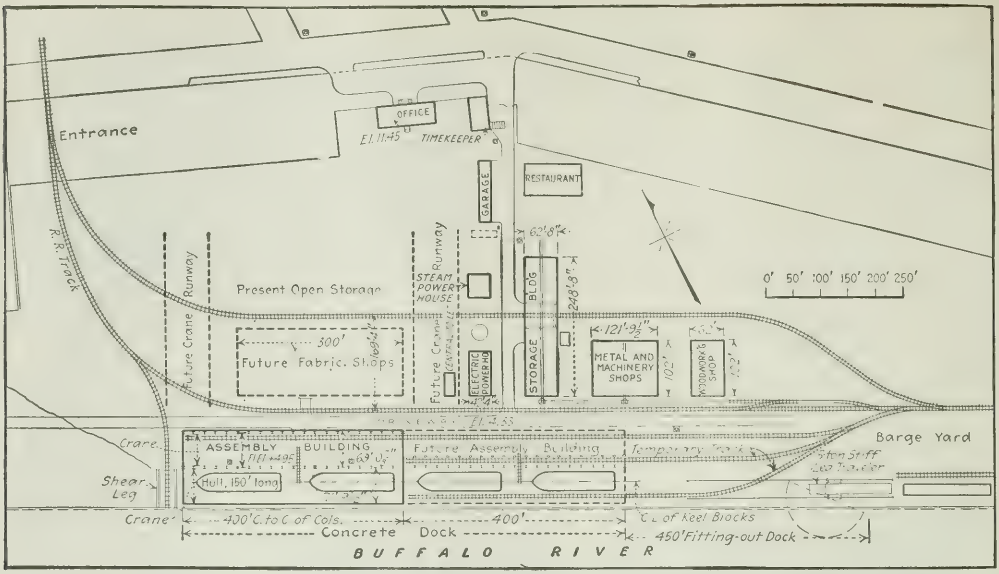
The shipyard occupies a site of about 33 acres, with a frontage of about 3000 ft. on the Buffalo River, which here has a depth of 20 ft. On this site, which in June was a rough waste, there have been built a general office building, and timekeeper's office and hospital at the street entrance, and in the yard area toward the river the plant buildings, comprising a garage, a restaurant, a steam and an electric power house and the separate shops for metal and machine working, wood working and storage. These shops are all so arranged that they can be extended shoreward from the present units in case future operations should demand a larger plant. All the shop buildings are of steel frame, with walls of stucco on metal lath.

Ships will be assembled on continuous ways paralleling the river front for a distance of about 800 ft. Along this front a new dock wall had to be built. This wall consists of a head wall of concrete at the water side, resting on embedded straight and battered piles with a row of Wakefield sheetpiles, also embedded in the concrete, to retain the fill. The concrete block is reinforced longitudinally as shown, and with cross rods carrying around the longitudinal rods and up into the upper part of the block. Tie-rods connect through the headblock of the dock wall back through the concrete keel-block foundation to the concrete footing under the shoreward columns of the assembly building. Additional protection against outward movement is had by lapped piles laid lengthwise along the outer piles under the keel-block stringer.

The assembly building is the structure of peculiar interest in the plant. As shown in the drawing, it is a two-bay steel structure, the shore bay of which is covered with an ordinary truss roof, and the waterside bay with a roof cantilevered out from the middle row of columns. For the present, and until the erection of the future fabricating shop, at least, the inshore side of the building will be completely inclosed. Material enters the landward bay by a standard-gage railroad track shown in the first drawing. The shore bay is to be used for steel storage and general assembly, and is commanded by a 10-ton girder crane spanning the outside and middle lower columns.

The waterside bay covers the berths. Running in this bay is a 10-ton semi-gantry crane, the inner end of which travels on a crane girder bracketed from the middle row of columns, while the outer end travels on a rail on the inside edge of the dock wall. Complete inclosure of the berth is effected by a continuous line of doors guided at the top from a stringer dependent from the cantilever truss, but rolling on tracks also on the concrete of the dock wall.

The berth foundation consists of a continuous concrete keel-block stringer some feet below the ground level of the berth and supported on pile footings on which keel blocks are set up according to the dimensions



SIDE-LAUNCHING BERTHS AT BUFFALO RIVER YARD WILL BE COVERED WITH ASSEMBLY SHED

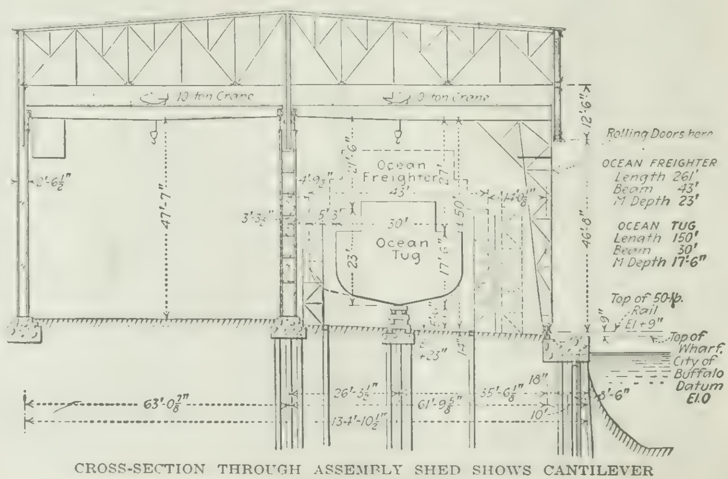
of the ships being erected. Additional sills on either side of the keel block, supported on piles, will serve as footings for shores. As shown in the cross-section, the present tugs under way do not come near occupying all of the clear space in this shed. Provision is made for the future erection of a vessel of 261 ft. length, 43 ft. beam and 23 ft. molded depth.

The launching ways will be laid across the floor of the berth over the rails of the gantry crane and of the rolling doors, neither of which have to be disturbed during the launching operation, and will have their outer ends resting directly on the head wall of the dock. A total drop of about 10 ft. will be required to launch the vessel.

The erection of the hulls now under construction is being carried out by means of locomotive cranes traveling on the final and temporary tracks shown in the drawing. These cranes will be continued in the ship erection until the traveling cranes inside the buildings are available. The assembly building will be first erected complete over the two upper hulls, which are the latest two to be started and the construction of which will run into the winter before completion. The two lower hulls should be launched before cold weather sets in, and the assembly building is not to be hurried over those, although the columns and the track for the gantry will be put up so that the erection can be continued with these machines. The middle line of columns which carries the crane will be braced and held in position by batter posts until the building is completed.

Entrance for material to the yard is effected through a single main, standard-gage railroad at the upper end. This track passes through the storage warehouse, so that material can be unloaded and distributed there, and also branches off so that it passes along the street between the assembly building and the main shop of the plant.

Switches at the lower end divert the track to the shops, where turntables permit the entrance of trucks or cars over standard-gage trucks into the shops themselves.



CROSS-SECTION THROUGH ASSEMBLY SHED SHOWS CANTILEVER COVER OF BERTHS

Another switch leading to a track running into the main assembly building will be used for the transportation of fabricated steel to the ships. A further branch of the main track goes directly to the river at the upper end of the assembly building, where either a shear-legs or an 80-ton derrick will be installed to place the engines and boilers in the hulls. After being launched, the ships will be brought down the river to the finishing dock, which lies directly below the assembly building. Handling equipment for this dock has not been decided upon.

Steel barges for the New York State Barge Canal are also being assembled by the company at the lower end of its plant. These boats are of the simplest steel-frame construction; their erection is handled entirely by locomotive cranes which travel on the adjacent track. No bulkhead has been put in here, but the building ways have been set up on piles and the barges will be side-launched on a rather steep slope. The barge frames and shell are fabricated at the company's main plant and are brought to the shipyard by train or truck.

Capt. James E. Ferguson, president, is the active head of the company. Edward P. Butts is manager of the shipbuilding department, and Thomas Leach is chief engineer of the company. Plans for the shipyard layout were made in Mr. Leach's office.

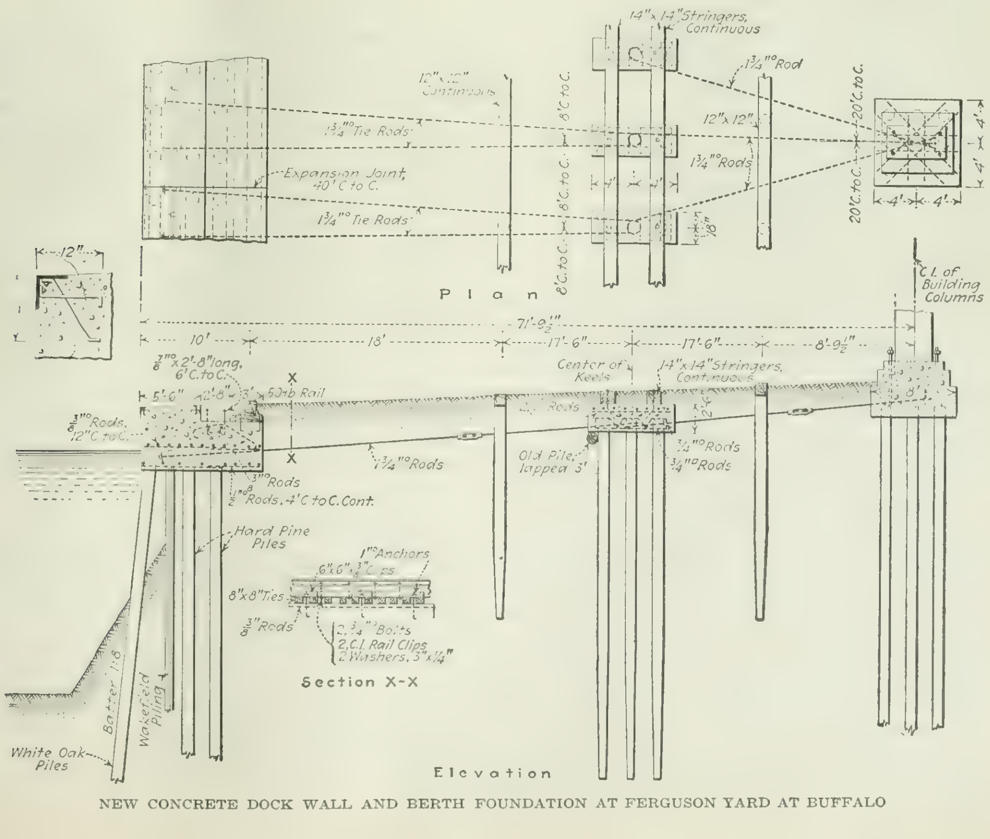
Inadequate Patrol and Dry Peat Raise Fire Loss

Meager Allotments for Minnesota Ranger System Blamed for Damage — Overdrainage Called Contributory Cause

(From St. Paul Correspondent of Engineering News-Record.)

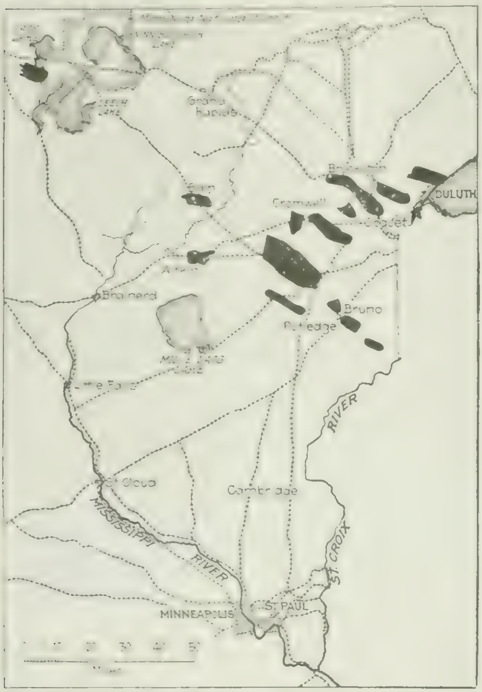
THE overdrainage of peat lands, with their consequent lack of protection, was responsible in great part for the recent Minnesota forest fires, reported in *Engineering News-Record* of Oct. 31, p. 822, according to officials of the state forest service. Lack of funds to support adequately a sufficient force of forest rangers, and lack of control over these dry peat lands, in which the fire spread, caused uncalled-for damage, it is said. in fact, the state legislature which cut the appropriations for the forest service is charged by many with the responsibility for the disaster. Inadequate legislation and lax enforcement of what laws do exist to curb the practices responsible for fires are also suggested as contributory causes.

There were numerous fires in progress at the same time, as explained in the news item mentioned above, and as shown upon the accompanying map. These took the direction of the wind, which was traveling about 60 miles per hour, and by this very action, while the



NEW CONCRETE DOCK WALL AND BERTH FOUNDATION AT FERGUSON YARD AT BUFFALO

flames covered long distances, they did not spread laterally, being pinched in. Many freakish things happened, similar to those that are noted in tornadoes, the fire jumping sometimes from one man's timber across a wooded farm to another tract. In one instance, the fire appears to have been stopped by the burning of the village of Cloquet, and while the entire village was burned up and even the ashes carried away, leaving the site practically clean, the grass was green a few hundred



TERRITORY COVERED BY RECENT FOREST FIRES IN MINNESOTA SHOWN IN BLACK

yards beyond the village. It is thought that the intense heat produced by the burning buildings caused such an upward draft that the fire was sucked up and out.

In fires of this magnitude, entailing a heavy loss in both property and in lives, many questions are asked, such as, "What was its cause?" There are 53,000,000 acres of land in Minnesota, one-half of which is wooded, and it is stated that the forest service organized in 1911 was entirely inadequate to take care of so great an amount of territory. Not only does it appear that this service was inadequate as originally organized, but the appropriations for it had been cut down from the original amount. Forest fires are preventable, but, it is maintained, the control of them must be permanently upheld by a fund adequate for the service. While the maximum amount ever appropriated for this service in Minnesota was $75,000, which has since been reduced to $40,000 and then raised to $50,000, it is pointed out that 1c. an acre, or a 1 30-mill tax would raise $530,000 for this work.

The state forestry service has many stubborn things to contend with. One of these is the idea that fires improve a new country. This viewpoint naturally leads to the starting of such fires, and the laws are entirely inadequate to cope with the situation. In fact, when the forest rangers have brought those responsible to justice, it is said that the courts refused to discourage the burning of wild land by punishing the men known to have started the fires.

One of the dangerous aspects in Minnesota, according to W. T. Cox, the state forester, is the overdrainage of peat lands and leaving them without control; another is the insufficient control of logging in a state where there are 2200 logging camps in existence every winter. Unregulated scattered settlements exist throughout the great forest areas, and the state has no land policy which can concentrate the settlements. Together with better regulation of the railroads, all these things, it is maintained, should be taken up and suitable laws passed to correct the difficulties.

More than ever before, the value of good roads has been shown, according to state highway officials, and the highway department, due to the fire, has a great problem upon its hands to fix up the cheaply constructed earth roads in the burned area. The surface, formed by using the peat formation along the roads to crown them, has been entirely burned off in many cases, and the wooden bridges and culverts have been destroyed. A more suitable type of surfacing for these roads is suggested.

Emergency measures are being taken by the state highway department under the guidance of C. M. Babcock, state highway commissioner, to repair the roads which have been damaged and to put out the fires which are still burning in the surfacing. To carry on this work it has been necessary to call upon the $50,000 state reserve fund to make repairs. One highway near Aitkin, built along a drainage ditch—in fact, built from the excavation of the ditch—had a fire in its surfacing for some time after the general conflagration had subsided. To put this out a fire engine was placed at the river outlet and the ditch dammed and filled with water; another engine pumped water from the ditch at its upper end to apply to the road, while a great deal of work was done by carrying water in pails. By this means a considerable portion of the road was saved.

Governor Burnquist has appointed a commission empowered to subpoena witnesses and make a thorough investigation of the responsibility for the catastrophe. The commission is requested to report at an early date, suggesting better methods for administration.

Pictures Show Water Waste to Consumer

That little drops of water falling continuously make a mighty waste is shown graphically in a recent circular of the Indianapolis Water Co. Three cuts show faucets flowing drops, a $\frac{1}{32}$-in. stream and a $\frac{1}{8}$-in. stream, while figures beneath them show the respective losses in gallons per day, week and year. The daily wastes are 15, 264 and 2788 gallons. This circular also lists various ways in which water is wasted, and says that under war conditions it is inexcusable to waste water and so cause loss of fuel and money spent for pumping. Three points made are: "Stop all waste; look at your fixtures; listen for leaks."

Gasoline Consumption Tests Demonstrate Value of Hard, Smooth-Surfaced Roads

Gasoline Saving Which Would Pay For the Construction of a Hard Surface in a Few Years Is Indicated Between Earth and Smooth Concrete, Where a Daily Motor Traffic of 500 Can Be Expected

By A. N. Johnson
Consulting Highway Engineer, Portland Cement Association Chicago, Ill.

TESTS carried on by the Portland Cement Association, using five 2-ton trucks placed at its disposal by the White Co., have shown the value of smooth, hard surfaces in promoting the efficiency of truck operation. A remarkable agreement among the individual trucks used in the test under the same conditions was noted. The poorest surface, the earth, required 204 per cent. more consumption of gasoline than the smooth concrete, and the saving recorded between the two would pay toward the construction of the smooth surfacing at the rate of $3000 per mile per year on a road carrying a daily traffic of 500 motor vehicles. The purpose of the tests was the determination of the relative amount of gasoline actually consumed in the operation of trucks over different types of road surfaces; more particularly, to determine the difference in gasoline consumption in operation over hard, smooth-surfaced roads and those not so improved.

Selection and Description of Test Roads

The first element of the problem was the selection of suitable pieces of road in the vicinity of Cleveland, to accomplish which a number of days were spent. Some 17 sections were first selected and designated by letter. They were so nearly level that whatever grades there were would have little or no effect on the final results. After the roads were located on the map and a route was outlined, it was found that it would be impossible to cover the 17 sections in a single day. Owing to the possible influence that changing weather conditions might have, it was deemed desirable that a day's run should include all of the test sections. Finally, a group of eight sections was chosen which could be covered in one day.

On account of the limitations thus imposed, it was not possible to include all of the pavement types originally selected. A brief description of those over which the tests were run follows. In addition, there are included typical photographs which will give a clearer idea of the surface conditions than can be given by word description.

Section P—Earth Road—Located on the St. Clair road in Cuyahoga County, adjoining the Lake County line. General direction southwest. Length 2.39 miles. This road is over clay soil, extending alongside a brick road. The road is used very little, and there were no ruts. Due to rainy weather prior to Sept. 4, the surface was slightly muddy, but it was firm immediately below this thin, soft top. It may be designated as an earth road in generally fair condition.

Section O—Gravel Road—A continuation of the St. Clair road into Lake County. General direction northeasterly. Length 1.70 miles. The west quarter of a mile is somewhat loose and a little rutted, with a few small chuck holes; the remainder of the road is smoother, although somewhat uneven. It may be designated as a gravel road in generally fair condition.

Section L—Gravel Road—Located on the Reynolds road in Lake County, extending in a northerly direction from a point 100 yd. north of the New York Central R.R. crossing, for a distance of 3.58 miles. This is a gravel road in excellent condition, carefully maintained.

Section I—Bituminous Macadam—Located on Euclid Ave. in Cuyahoga County near the Lake County boundary, extending thence in a southwesterly direction for a distance of 2.61 miles. Originally a water-bound macadam, this road was afterward resurfaced with asphalt penetration macadam. The road has been repaired many times. The bituminous surface is unbroken, although it has become uneven and incipient chuck holes are forming. A number of these were being repaired during the days of the tests.

Section R—Brick Road—Located on Euclid Ave. about three miles from the Cuyahoga County line in Lake County, extending in an easterly direction. Length 1.16 miles. This road has a cement grout filler, is laid on a sand cushion and is typical of a majority of the brick roads about Cleveland. The road receives maintenance yearly, is somewhat worn, but is generally in fair condition.

Section PB—Brick Road—Located on the St. Clair road in Cuyahoga County, immediately alongside of Section P, above described. It is the same length as Section P—2.39 miles. This road has a cement grout filler and is laid on a sand cushion. It is not traveled much and is in fine condition, the surface being extra smooth.

Section K—Brick Road—Located on Euclid Ave. in Lake County, beginning at a point near the intersection of Reynolds Road and extending northeasterly 5.61 miles for the run made Sept. 4, while the test section used for the runs Sept. 5 and 6 was 4.22 miles. This road is laid on a sand cushion, has a cement grout filler and is probably the best section of brick road to be found in the neighborhood of Cleveland, the surface being exceptionally smooth.

Section M—Concrete Road—Located on Euclid Ave. in Lake County, beginning at a point east of Painesville at the intersection of the River Road and extending northeasterly 5.61 miles for the test run made Sept. 4 and 4.39 miles for the runs of Sept. 5 and 6. This is a two-course concrete road laid in 1916, is reinforced with mesh and has metal protected joints. The surface is generally good, although at the joints there is a slight unevenness.

Description of Trucks

The trucks used in the tests were five new White, 2-ton double reduction gear driven trucks that had been run but a few miles, sufficient only to put them in gen-

eral adjustment for operation. They are the type of truck furnished by the White Co. for the United States Army and known as United States Army Standard A truck. They were provided with wooden bodies but did not have canopy tops. The trucks were arbitrarily numbered from 1 to 5 and are referred to by the numbers. At the time of making the tests the trucks had not been accepted by the Army officers. Their weight as operated empty was 5500 pounds.

Gasoline-Measuring Apparatus

In order to make accurate determinations of the amount of gasoline used, there was attached to the footboard of each truck a small tank, holding approximately 1 gal., being one of the stock tanks used on White trucks for lubricating oil. To each tank was attached a glass gage tube. By placing against the glass gage an engineer's scale, graduated to inches and tenths, the height of the gasoline in the tank could be interpolated to the nearest 0.01 in. These tanks were each calibrated by filling them with 100 c.c. of gasoline at a time, and recording the height of the gasoline as shown in the gage tubes.

The results of the calibration measurements showed remarkable accuracy in the construction of these small tanks, in that they are practically of uniform size. It so happened that 1 in. in height on the gage was within one or two thousandths of a gallon of being exactly 0.1 gal. From the average of these readings and the known quantity of gasoline added to the tanks a coefficient was obtained by which the readings in inches on the gages of each tank could be reduced to gallons. These coefficients were as follows: Truck 1, 0.0996; truck 2, 0.0985; truck 3, 0.0996; truck 4, 0.0975; truck 5, 0.0999.

Leading from the test tank was a tube that connected with the tube feeding the gasoline from the main supply tank to the carburetor. Just below the test tank was inserted a valve V_2 and in the main tube from the main tank to the carburetor there was also a valve V_1. A sufficient quantity of gasoline for making the tests was set aside, so that the same quality of gasoline would be used throughout the tests. As determined in the laboratories of the White Co., this gasoline tested 57° gravity Baumé, and 93% of it had distilled or evaporated under 450° Fahrenheit.

Meteorological conditions were obtained from the United States Weather Bureau station at Cleveland for the days on which the test runs were made: viz., Sept. 4, 5, 6 and 7, and are summarized in Table I.

Methods of Making Test Runs

In conference with engineers of the White Co., it was decided to make test runs as follows: One series with the trucks run empty but on third gear and at a uniform speed of 15 miles per hour, the trucks used having four gears or four speeds; a second series run at a uniform speed of 15 miles per hour on third gear, but with a 2-ton load; a third series with the trucks loaded but on fourth gear, the trucks to be operated as they would be in practical use—that is, where the road was rough or uneven and 15 miles an hour would cause too much jolting, the speed was to be reduced accordingly, while on the smooth roads it was to vary from 15 to 18 miles per hour; a fourth series with the trucks run empty on fourth gear. The third and fourth series were designated as "commercial runs."

TABLE I METEOROLOGICAL CONDITIONS OF TESTS TAKEN FROM RECORDS OF WEATHER BUREAU

	Sept. 4	Sept. 5	Sept. 6	Sept. 7
Precipitation	p.m., 0.09 in.	Numerous showers	0	0
Character of day	Cloudy, misty, occasionally sunshine in a.m.	Cloudy, misty; little sunshine	Clear sunshine	Clear sunshine
Prevailing wind	Northeast	North	North	West
Average hourly velocity	10.8 m.p.h.	22.0 m.p.h.	12.1 m.p.h.	8.2 m.p.h.
Reduced barometer	a.m. 30.13, p.m. 29.85	a.m. 29.84, p.m. 30.04.	a.m. 30.09, p.m. 30.08.	a.m. 30.12, p.m. 30.07.
Relative humidity	a.m. 87, p.m. 95	a.m. 90, p.m. 76	a.m. 67, p.m. 54	a.m. 65, p.m. 57
Dry temperature, noon	68 5°	58.0°	60.1°	68 0°
Wet temperature, noon	65.0°	56.0°	51.1°	55.5°
Dew point	64 0	55 0	43 0	44 0
Vapor pressure	0 595	0 432	0 277	0 287

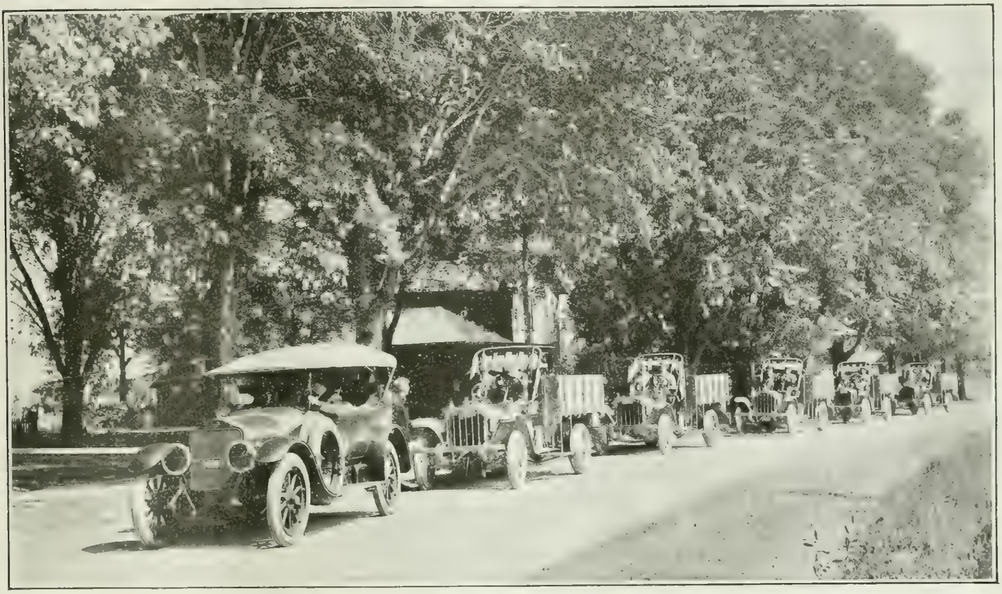
In general, this program was followed, but not completely on all the test sections, because it was impossible to give immediate attention to the necessary detailed arrangements for a prompt start each day. The time for making the tests was therefore in some instances so limited that not all of the test sections could be covered. Again, owing to rain, the condition of the earth road had become somewhat slippery, and it was not possible on Sept. 5 to run the trucks loaded over it unless chains had been attached, and as the chains might mar the tires, it was undesirable to use them. The data secured, however, are considered reasonably complete.

Observer and Signal Man Checked Consumption of Gasoline Used

An experienced driver was furnished by the White Co. for each car. With each driver there was an observer. At the beginning and end of each test section, a card with the letter of the section was placed alongside the road. The trucks would line up in order, 100 yd. or more from the test section, and at a given signal would get under way, using the gasoline from the main supply tank—that is, with valve V_1 open and valve V_2 closed. As each truck passed the beginning of the section, the observer closed valve V_1 and immediately opened valve V_2. At the ends of each test section a signal man was stationed, and as each truck completed its run the observer closed valve V_2 and opened valve V_1, so that during the passage of each truck over the test section all the gasoline consumed during the run was supplied from the test tank.

Before each run, the height of the gasoline in the gage was measured, and the observer noted the same on a slip provided for the purpose. A check reading was made by another observer, and the reading already set down on the slip was checked. At the end of the run, similar readings were again made, and the difference in the height of the gasoline gave the amount in inches of gasoline consumed by the test run. Care was taken that the operation of the truck while gage readings were being made was practically level, this being checked by a small machinist's level placed upon the frame of the truck. These readings in inches were then reduced to gallons by multiplying the readings for each truck by its appropriate coefficient. The results for each test run for each truck are given in the accompanying Table II.

Five Trucks Used in Gasoline Consumption Tests, and Eight Roads on Which the Tests Were Made



PILOT CAR, AND FIVE TWO-TON TRUCKS USED FOR GASOLINE CONSUMPTION TESTS

LEFT—SECTION P, EARTH ROAD, GENERALLY FAIR CONDITION—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.1730 GALLONS PER MILE, 5.78 MILES PER GALLON

RIGHT—SECTION PB, BRICK ROAD, EXTRA GOOD—GASOLINE CONSUMPTION EMPTY, 0.0738 GALLONS PER MILE, 13.55 MILES PER GALLON—NO TEST MADE WITH TWO-TON LOAD

SECTION O—GRAVEL ROAD, FAIR CONDITION—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.1390 GALLONS PER MILE, 7.19 MILES PER GALLON

SECTION L—GRAVEL ROAD, GOOD CONDITION—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.1063 GALLONS PER MILE, 9.39 MILES PER GALLON

SECTION I—BITUMINOUS MACADAM ROAD, SOMEWHAT WORN AND UNEVEN, GENERALLY FAIR CONDITION—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.1054 GALLONS PER MILE, 9.48 MILES PER GALLON

SECTION R—BRICK ROAD, GENERALLY FAIR CONDITION, BUT WITH PATCHED PLACES SHOWING GENERAL WEAR—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.1012 GALLONS PER MILE, 9.88 MILES PER GALLON

SECTION K—BRICK ROAD, GOOD CONDITION, EXTRA SMOOTH—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.0875 GALLONS PER MILE, 11.41 MILES PER GALLON

SECTION M—CONCRETE ROAD, GOOD CONDITION—GASOLINE CONSUMPTION WITH TWO-TON LOAD, 0.0849 GALLONS PER MILE, 11.78 MILES PER GALLON

Table III is a summary table for each test section, using the averages obtained from the five trucks. The gasoline consumed in making a run was first ascertained over the section in one direction, called "in," and then for the opposite direction, indicated as "out," so that by averaging the results on a particular section for "in" and "out" readings the influence of the slight grades and wind would be practically balanced. In the summary table all results are reduced to gallons per mile for each type of road surface.

TABLE II. GASOLINE CONSUMPTION IN GALLONS PER MILE

Truck Number	Trucks Empty, Sept. 4, 15 Miles per Hour on 3rd Gear		Trucks Loaded, 2-Tons, Sept. 5, 15 Miles per Hour on 3rd Gear		Trucks Loaded, 2-Tons, Sept. 6, "Commercial Run" on 4th Gear		Trucks Empty, Sept. 7, "Commercial Run" on 4th Gear	
	Out	In	Out	In	Out	In	Out	In
Section P Earth Clay—A Little Mud—Generally Fair Length of Test, 2.39 Miles								
1	0.151	0.115			0.154	0.160	0.096	0.085
2	0.172	0.146			0.240	0.207	0.136	0.131
3	0.130	0.102			0.185	0.150	0.099	0.084
4	0.147	0.126	.....	.....	0.167	0.158	0.105	0.099
5	0.128	0.114	.....	.....	0.171	0.138	0.095	0.093
Total...	0.728	0.603	.....	.....	0.917	0.813	0.531	0.491
Average,	0.1331				0.1730		0.1022	
Section O—Gravel—Fair Condition—Length 1.70 Miles								
1	0.103	0.079	.....	.....	0.140	0.107	0.072	0.076
2	0.140	0.134			0.176	0.167	0.110	0.117
3	0.103	0.091			0.142	0.127	0.085	0.088
4	0.119	0.121	.....	.....	0.137	0.132	0.091	0.098
5	0.115	0.116	.....	.....	0.133	0.129	0.089	0.092
Total...	0.580	0.541	.....	.....	0.728	0.662	0.447	0.471
Average,	0.1121		......		0.1390		0.918	
Section L—Gravel—Good Condition—Length 3.58 Miles								
1	.....	.....	0.134	0.149	0.097	0.093	0.082	0.071
2			0.173	0.166	0.133	0.128	0.119	0.105
3	.....	.....	0.143	0.135	0.106	0.095	0.083	0.075
4			0.138	0.134	0.110	0.102	0.092	0.085
5	.....	.....	0.131	0.130	0.103	0.097	0.088	0.078
Total...	.....	.....	0.719	0.714	0.548	0.515	0.464	0.414
Average,			0.1433		0.1063		0.0878	
Section I—Bituminous Macadam—Somewhat Worn and Uneven—Length 2.61 Miles								
1	0.093	0.084	0.102	0.084	0.105	0.088	.....	.....
2	0.125	0.120	0.136	0.121	0.126	0.123		...
3	0.080	0.088	0.105	0.096	0.106	0.098		
4	0.105	0.086	0.113	0.099	0.110	0.099		
5	0.101	0.085	0.104	0.096	0.103	0.096	.....	.....
Total	0.504	0.463	0.560	0.496	0.550	0.504	.....	.....
Average,	0.0967		0.1056		0.1054		.....	
Section R Brick Fair to Good Somewhat Worn—Length 1.16 Miles								
1	0.095	0.079	0.109	0.086	0.104	0.078		
2	0.122	0.114	0.140	0.119	0.124	0.116		
3	0.109	0.086	0.110	0.094	0.110	0.087	.....	.....
4	0.097	0.087	0.112	0.087	0.111	0.089	.....	.....
5	0.099	0.092	0.105	0.088	0.100	0.093	.....	.....
Total	0.522	0.458	0.576	0.474	0.549	0.463	.....	....
Average,	0.0980		0.1050		0.1012			
Section PB Brick Extra Good Condition—Length 2.39 Miles								
1	.....	.....	.....	.....	.....	.....	0.066	0.063
2	.....	.....	.....	.....	.....	.....	0.096	0.096
3	.....	.....	.....	.....	.....	.....	0.059	0.068
4	.....	.....	.....	.....	.....	.....	0.071	0.075
5	.....	.....	.....	.....	.....	.....	0.071	0.073
Total							0.363	0.375
Average,							0.0738	
Section K Brick—Good, Extra Smooth—Length, Sept. 4, 5.61 Miles, Sept 5-6, 4.22 Miles								
1	0.077	0.076	0.085	0.081	0.086	0.077		
2	0.101	0.109	0.122	0.116	0.109	0.106		
3	0.080	0.077	0.089	0.089	0.085	0.082		
4	0.084	0.080	0.096	0.087	0.084	0.087		
5	0.086	0.080	0.097	0.087	0.080	0.079		
Total...	0.428	0.422	0.489	0.460	0.444	0.431	.....	....
Average,	0.0850		0.0949		0.0875		.....	
Section M—Concrete—Good Condition—Length, Sept. 4, 5.61 Miles, Sept. 5-6, 4.39 Miles								
1	0.083	0.071	0.098	0.085	0.080	0.074	.....	
2	0.106	0.092	0.134	0.118	0.110	0.098		
3	0.086	0.076	0.106	0.088	0.084	0.079		
4	0.091	0.078	0.106	0.087	0.090	0.078		
5	0.092	0.076	0.107	0.088	0.081	0.075		
Total	0.458	0.393	0.551	0.466	0.445	0.404		
Average,	0.0851		0.1017		0.0849			

It will be noted that there is in general a remarkable agreement between the different trucks with the exception of truck 2, which in all instances shows a somewhat higher gasoline consumption than the other four trucks. This may be explained by the fact that the size of the opening to the carburetor for this truck is probably slightly larger than for the others.

In general, it will be noticed that the consumption of gasoline in one direction is more than in the other direction on a given test section of road, and that this is true for each individual truck. There are, however, four or five exceptions to this, believed to be due to the transferring of readings that should have been indicated as "out" runs under the heading "in." However, as an examination of the original records does not show that such errors were made, the results are given exactly as recorded.

Reference to the summary table will disclose the most significant conclusions to be drawn. The operation of the trucks on third gear, which is direct and at uniform speed, evidently does not give the true relative difference in gasoline consumption. On smooth, hard roads, when the truck is operated on third gear there is a certain waste of gasoline, while on the softer roads, or those pulling harder, there is not so much difference.

The results obtained with the trucks loaded with two tons, operated on fourth gear on "commercial runs," as indicated in the third column of the summary table, tests made Sept. 6, probably furnish the most instructive data. It will be seen here that the amount of gasoline consumed per mile on the hard, smooth roads—concrete and the smooth brick—is about 0.085 gal. of gasoline, as compared with a consumption of 0.173 gal. on the earth road, or 204% of the quantity of gasoline used over the hard, smooth surfaces.

In proportion as the surface of the road was of a character that offered greater resistance, the increase in the amount of gasoline is to be noted. Thus, on the brick road which was somewhat worn there was an increase of 19%; on the bituminous macadam 24%; on the good gravel 25%, and on the fair gravel road 64% of the amount of gasoline consumed over the hard, smooth surfaces. Or, to state the results in terms of miles per gallon of gasoline, 5.78 miles would be made over the earth road, 7.19 over the fair gravel road, 9.39 over the good gravel road, 9.48 on the fair bituminous macadam road, 9.88 over the fair brick road, 11.44 over the extra smooth brick road and 11.78 over the good concrete road.

Economy of Hard, Smooth Roads

These results furnish a sound basis for some reasonably definite conclusions as to the economy of constructing roads that will have and maintain a hard, smooth condition of surface. An illustration of the use of these data for such purpose can be made in the instance of the projected state system of highways for Illinois, for which there is proposed a bond issue for $60,000,000 to build approximately 5,000 miles of highways. On the supposition that these highways develop an average traffic of 500 motor vehicles per mile per

TABLE III. SUMMARY OF RESULTS OF GASOLINE CONSUMPTION IN GALLONS PER MILE, OVER VARIOUS TYPES OF SURFACE ON LEVEL ROADS—PERCENTAGES BASED ON MINIMUM AVERAGE CONSUMPTION FOR EACH DAY'S TESTS

Type of Road Surface Section Letter and General Condition	Truck Empty, Sept. 4, 15 Miles per Hour on 3d Gear Gas, Gal.	%	Trucks Loaded, 2 Tons, Sept. 5, 15 Miles per Hour on 3d Gear Gas, Gal.	%	Trucks Loaded, 2 Tons, Sept. 6, "Commercial Run" on 4th Gear Gas, Gal.	%	Trucks Empty, Sept. 7, "Commercial Run" on 4th Gear Gas, Gal.	%
P Earth—a little sand—generally fair	0.1331	156	Rain made too slippery to operate		0.1730	204	0.1022	138
O Gravel—fair	0.1121	132	......	...	0.1390	164	0.0918	124
L Gravel—good			0.1433	151	0.1063	125	0.0878	119
I Bituminous macadam somewhat worn and uneven	0.0967	114	0.1056	111	0.1054	124		
E Brick—fair to good somewhat worn	0.0980	115	0.1050	111	0.1012	119		
PB Pre[illegible] concrete [illegible]—extra good							0.0738	100
K Brick—good—extra smooth	0.0850	100	0.0949	100	0.0875	103		
M Concrete—good	0.0851	100	0.1017	107	0.0849	100		

day for 300 days in the year, and that the roads constructed will afford a hard, smooth surface, the saving in gasoline consumption over the operation of a similar amount of traffic, even if it were possible, on earth roads in fair condition, gives a grand total of 66,000,000 gal. per year, of an approximate value of $15,000,000, or $3000 per mile per year. This single item in fuel consumption would thus warrant the construction of the roads even at a cost considerably over the proposed amount of the bond issue.

This estimate of the value of the roads leaves out the decreased cost due to time saving in the operation of the trucks, to reduced wear and tear and therefore greater length of service to be obtained, and to tire economy, and particularly leaves out entirely the commercial value of the traffic.

Another suggestive study is made by comparing the amount of gasoline consumed because of the addition of a load of two tons on the different road surfaces. For this purpose compare the amount of gasoline per mile, 0.0849 gal., for a loaded truck over a smooth, hard surface, with the empty truck operated in similar manner over such a surface, 0.0738 gal., the difference due to the addition of two tons to the load being 0.0111 gal. Similarly, the difference due to a load of two tons on the earth road is seen to be 0.0708 gal., or nearly seven times as great as over the hard, smooth-surface road. This result bears out the increase in tractive resistance noted in the results of tests made by Prof. J. B. Davidson of the Division of Agricultural Engineering for the California State Automobile Association, published in 1917.

While the tests described in this paper are far from exhaustive, it is believed that they suggest some very significant facts in road economy. Particularly do they point to the necessity and the value of much more extended series of tests to determine not only the relative fuel consumption over various types and conditions of road surfaces, but also the fuel cost for operating on grades, on which there are at present no data whatever. The determination of a proper profile for our roads is one of the fundamental considerations of road improvement, and evidently affects vitally the fuel consumption necessary to operate a given piece of road.

Irrigation District Plan Favored in California

Experience Shows It Is Better Than Either Private or Mutual Water Companies—Irrigation District Bond Commission

ECONOMIC conditions in California now are such as to encourage greatly increasing the area under cultivation and additional acreage is being added at a rapid rate. Much of this is in irrigated tracts because that is probably the most convenient means of increasing the more valuable class of arable land. Irrigation developments are ordinarily most economical when developed so as to serve large areas, and the tendency has been to organize so as to distribute the cost as much as possible. There are three methods under which irrigation systems are developed in California: by public utility corporations, by mutual water companies, and by the formation of irrigation districts. Of these the last named now meets with more general approval than the others.

Even under conditions obtaining prior to the advent of the railroad commission the management of irrigation projects by public utility corporations was seldom successful. Since the railroad commission has exercised jurisdiction over such utilities there has been frequent statement of the belief that there is little hope of profit in such ventures and great possibility of heavy losses on the capital invested. Be this as it may, irrigacion developments of importance are no longer financed in California by public utility corporations.

MUTUAL WATER COMPANIES

The mutual water company plan was formerly much used, particularly in southern California. Such companies are not subject to the jurisdiction of the railroad commission and tend rather toward extreme examples of the need for regulation. They are not empowered with the right of eminent domain, cannot force a minority of stockholders to conform to the majority ruling and in case of non-payment of assessments can sell only the water stock and not the land of delinquents.

From the landholder's point of view the mutual companies have the disadvantage that they can be manipulated for the profit of individuals at the expense of the farmers. Mutual companies usually originated with owners of large tracts of land, who formed companies for the sale of their land and organized mutual water companies at the same time. With each acre of land sold a share of water stock was included entitling the purchaser to an amount of water sufficient for the irrigation of his land.

In most cases lands purchased under this system were paid for on terms, and until the purchasers paid at least a majority of the money due the land company continued to vote the stock. The usual procedure, which had many variations, was for the original owners just before losing control of the water company to mortgage the water system for as near its full value as possible, and then after turning the system over to the new owners to hold a mortgage on the system which

the purchasers never contemplated when buying the lands. This procedure has now been practically stopped in California by new corporation laws.

Changes in Irrigation District Plan

The irrigation district plan has undergone many changes since first authorized by the Wright act in 1887. Soon after the passage of the act so many ill-advised districts were launched which did not do well that in a few years California irrigation district bonds could not be sold for anywhere near their face value. There were revisions of the law and various improvements were tried, but the most successful plan was not reached until 1913, when the Irrigation District Bond Commission was formed. This consists of the attorney-general, the state engineer and the superintendent of banks, and its function is to investigate irrigation districts and give approval before the securities of such districts shall be legal investments for trust companies, insurance companies, trust funds, city school funds, and in money which may be invested in bonds of counties, cities, school districts or municipalities.

Irrigation District Bond Commission

In five years of operation under the Irrigation District Bond Commission no district which has obtained its approval of securities has ever failed to meet its obligations. This fact has become known in a general way to investors. Although it is legally possible to sell irrigation bond securities which have not been approved by the Irrigation District Bond Commission, bond houses are so unwilling to buy securities not so approved that all enterprises which failed to secure the commission's approval have been abandoned.

On the other hand, securities which have been approved by the Irrigation District Bond Commission have found a much more ready sale than irrigation securities in other sections of the country, and the districts themselves have prospered accordingly. California irrigation district bonds are now selling practically at par and have found a ready market even during war times and in the face of Liberty Loans. The second issue of Anderson-Cottonwood district, aggregating more than $500,000, was sold wholesale to one of the San Francisco bond houses since the beginning of the war for approximately 96 per cent.

As the law now stands a majority of votes absolutely rules the affairs of the irrigation district, it can exercise the right of eminent domain and can sell the land of delinquents for non-payment of assessments. Finally, the U. S. Reclamation Service has indicated its preference for this plan where reclamation projects are being turned over to the management of landholders. These facts explain the popularity of the California plan and the extent to which other states are endeavoring to put the same methods into effect.

Macadam and Hard-Surface Paving Upkeep Compared

Hard Surface Favored by Washington State Official When Maintenance Exceeds $500 Per Mile Per Year

WHENEVER any macadam or gravel-surfaced section of highway requires more than $500 per mile per year for upkeep under its increasing traffic, a hard-surface pavement is overdue, on the ground of public economy. This is the conclusion drawn by G. F. Cotterill, chief engineer of the Washington State Highway Commission, from the tabulated maintenance cost records for the State of Washington. The statement was made in an address before the joint convention of the county highway engineers and commissioners, at Seattle, Wash. The uniform cost system under which these records were compiled has been in operation for about a year, and was described in *Engineering News-Record* of Apr. 4, p. 660. A brief abstract of Mr. Cotterill's address, with an explanatory table, follows.

During the six years preceding 1917 the Washington program of good roads had resulted in about 1250 miles of construction along the primary state highway routes, of which 330 miles had been improved by the counties under the permanent highway law. The counties had

EXPENDITURES FOR MAINTENANCE AND REPAIRS OF WASHINGTON PRIMARY STATE HIGHWAYS, SEGREGATED BY TYPES OF SURFACE

	(1) Brick Pavement	(2) Concrete Pavement	(3) Sheet Asphalt	(4) Asphaltic Concrete	(5) Bithulithic (Warrenite)	(6) Bituminous Macadam	(7) W B Macadam (Cr Rock)	(8) Gravel Surfacing	(9) Nat Earth Grade	(10) Bridges and Trestles	Totals all Types
Period June-Dec. 1917.											
Counties	1	10	2	2	3	6	14	24	4	3	29
Road sections	3	20	3	6	4	13	40	108	12	4	213
Mileage	8.81	90.59	5.97	19.74	14.41	40.21	1,159.90	792.40	169.74	2.00	1,243.77
Expenditure	$9,456.51	$5,092.45	$326.03	$319.76	$2,978.50	$5,493.49	$25,333.79	$143,311.52	$11,043.37	$8,474.47	$210,829.89
Expenditure per mile....	$1,073.38	$56.21	$54.61	$16.19	$206.70	$136.62	$158.43	$180.85	$100.63	$3,737.23	$169.50
Jan.-May, 1918.											
Counties	1	12	2	2	4	6	14	27	8	7	31
Road sections	3	24	3	8	5	13	45	115	20	10	246
Mileage	8.81	102.41	5.97	23.24	17.81	40.21	174.74	839.90	168.54	3.70	1,385.33
Expenditure	$3,352.32	$2,809.97	$36.52	$225.52	$3,748.29	$4,833.66	$29,536.06	$149,379.28	$8,434.02	$17,003.10	$219,358.74
Expenditure per mile....	$380.51	$27.44	$6.12	$9.70	$210.45	$120.21	$169.03	$177.85	$50.04	$4,595.40	$158.34
Combined Year:											
Expenditure............	$12,808.83	$7,902.42	$362.55	$545.28	$6,726.79	$10,327.15	$54,869.85	$292,690.80	$19,477.39	$24,477.57	$430,188.63
Expenditure per mile	$1,453.89	$83.65	$60.73	$25.89	$417.15	$256.83	$327.46	$358.70	$150.67	$8,332.63	$327.84

EXPLANATIONS AND REMARKS FOR COMPARISONS

GENERAL NOTE: Figures include all expenditures upon entire highway for Maintenance, Repairs, Equipment and Supervision
(1) BRICK PAVEMENT: Large repair expense replacing broken sections due to settlement and other defects in original construction
(2) CONCRETE PAVEMENT: "One-course," "two-course," and "grout-filled" types, one to five years old
(3) SHEET ASPHALT: Only three sections in two counties adjacent to cities, one to four years old
(4) ASPHALTIC CONCRETE: Mostly new work, in first or second years, requiring only nominal maintenance
(5) BITULITHIC (Warrenite): High cost due to 6.11 miles Warrenite N. from Seattle ($783.43 per mile), also repairing washed-out section, Yakima Co. ($361.65 per mile); remainder cost $85.59 per mile
(6) BITUMINOUS MACADAM: Includes all oil bound surfacings by "penetration" system, sections two to eight years old
(7) W-B MACADAM, ETC.: Includes all crushed rock surfacings except oil bound
(8) GRAVEL SURFACING: Figures include resurfacing several sections but average fair as applied to all.
(9) NATURAL EARTH GRADE: Traffic much less than on other types, surfacing unnecessary or deferred
(10) BRIDGES AND TRESTLES: Items cover special repairs or renewals on large scale of certain structures.

also constructed about 400 miles of permanent highway on the secondary state routes and at least 350 additional miles from the proceeds of county bond issues. This gave a total of about 2000 miles of highway, representing an investment of at least $15,000,000.

Prior to 1917, the maintenance of this highway system had been attended to in a haphazard manner, but in that year a law was passed which provided sufficient money and prescribed certain rules for the maintenance of the state highways by the counties in which they lie, the State Highway Department having regulative control and power to enforce standards of maintenance on primary state routes. Maintenance of the existing primary state highways now stands ahead of all other road work and must be taken care of, even it is necessary to utilize highway construction funds. The law has worked exceedingly well, and the roads were never in better condition than at present. The only exceptions are certain gravel roads on which the traffic is so heavy that they cannot be maintained successfully at any price.

In the exercise of its regulative authority the State Highway Board adopted a series of rules for the guidance of county officials. Particular emphasis was placed upon uniform maintenance cost records, and the form in which reports were to be made was given in detail. The table shows a summary of the expenditures for maintenance on the primary state routes, segregated by types of surfacing. The record covers the period from June 1, 1917, to May 31, 1918, the two years being kept separate. The number of counties reporting, the total mileage, the total expenditure and the expenditure per mile, accompanied by a statement of the particular conditions governing each type, are given.

While it is appreciated that statistics for one year do not afford an adequate basis for detailed comparisons, still the data are definite enough for the forming of general conclusions concerning the two types. In doing this, however, certain special conditions must be considered, and these have been set forth in the footnotes of the table.

Referring to the table, it is interesting to note that, during the seven months closing 1917, there was a total expenditure of $210,829.89 reported upon 1243.77 miles of primary highway, and that, during the opening five months of 1918, an additional sum of $219,358.74 was expended upon 1385.33 miles, or a total of $430,188.63 for the entire year. This makes an average expenditure per mile per year of $327.84. It is believed that this figure is high, on account of the fact that, in anticipation of the new maintenance law becoming effective on June 7, practically all the spring maintenance was held up until that date. Thus the heavy maintenance for two spring periods was carried in the one year. The present high prices have also had their effect upon the figures, and under normal conditions the annual charge may be brought down to $200 per mile.

The statement of expenditures segregated by types of pavement or surfacing present an interesting field for comparative study of general features. The first five classifications include what are commonly referred to as hard-surface pavements. For purposes of comparison, it must be recognized that the brick and bitulithic roads tabulated were extensively repaired, being practically reconstructed. Eliminating these, it can be broadly stated that the annual upkeep of approximately 150 miles of primary highways covered with hard surfaces was from $50 to $100 per mile. In sharp contrast, the next three classifications, including the various types of oil- and water-bound macadam, crushed rock and gravel surfacing, covering nearly 1100 miles, cost from $250 to $350 per mile. Here is a distinct gap of $200 to $300 per mile for annual maintenance cost, between the hard-surface and macadam gravel groups. Furthermore, it is evident that this contrast does not fully measure the gap, because the 150 miles of hard-surface pavement cover highway sections which carry double or triple the traffic that is carried by the other group.

A study of the highways by counties shows that the annual maintenance cost has varied from $75 to $900 per mile, and that this variation is directly proportional to the amount of traffic. It seems safe to conclude that, if the hard-surface pavement mileage had been of the macadam and gravel type, the annual cost for upkeep would have averaged more than $600 per mile. Therefore at least $500 per mile, or the equivalent of 5% interest on a $10,000 investment, is being saved wherever a properly built hard-surface pavement has replaced macadam or gravel on heavy traffic highways.

"Vestibule" Schools for Women Mechanics

Industrial training for female machine-tool operators is expedited by placing the women in a "vestibule" or preliminary instruction room for a few days under a competent instructor. The idea is to take away from the woman the fear of the shop and to give her a fair knowledge of the tools she is to handle. At the plant of the Lincoln Motor Co., Detroit, which is building Liberty motors, an 18 x 40-ft. room is equipped for training purposes with a lathe, a milling machine, a gear cutter, a drill press, a profiler and similar tools.

Only women 21 years of age or over are admitted. They are trained in the school for from one to three days. More than 50% of the first 500 had never been in a manufacturing establishment, but one day is found sufficient to remove the fear of the shop, according to a recent report to the section on industrial training for the war emergency of the Council of National Defense, from which these notes are taken. From its experience the company is of opinion that the vestibule school has come to stay and that eventually instruction will be given in this way to men as well as women. The training department of the Curtiss Aëroplane & Motor Corporation also gives employees preliminary training in mechanical operations and shop practice. Regular parts are made, and 100% inspection for quality is maintained. The school has a capacity of two hundred, and the time of instruction is from two to five days. An adjustment department is being developed to interchange labor, by means of the training department, from one department to another, without losing it. It has been found that when women have been introduced into mechanical activities without training, both employees and foreman are likely to become discouraged. If preliminary instruction is given, however, the employees are made adaptable to work for which they are fitted, and the company gets the help which it needs.

Large Freighters of Isherwood Framing Adapted to Bridge-Shop Fabrication

Problems Worked Out By Coöperation of Naval Architect and Engineer of Barge Shop—200 Tons Weight Saved—Time Gained in Detailing—All Molded Work Done in Large Shop at Shipyard

(Passed by Publication Approval Committee, Emergency Fleet Corporation)

STARTING out last July to build standard-type fabricated ships for the United States Steel Corporation, the Federal Shipbuilding Co., has developed specially efficient ship production through success in working out an economical shop-fabricated design and through coöperation with a bridge works that had been engaged in river-barge construction for a number of years. Utilizing the equipment and methods of the bridge shop, which were excellently adapted to the fabrication of straight parts of ships, the Federal company made a distinct saving in time. It was relieved of making a great many shop drawings and templets that otherwise would have had to be produced at the shipyard.

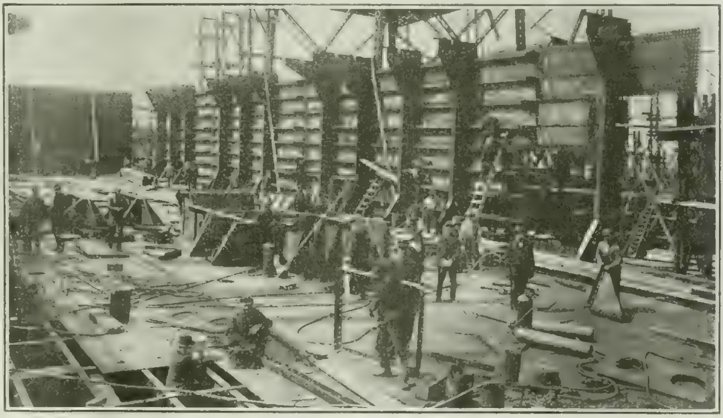


FIG. 1. INTERIOR VIEW OF HULL DURING ERECTION, SHOWING TYPE OF FRAMING AND SOME CHARACTERISTIC DETAILS

The same coöperation was of material influence on the adoption of the Isherwood type of framing. A saving of 200 tons of steel in the hull of the ship was accomplished through the adoption of this type, at first considered unsuitable for fabrication. This is a 7% reduction in hull weight, and means a saving of about $25,000 in the first cost of the ship; furthermore, the vessel can carry 200 tons more cargo for the same displacement.

The Federal yard, at Kearny, N. J., is building one of the largest types of ship under construction for the Emergency Fleet Corporation. Its dimensions are: Length 410½ ft. over all, and 395½ ft. between perpendiculars; molded breadth 55 ft.; molded depth 34 ft. 11 in. Its dead-weight carrying capacity is 9600 gross tons. For comparison, it may be stated that the Fleet Corporation's three agency yards are constructing vessels of 5000-ton (Submarine), 7500- and 8800-ton (Hog Island), and 9000-ton (Merchant) carrying capacity. Although these ships are materially smaller, the Kearny yard completed its first hull and launched it on June 19, well ahead of the earliest launching dates of Hog Island and Bristol, and less than three weeks after the first launching at the Submarine Boat Corporation's Newark Bay shipyard.

During the Government's indecision as to its ship program, last summer, when nothing was settled as to type of vessel, material or construction program, the United States Steel Corporation took up the construction of steel vessels on a large scale, using its own money, without waiting for Government action. It organized the Federal Shipbuilding Co. in July. Under direction of Robert McGregor, vice-president and general manager, the new company at once started developing plans for a yard, ship designs and production methods. Yard construction began in August. By that time the general lines of the ship had already been laid down. Soon afterward the projected ships were commandeered by the Emergency Fleet Corporation. The plant was planned and built as a permanent enterprise, to continue actively in shipbuilding, repair and dock service after the war emergency is overcome. Shipyard experience and precedent accordingly controlled the entire layout, though the fabricating procedure as well as the erection equipment, described in *Engineering News-Record* of June 13, p. 1129, was studied on the basis of bridge and structural-steel experience.

Ample shop facilities are the most striking feature of the plant, when compared with most other yards building fabricated ships. They find their explanation in the company's intention to do all its hull work in the yard shops, once the war emergency is over. Fabrication in distant bridge shops is used as a temporary expedient, to permit of turning out ships at maximum rate of speed. However, even now one-third of the entire hull fabrication is done at the yard.

The American Bridge Co. naturally became a part of the Federal company scheme, since both concerns are constituents of the United States Steel Corporation. The producing capacity of the bridge shops had to be depended upon to furnish the necessary steel for erection at the yard. The ten shipways at Kearny, if

crowded at greatest speed, may succeed in launching ships at as high a rate as 200,000 to 300,000 tons of hull weight per year. There was no time to wait until plate and angle shops of this great capacity could be equipped. The American Bridge Co. took up its part of the work without delay. It was well prepared through experience in similar work for a number of years before.

Barge building was made a specialty of the company's Ambridge, Penn., plant about twelve years ago. Launching ways and a plate shop to serve them were put in, and many steel freight barges, most of them now navigating the Ohio River and its tributaries, were built there. The shop force, the drafting room and the templet loft acquired experience in this special class of fabrication, and developed methods to suit. John L. Taylor, engineer of the barge department, sketches the development in the following brief statement:

"The company has been in the business of building steel barges for a dozen years. The vessels built range in size from cane punts, for export, about 20 ft. long and weighing a few hundred pounds, to car floats 308 ft. long and 50 ft. wide, weighing a thousand tons. For the first four or five years the steel-barge building was on a small scale, and regular structural shop methods proved satisfactory. As the volume of work began to increase, however, we found it expedient to abandon the practice of making detail drawings and bench templets, and began giving the templet loft only a general drawing and typical details to work to.

"Great care and forethought had to be used in both designing and detailing to permit as great a use of the multiple punch as possible, and in other ways to simplify construction, so that we might *manufacture* rather than *build* barges. The templet loft was skilled in adjusting the rivet spacing to suit multiple punching, and, as it also had to lay down the ship's lines and take off the various plates, frames and connections, it virtually became the equivalent of a shipyard mold loft and structural templet room combined.

"The barge-building experience gave us the necessary confidence to accept an order, some three years ago, for the parallel-body portion of a 400-ft. oil tanker. This was a vessel under construction by the Chester Shipbuilding Co., which, through the efforts of Capt. C. P. M. Jack, undertook to build several ships by the new procedure of getting all the straight parts punched and (so far as possible) riveted at a bridge shop, in order to reduce the shipyard work. Since that time we have furnished material for 13 other ships, before starting in on the Emergency Fleet Corporation work.

"There are only two differences between our barge and our ship work. The first is that the metal in the ship is much heavier than that used in the average barge, and slightly heavier than that used in our largest barges. The second difference is that in building barges we generally made our own designs, wrote our own specifications and used our own judgment in regard to rivet spacing and other details of construction, while in the case of a ship the design is furnished by the customer, and rivet spacing and details of construction are governed by the rules of a ship-classification society. Both design and details, therefore, required modification and adjustment in various ways to suit the shop tools.

"After these adjustments are made we find that a so-called fabricated ship is exactly the same as other steel construction. Moreover, it is identical with a built ship, except that (1) rivet spacing has to be juggled a little to permit the use of the multiple punch, and (2) the fabricating shop is 300 or 400 miles away from the building ways instead of 300 or 400 yards, which means that the design once made must be held to."

With an organization at the Ambridge barge shop ready to take up intensive fabrication of ship parts last summer, the Federal company was able to count on getting shopwork started without lost motion and having it continue at maximum speed. In the working out of design and production routine this fact was of marked influence.

Two Designs of Ship Compared Before Fixing on Type

Being organized to build vessels for regular trade service, the Federal company made its design accordingly. John C. Craven, the company's naval architect, states that it was decided to build ships for the South American trade, and the size was fixed at what practice showed to be suited to this service—about 10,000 tons carrying capacity. Many ships of approximately that size are now trading with South America, and several of these are of the Isherwood longitudinally framed type. Mr. Craven was convinced that a material saving of weight could be realized through adopting the Isherwood system.

However, it was learned that three barges of Isherwood framing had been built at Ambridge previously, and had proved troublesome. Hardly any two pieces were alike, and the work was excessively slow. It was felt that if the shop should find corresponding difficulty with Isherwood-frame ships, it would probably be better to use ordinary transverse framing, even though this weighed somewhat more. Two designs for the Federal

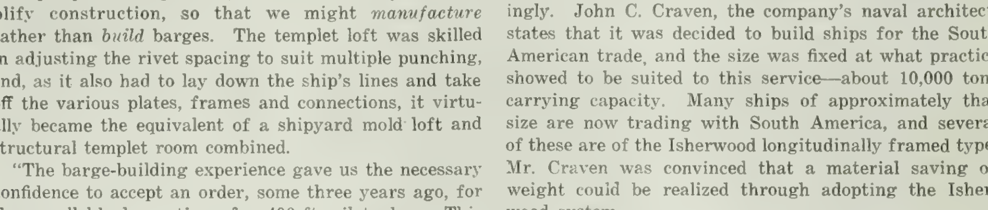
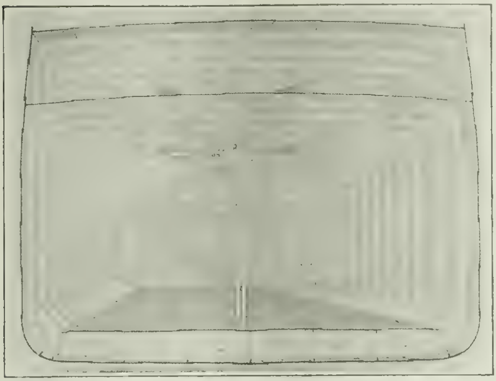


FIG. 2. SHELL EXPANSION; SHADED AREA SHOWS BRIDGE-SHOP WORK

ship were therefore worked out, one with transverse framing and one with Isherwood framing—the latter proving to be the lighter by 200 tons—and both designs were submitted to the bridge company for estimates.

Looked at from the shop's point of view, Mr. Taylor says, the Isherwood design at first appeared just as troublesome as the barges of the same system which had been built previously. Detailed study showed, however, that the anticipated difficulties either did not exist in the large ship or could be overcome by suitable detailing, especially as regards location of joints of the plating and rivet spacing. If anything, the fabrication appeared simpler than that for the transverse-framed ship. Much duplication of parts was feasible. The long frame spacing (10½ ft.) favored multiple punching, and reduced the amount of cutting and fitting in floor transverses and main frames. Above the double bottom, erection was simpler. On this favorable showing, the Isherwood design was adopted.



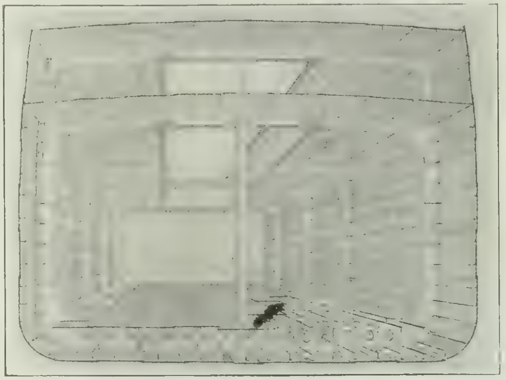


FIG. 3. DIAGRAMS OF TRANSVERSE FRAMING AND ISHERWOOD OR LONGITUDINAL FRAMING
[Sketches taken from a paper by J. W. Isherwood recently published in the *Journal* of the Society of Engineers]

The Federal ship has 40% of parallel length, which is stated to be about normal for slow freighters. While the shape of the ship was simplified somewhat in cross-section, Mr. Craven says that "not a single concession from the full requirements of navigability is contained in the design."

The mid-ship section was squared up by using no tumble-home and by making the bilge curve short (4-ft. radius). The outer bottom was given a 6-in. dead-rise from the keel, and the inner bottom was made parallel to it, so that the floors became a uniform depth, permitting them to be multiple-punched. The tank-top margins were carried out straight to the sides of the shell, to eliminate flanging and other difficulties of construction here, while drainage of the hold is provided for by the down slope to the keel. As to sheer and camber, the design is closer to shipbuilding custom than that of most of the emergency ships. The deck profile, while horizontal throughout the parallel-body portion, shows a curved sheer from here to the ends, rising 7½ ft. to the bow and 3 ft. 1 in. to the stern. The weather deck is fully cambered, with straight slope to the sides of the hatches and a curved middle portion. The main deck is flat transversely.

Multiple punching being counted on from the beginning as an important aid to rapid shop production and low cost, all shell plating, decks and bulkheads of rectangular outline were detailed to permit using the multiple punch. Careful study was given to simplication of the plating, in order to make as many plates as possible alike. In both respects considerable help was obtained through modifications of the ship-classification rules, permitting variations in rivet spacing and giving latitude in the spacing of the longitudinal frames. The seams (longitudinal splices) were made uniform in their relation to the longitudinal frame members, so that the "in" and the "out" plates of the shell have identically the same punching. The butts (transverse splices) were made uniform in rivet spacing and in their location with respect to the main transverses. As a result, in the shell of the parallel-body portion eight strakes of shell plating are alike on each side of the ship.

Simplification of rivet spacing to suit multiple punching was handled by the drafting room and templet loft of the bridge shop, which, as already explained, had experience in similar work. Drawings showing the layout of all the plating, and typical detail sheets showing the rivet-hole arrangement in the different classes of joints and connections, were prepared in the drafting room. The actual laying out of the rivet holes, however, was done in the templet loft, using the typical detail sheets and also following the modified ship-classification rules. The effect of the concessions permitting rivet spacing to be varied is thus explained by a shop representative:

"In the case of a typical shell plate, for example, three kinds of transverse spacing of rivets in addition to the marginal or seam spacing are found—at ordinary frames, at water-tight transverse members, and at butts. The spacing of the classification rules made it impossible to line up the punches of the multiple-punch gang to suit any two conditions exactly. However, with the concession as to rivet spacing, all three could be made to match. Irregular spacing was permitted provided that for every three or four rivets it would average the exact spacing called for by the rules. This enabled the templet loft to line up the butt spacing with the spacing at the ordinary frames, and locate the water-tight frame spacing be-

ween the two with no rivet distance less than 2 in., so that the individual punches of the gang could be set on the several holes."

The Federal Shipbuilding Co. has a smaller percentage of bridge-shop fabrication than any one of the three emergency yards. Only a little more than 60% of the fabricating work on the ship is done at the bridge shop

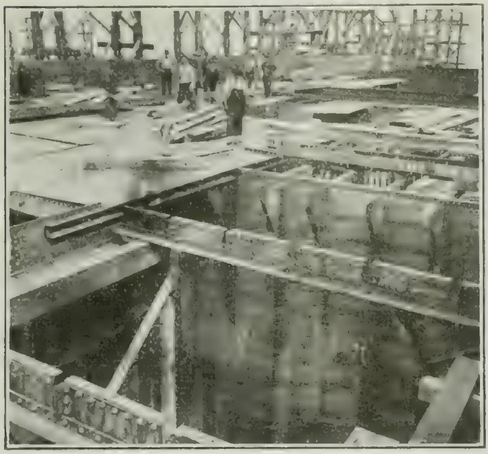


FIG. 4. FIRST OF THE FEDERAL SHIPS BUILT TO UPPER DECK LEVEL

(Fig. 2), and the other 35 to 40% is done at the Kearny yard, where a large and fully equipped shop has been set up. The decision to make such a division rested partly on the fact that the yard was to be built for permanent service, requiring a large shop in any event, and partly on the fact that the most efficient use of the existing bridge-shop facilities and organization was obtained by restricting the allotment to the parallel body of the shop. Bending and plate-rolling facilities as required for the shell plating and frames of the molded ends did not exist in any bridge shop, and thus had to be provided new, whether at bridge shop or shipyard. The same amount of time would be required in either case. It was believed that if the bridge shop were required to do both the straight work, which is similar to bridge and structural work, and the molded work, it could not manufacture as efficiently as if it did only the straight work.

Furthermore, the total tonnage of straight work which would be needed was sufficient to tax the spare capacity of the Ambridge plant, and probably of several other bridge plants in addition. In the circumstances, the molded work was allotted to the shipyard shop and a complete installation of the necessary machinery was made during the winter and spring.

The work done at the shipyard shop includes the punching and shearing of molded work as well as the bending. It was necessary to provide in the shop for ultimate equipment of punches and shears ample in capacity for extensive shipwork, and the required tools were available immediately through purchases of new equipment and machinery from a large shop just being dismantled.

Only two or three special operations involved in the ship work were found to be out of the ordinary for the Ambridge shop. The ship design called for scarfing—tapering off the shell plates to a chisel edge for forming a smooth overlap at the junction of three plates. As no scarfing is done in structural and bridge work, a machine had to be rigged up for the purpose. Two old vertical-spindle drills were set on a base plate, adjustably, so as to take the width of the plate horizontally between them and bring over each edge of the plate an inserted-tooth milling cutter mounted on the spindle. Wedge-shaped bearing blocks on the tables of the two machines carried up the end of the plate on the slope of 1 in 16, the standard slope of the scarfs. Provision was made for feeding the plate, with the bearing block on which it rested, across the table of the machine, thereby enabling the cutters to cut the two scarfs.

The rivet holes in the shell and deck plating of ships are countersunk. While bridges have few countersunk holes, the barge building required practically as much countersinking as ship work, and an efficient tool had been developed. This is handling the heavier work on the ship plating just as successfully. It is a portable electric drill, hung to the forward half of a small two-wheel buggy which the workman runs over the plate as it lies on the floor. The buggy frame is counterweighted at the rear, so as to tip the buggy back and lift the drill off the work except when the operator presses down on handles at the front end of the frame. Countersinking $\frac{7}{8}$-in. rivet holes is done at the rate of about one in every five seconds.

The lightening holes in the floors, and the notches in the floors and transverses to pass the longitudinal frame channels, are punched out on a large manhole punch. Bulldozers, crimping presses and other regular bridge-shop tools do the small amount of bending, crimping, etc., required. The cylindrical bilge plates are rolled to curvature after being punched.

Design Details Simplified as Far as Possible

Joggling and scarfing were considered to be undesirable shop operations, but study of the saving of weight and other advantages secured through them resulted in the decision that both should be used quite extensively. In consequence, scarfing is used throughout the shell plating. It not only eliminates the dead weight of a beveled liner which otherwise would have to be used, and in addition the weight of material cut off in scarfing, but also keeps the rivet length at the triple lap down to two plate thicknesses, which make it easier to get tight work. In view of these advantages of scarfing, detailed cost comparisons between scarfing and beveled liners were not entered into; it was believed, however, that beveled liners would give much trouble in fitting, and so would involve expense not included in a comparison of direct costs.

With respect to joggling of frames and floors to follow the in-and-out shell plating, the decision was to use joggling rather generally as soon as the necessary presses could be installed, but to use parallel liners in place of joggling, in the first few ships.

The wide spacing of the main frames of the Isherwood system reduces the amount of joggling considerably. The channel longitudinals are set in and out to follow the shell plating, and require a filler only at butt splices in the plating.

About 600,000 rivets are contained in each ship. Only

8% of these are shop rivets, while 550,000 are field rivets. In general, only ¾- and ⅞-in. rivets are used. The middle body shell under strict reading of ship classification rules would require some 1-in. rivets, but it is detailed throughout with ⅞-in. rivets. The ends of the shell and the entire double bottom have ¾-in. rivets.

In punching, advantage has been taken of the accuracy of spacing secured through the multiple punch with automatic spacing table, to reduce reaming. For ⅞-in. rivets a ⅞-in. punch and a $\frac{15}{16}$-in. die are used. This makes the hole slightly oversize, just enough to insure easy entrance of the rivet when the holes are perfectly true. The countersink, which works on the die side of the hole—all punching is done from the contact face or "faying surface" of the plates—is proportioned as for $\frac{15}{16}$-in. holes.

Snow Removed by Various Methods at Milwaukee

Street Railway Loads Snow by Electric Shovels into Dump-Car Trains and Motor Trucks Dumping Through a Bridge

CLEARING snow from street-car tracks was an unusually difficult problem for the Milwaukee Electric Railway & Light Co. in January last, owing to the heavy storms. The snowfall for the month amounted approximately to 50 in., the heaviest storms being as follows: Jan. 1, 9 in.; Jan. 5, 19.7 in. (30.4-mile wind); Jan. 11, 10.5 in.; Jan. 26, 2.1 in. (25-mile wind); Jan. 28, 8.1 in. (31-mile wind). The weather was cold and the snow was dry, but the high winds caused heavy drifting and hard packing. Between the storms there were several days when high winds blew considerable amounts of snow back onto the tracks, so that a large part of it had to be handled more than once.

Rotary sweepers and nose plows attached to work cars cleared the greater part of the snow from the tracks. The company has 16 double-truck and 5 single-truck sweepers for city use, together with eight utility cars equipped with nose plows and 15 salt cars. The sweepers were always placed in service in the early stages of the storms, and by this means the lines were kept open so that even under the worst conditions there was no interruption of traffic on city lines. The mechanical equipment piles the snow on the sides of the street, just outside of the track zone. It is then leveled by means of heavy wings attached to the sides of the sweepers and work cars. In the heavy storms these piles became so high that they could not be leveled sufficiently to accommodate the traffic on the sides of the street, the entire space between the track zone and the curbs being occupied by the slopes of the piles. The company operates 403 miles of single track, with approximately 180 miles (or 90 miles of double track) inside the city limits. The amount of snow removed from the tracks in the city and piled on the sides of the street by the end of January amounted to more than

STREET RAILWAY USES ELECTRIC SHOVELS TO LOAD SNOW FROM STREET INTO DUMP CARS

1,500,000 cu.yd., as there were no thaws during the month. The company hired every available man, team and automobile truck, and put all of its work trains into service loading and hauling snow. The company forces loaded and removed the snow from all important street intersections and passenger landings, and gave substantial assistance to the city in removing snow from the sides of the streets.

Consent was obtained from the city to abandon one of the older drawbridges over the Milwaukee River, in the downtown district. Openings with trap doors were cut in the floor of this bridge, and practically all of the snow from the downtown district was hauled to the bridge by motor trucks and trains and dumped into the river through these openings. Two ⅜-yd. electric shovels which the company uses in excavating for track foundations were put in service. It was soon found that the capacity of the dippers was too small, and the ordinary method of moving on short sections of portable

ELECTRIC SHOVEL IS ADAPTED FOR LOADING SNOW BY SPECIAL 1½-YARD BUCKET AND HOME-MADE TRACTION WHEELS

track was not satisfactory. New reinforced sheet-metal dippers of approximately 1½-yd. capacity were designed and constructed in the company's shops, and improvised traction wheels were placed on the axles. After these changes much better progress was made.

The shovels were used in the business district to load the snow from the sides of the street onto trains of the company's small four-wheel dump-cars. It was necessary to close one track to traffic while this loading was in progress. More than 20,000 cu.yd. of snow was handled by these shovels. The output was limited by the ability to keep trains at the shovels, the principal difficulty being caused by traffic delays. The shovels were capable of loading 50 to 60 cu.yd. per hour, the dipper loads averaging about 1 yd. Hand loading of wagons and trucks by means of shovels averaged about 2½ cu.yd. of snow per hour per man.

Says Utilize Full Life of Light Railway Bridges

C. F. Loweth Decides Whether To Repair or Renew on Study of Limiting Unit Stresses and Loads for Old Structures

BRIDGES of light capacity which impose more or less restriction on the train loadings are found on most railways more than 25 years old, and it is an economic problem how to get full life and service out of such structures under the conditions of increased modern loading. This problem is of special importance at this time, when the supply of steel for new structures is so restricted that it is desirable to avoid renewals and replacements as far as possible. Special methods employed to ascertain the safe carrying capacity of old bridges were described at the convention of the American Railway Bridge and Building Association by C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul Ry. The following is an abstract of his paper:

Systematic investigation, or classification, as it is called, of all light-capacity bridges is made on the Chicago, Milwaukee & St. Paul Ry. in order to determine the maximum loads which can be carried safely. Every part of the structure is figured or taken into consideration. The carrying capacity is determined in terms of a standard series of loadings, and proposed new engine and car loadings are compared with these to show whether they can be carried safely.

Unit Stresses and Loadings

Maximum safe unit stresses to which the various materials can be subjected are first established. These are taken as near the limit of strength as is considered safe, but must be sufficiently low to preclude danger of the material failing in any way after being subjected continually to this limiting stress.

Safe limiting unit stresses may be taken as follows for structures of good design and in good condition: Beams and girders, fiber stress in bending, 22,000 lb. per square inch for wrought iron and 26,000 lb. for steel; truss members, tension on net section, 20 000 lb. and 24,000 lb. for iron and steel; timber stringers, 2000-lb. fiber stress in bending, with suitable reduction for exposed timber more than six or eight years old.

In fixing limiting unit stresses for loading old bridges, the following factors are taken into account: (1) Character of design and workmanship; (2) deterioration; (3) action under load; (4) probable speeds and observance of speed restrictions; (5) certainty as to the assumed loading being the maximum to which the bridge will be subjected; (6) importance of traffic and result of temporary disablement of the structure; (7) probability of early renewal, since a higher limit might be allowed for a short time to meet an emergency than for a structure to be kept in service indefinitely. Care and good judgment must be exercised in order to be on the safe side and at the same time conserve the maximum life of the structure.

For a unit loading, Cooper's series furnishes a convenient basis. Allowances must be made for impact, traction or longitudinal pull and centrifugal force on curves. Dead-load stresses and wind stresses must also be considered.

After the classification of the light bridges on various lines is completed, a tabulation is made of the load-limiting details of each bridge. Classification is made also of all engines, single and double headed, with appropriate train loadings; also of wrecking derricks and other heavy loads. Then a list is made of the loadings which may be permitted, with note of speed restrictions. This is issued in a form convenient for operating officers.

Where many bridges on one line require speed restrictions for certain loadings, it is generally desirable to rule off such loadings, as it is difficult to obtain the observance of a large number of speed restrictions. Double-heading of engines should be assumed, and special note made where it is not permitted. The schedule should also indicate the heaviest car loadings possible on the various lines.

Internal deterioration of the metal does not occur where a bridge has not been subjected to excessively high stress. Therefore, if bridges are not reduced in section by rust, and are not shaky on account of inadequate bracing, they are capable of carrying the figured loads at reasonable limiting unit stresses, provided they are carefully inspected and properly maintained.

Reinforcing Light Bridges

Strengthening of light bridges to adapt them to heavier loadings may consist of reinforcing minor details which limit the carrying capacity, or heavy reinforcing to increase the strength of the structure throughout. Minor strengthening can be done usually at small expense, and is an economical method of increasing the life considerably.

Heavy reinforcing may or may not be economical, as it involves expensive work in the field. Maintenance of traffic during the work is usually expensive, and involves some risk. On some large bridges, where the cost of replacing would be considerable, extensive strengthening operations have been carried out economically. In reinforcing bridges it is usually preferable to add new material, so that the structure is not temporarily weakened, rather than to remove parts and substitute heavier ones.

The cost of strengthening bridges varies with the

size of the job, the amount of staging required and its shifting on the work, the size of the crew needed and other factors. In general, the cutting out and replacing of rivets on such work costs from 25 to 75c. each; drilling and driving new rivets, 50c. to $1 each.

With old and light-capacity bridges, the question continually arises whether it is more economical to strengthen a structure or renew it. As a general proposition it would be permissible to spend each year for strengthening an amount equal to the interest on the investment in a new bridge, less the cost of additional maintenance required by the old bridge. For illustration, the accompanying table shows the cost of through spans designed for E-55 loading, replacing similar spans designed in the early nineties. New steelwork taken at 5c. per pound erected; falsework, $10 per linear foot; removing of old structure, $10 per ton; salvage on old spans, 2½c. per pound; additional cost of maintenance of the old span on account of additional inspection, classification and supervision, $1 per foot of span per year. The last column shows the amount which could be spent annually in strengthening old spans rather than in renewing them.

COST OF BRIDGE RENEWALS—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

Span, Ft	New Steel Weight, Tons	Cost, Erected	Salvage	Net Cost	Interest on Net Cost at 5%	Available for Strengthening Each Year
50	33	$4,330	$1,130	$3,200	$160	$110
100	100	13,390	3,700	9,600	480	380
200	400	46,800	12,500	34,300	1,715	1,515
300	800	92,200	25,000	67,200	3,360	3,060

Renewal of a bridge having three 400-ft. spans, proposed about 10 years ago, would have cost about $370,000, after the salvage value of old spans had been deducted. Interest on this investment for the 10 years would have amounted to about $185,000. Instead of being replaced, however, these spans have been carefully maintained and inspected and the details strengthened wherever the classification showed that this was necessary to carry the heavier traffic. The actual cost of strengthening, together with the additional maintenance expense, has amounted to not more than $100,000 during this period, showing a saving for this one bridge of about $165,000 due to the policy of getting its longest practicable life.

With old and light bridges a limit is reached beyond which it is not economical to strengthen them, and replacement then becomes necessary. It must be recognized, of course, that a newly designed and heavy structure is preferable to a lighter structure. It is possible that in case of a serious accident on a bridge, a light structure might be destroyed while a heavy new structure might not be seriously disabled. Such considerations must be taken into account in shaping the general policy in keeping light bridges in service.

War-Time Repairs Form Basis of Future Sewer Reconstruction

By S. M. Bailey

Assistant Engineer, Department of Public Works, Newport, Ky.

During the winter of 1917-18 at Newport, Ky., a break occurred in the Washington Ave. egg-shaped brick 3-ft. 4-in. x 4-ft. 3½-in. trunk sewer, at about 120 ft. from the outlet into the Ohio River. The sewer at this place is in sandy soil, which is from 12 to 20 ft. deep under the invert and rests upon a layer of soapstone. After the break occurred in the sewer, high water

TEMPORARY PIPE WILL BE USED AS INNER FORM FOR PERMANENT CONCRETE SEWER

and storm undermined and washed out the brickwork for 120 ft. and also the concrete outlet. This washout also caused an old masonry retaining wall, which had withstood numerous floods, to cave in and slide into the cut formed by water emptying from the broken sewer.

In the spring of 1918 it was necessary to make repairs at once, but because funds were limited only temporary construction could be undertaken. As the original break had been caused by the shifting of the sand overlying the soapstone, it was deemed necessary to drive piles through this soapstone. The outlet, consisting of about 20 cu.yd. of concrete, had been picked up and carried bodily down stream about 30 ft. For this reason the new outlet (35 cu.yd.) was built on 19 piles, at a distance of 160 ft. from the old brick sewer or 40 ft. further down the river bank.

Pile bents were then constructed on 4- and 8-ft. centers from the new outlet to the break in the brick sewer. The piles were driven 4 ft. through the soapstone. On top of these bents was placed 48-in. corrugated galvanized pipe in 14-ft. lengths securely bolted together.

At the outlet end the pipe was encased in the concrete, and at the brick sewer the connection was made by a brick manhole resting upon a foundation of six piles and 22.5 cu.yd. of concrete. Since the completion of the work there have been heavy rains, without any bad effect upon the construction. It is the intention next year to encase the corrugated pipe in concrete, using it as an inside form.

State and Districts Get Royalty on Sand

Kansas now collects a royalty of 10c. a ton on all sand taken from the beds of navigable streams. Part of the money goes to the natural drainage districts from which the sand is collected, and the remainder goes into the fund of the state water commission for use in drainage investigations. The first year under the new law, recently completed, yielded a total sum of $67,833 in royalties.

Steel Construction Characterizes Chicago Church

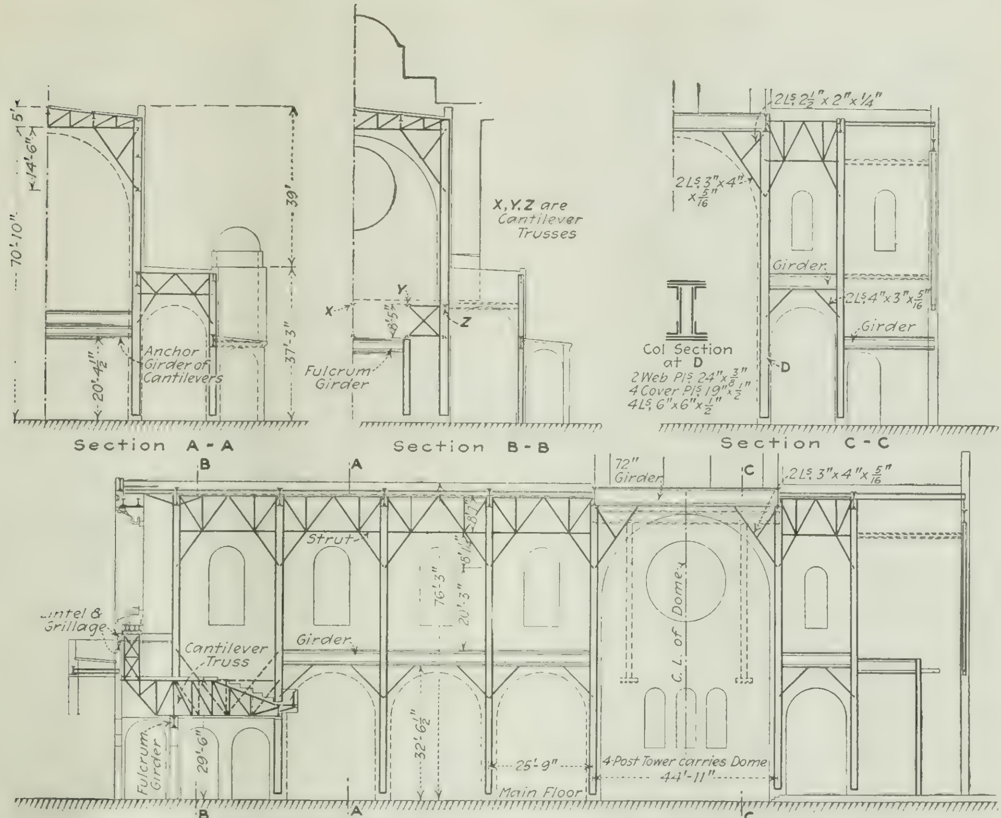
Cantilever Trusses Carry Front Wall and Gallery—Dome Trusses Are Supported By Girders On Tall Four-Post Tower Having No Interior Bracing

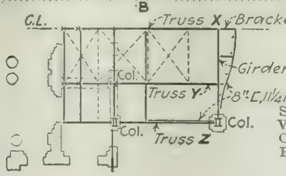
STRUCTURAL design of the church of St. Mary of the Angels, Chicago, is notable in that self-supporting steel-frame construction is used, independent of masonry walls, and that this framing includes cantilever trusses and a large dome. This church is cross-shaped, 215 ft. long, 100 ft. wide in the body and 124 ft. wide over the arms. The height is about 76 ft. under the main roof trusses and 35 ft. under the side roofs, while the top of the dome is 150 ft. above the floor.

Cantilever support for the upper part of the masonry front wall forms the most striking feature in the structural design. In the original plans no supporting columns were provided for the front wall, as the entrance was to be left until the last. Masonry construction was begun in 1912 and carried on intermittently. When the roof design was undertaken, in 1916, it was not practicable to place the supporting columns, with necessary foundations, in the front wall, which was already erected for a portion of its height. A cantilever frame was designed, therefore, to carry the upper part of the wall, transmitting the load to the interior columns. It was utilized also to support the gallery within the end of the church. This frame spans the open space or lobby between the street entrance and the entrance to the body of the church. It carries a load of about 240 tons.

The design of this cantilever framework is shown in the drawings. There are five longitudinal trusses 38 ft. long and 8½ ft. deep, having a cantilever projection of 12 ft. Each outer truss is in two parts, one part being framed between two of the main columns of the church, and the other being a cantilever bracket beyond the outer column. The two inner trusses are continuous, their lower chords being seated on short columns which form their fulcrum bearings. Between these two columns is framed a transverse 36-in. plate girder which forms the fulcrum bearing for the middle truss, thus eliminating a central column and giving a clear space of 26 ft. for the main entrance. The rear ends of these three middle cantilever trusses are attached to a 30-in. anchor girder framed between the tall columns carrying the two outer cantilever trusses.

STEEL FRAME OF CHURCH INCLUDES HIGH DOME AND CANTILEVER SUPPORTS FOR FRONT WALL





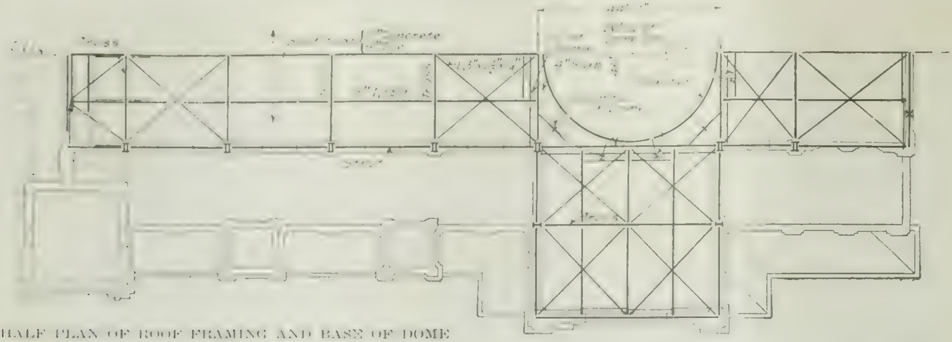
SECTIONAL ELEVATION SHOWS CANTILEVER FRAME AND DOME SUPPORTS

The truss system is fully braced, as shown. Sway frames are fitted between the trusses, while lines of struts are laid across their top and bottom chords, and diagonal bracing is riveted to the bottom chords. The rear portion of this frame being utilized to carry the end gallery inside the church, the three middle trusses have their top chords inclined to conform to the slope of the gallery floor. The outer trusses have parallel chords, but brackets on the posts carry inclined 8-in. channels which support the ends of the floor. This floor is built up of 2 in. of concrete and 5-in. hollow tile. A curved 8-in. channel carried by brackets on the face of the anchor girder forms the front of the gallery and is surmounted by a steel railing.

Four columns, about 70 ft. high, at the intersection of the main body and the arms of the church, form a tower supporting the dome. These columns are of heavy box section and are made especially rigid on account of the impossibility of putting bracing between them. Each column, however, is braced outwardly in two directions by the lines of longitudinal and transverse struts between the main and the side columns. Four 72-in. plate girders are framed between the tops of these columns, and have diagonal struts across the corners. This tall structure, with columns connected only at the top and braced only from the outside, forms a portal system which must take all lateral stresses. The weight of the dome, as carried by the girders, is about 720 tons.

The dome proper is hemispherical, with a radius of 30 ft. It rests upon a cylindrical base or tower 52 ft. in diameter and 30 ft. high, carried by the four 72-in. girders. Surmounting the dome is a lantern 18 ft. in diameter and 20 ft. high, making a total height of 150 ft. from the floor to the top of the steel work. The cylindrical tower has 12 columns of I-section seated on framing attached to the 72-in. girders. They are built up of 12-in. web plates and four angles, and are connected by ring braces of 15-in. I-beams and by struts between the heads of the columns.

Rib trusses of the dome are seated on these columns and have members built up of pairs of angles, as shown on the drawing. Across these ribs are laid purlins of T-section, some built up of pairs of angles and others being T-bars. An angle-iron ring 18 ft. in diameter connects the heads of the rib trusses and forms the seat for the twelve columns of the lantern. These in turn

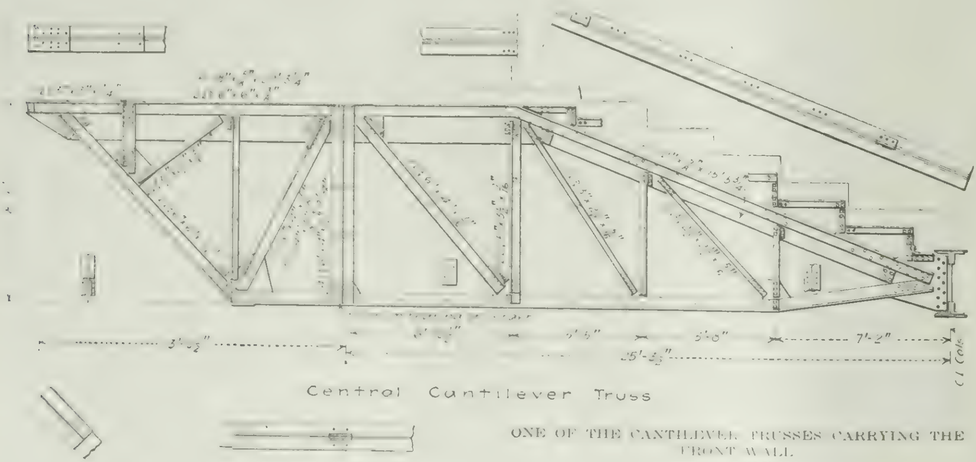


HALF PLAN OF ROOF FRAMING AND BASE OF DOME

carry curved T-bar ribs which unite in an angle-iron top ring. Outside of the steel frame of the dome, with its base and lantern, is a 3-in. shell of concrete. A decorative exterior covering of terra cotta over a waterproofing layer of felt is used on the dome, while on its cylindrical base this covering is brick and terra cotta. The members of the steel skeleton frame are protected by a fireproofing casing of concrete and tile.

Steel framing for the main body of the church consists of four rows of columns having a longitudinal spacing of 25 ft. 9 in. Those of the middle row are of box section, almost 76 ft. high, spaced 45 ft. on centers the bracing between the roof trusses also stiffens the structure longitudinally. Except for the roof trusses, there is no transverse connection or bracing in the 45-ft. space between these tall columns. At the level of the lower side roofs the columns are braced longitudinally by a line of girders, and laterally by the transverse girders and struts of these roofs.

Concrete footings on piles form the foundations of the columns. Uplift on the two main columns to which the cantilever frame is anchored is taken care of by the weight of the clerestory walls, which are carried by plate girders to these columns.



ONE OF THE CANTILEVER TRUSSES CARRYING THE FRONT WALL

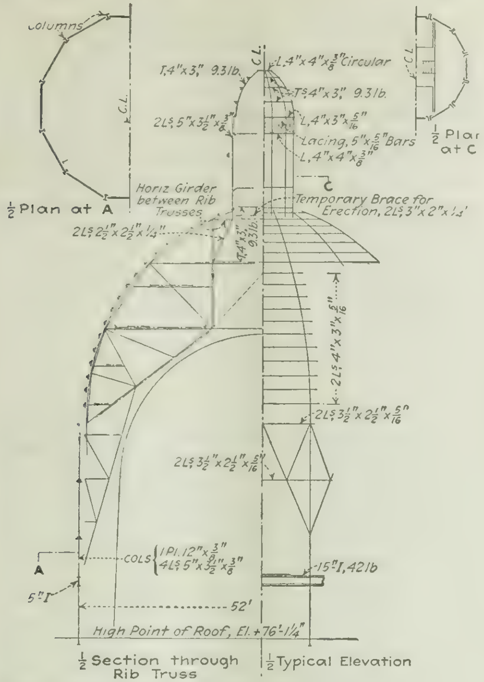
and carrying shallow roof-trusses framed between them.

The outer or wall columns are about 30 feet high, with transverse girders framed between these and the main columns, to support the side roofs. Typical construction of the box columns consists of two 24-in. web plates, four outside angles and two or four cover plates 19 in. wide. The wall columns are of I-section, consisting in general of a 24-in. web plate and four flange angles. Struts and girders with truss bracing connect the columns and complete the structural framework.

Longitudinal bracing of the tall interior columns is provided by deep trusses framed between their tops;

A roof of 2-in. concrete on 8-in hollow tile is supported by 18-in. I-beam purlins between the transverse trusses and girders, and is covered with a composition roofing. Brick walls form the sides and have stone and terra-cotta facing. Fireproof casing of tile and concrete protects the steel work. A decorative arched ceiling of plaster on steel lath conceals the roof framing. Similar decorative work is carried up inside the dome, with a false dome or ceiling suspended from the ribs, as indicated in the drawings.

Worthmann & Steinbach were the architects, while the structural steel design was prepared by the La Salle Engineering Co. Steel work in the foundations and



DOME HAS RIB TRUSSES SPRINGING FROM COLUMNS OF CYLINDRICAL BASE

basement was furnished by A. Bolter's Sons. That for the superstructure was furnished by the Hansell-Elcock Co. and Cerny, Pickas & Co., and was erected by the former. All the above are Chicago firms.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Ethics of Right Living Basis of Engineers' Code

Feeling that all codes for society adoption were of little value unless backed by moral obligation rather than disciplinary measures, the joint meeting last May of the American Association of Engineers and the Committee on Engineering Coöperation decided to put the writing of a code up to a committee of one, an individual engineer whose opinion was highly respected, and whose personal views would carry weight. The committee has recently completed what it calls "The Engineers' Creed." The American Association of Engineers printed the whole article in the November *Monad* and will distribute the essential portion in form for framing.

The subject is opened by establishing the fact that engineers are kin to the human family, and that "no man liveth unto himself." Since the discharge of that debt, which is a debt of honor, is the desire and effort of every honorable man, it is concluded that engineers need no more than the common every-day ethics of right living which are applicable to every vocation, calling or profession—"the honesty which is unswerving, the truthfulness which abhors a lie, the helpfulness which lightens the burdens of life, the human sympathy which gladdens aching hearts, the honor which scorns to take a mean advantage, the courage which always dares to do right, and the courtesy of kindliness."

As to the necessity of a code when each man carries in his own mind and heart rules of right living and honorable action, the committee states as follows: "It is, 'Lest we forget.' The law-abiding are not conscious of the restraints of the law, but the lawless are made to feel its power. A code of ethics accepted by the great body of professional men is the declaration of their faith, the chart by which they direct their course in the voyage of life. To this chart one who is in doubt may turn for suggestion as to the right course in any time of perplexity, and by the principles laid down in this chart transgressors will be judged and disciplined by their fellows."

The Code

"An engineer may not 'go beyond and defraud his brother' by any underhanded act or method. He may not do or say anything which will injure his brother's reputation or his business, for the purpose of securing his own advancement or profit. This admonition carries with it no obligation to refrain from telling known and absolute truth about an unworthy brother, as a protection to others, but the truth so told must be such as can be substantiated, and he who tells it must have the courage which will not shrink from the consequence of his telling.

"The engineer owes his client allegiance demanding his most conscientious service. But conscientious service to the client must never entail a surrender of personal convictions of truth and right.

"An engineer who receives compensation from an employer may not receive gift, commission, or remuneration of any kind from a third party with whom he does business for that employer.

"An engineer seeking to build up his business may not resort to self-laudation in advertising. He may state briefly the lines of work in which he has had experience and enumerate responsible positions which he has held and give his references.

"An engineer who employs others, either in his own service or in that of the client who employs him, should recognize in his relationship to them an obligation of exemplary conduct, of helpfulness and personal interest in those with whom he is thus brought in contact, and he should discharge such obligation tactfully and kindly.

"The honor of the profession should be dear to every engineer, and he should remember that his own character and conduct reflect honor, or the reverse, upon the profession.

"If, then, he so lives that his own honor shall never be smirched by his own act or omission, he will thus maintain the honor of the organization to which he belongs."

Letters to the Editor

Comment on Matters of Interest
to Engineers and Contractors Will Be Welcome

Cleared Areas Measured with Planetable and Planimeter

Sir—In making monthly estimates of clearing and grubbing on a land-development project a method involving the use of planetable and planimeter was found eminently satisfactory.

The field work consisted simply of making a planetable survey of the clearing, obtaining all distances by stadia. It was generally possible to station the instrument in a commanding position, so that the rod could always be read when held at such points as were required to define the edge of the clearing. When two or more set-ups were necessary they were connected by stadia traverse. It was a matter of minutes to arrive at the area cleared by planimetering the map so made in the field.

The results derived by this method of measuring were of quite sufficient accuracy, inasmuch as monthly estimates were frankly understood to be approximate, the price per acre was the relatively low figure of $7.50, and the final estimate was based on the area of the field, previously obtained by a carefully chained survey.

Washington, D. C. EDWIN P. ARNESON.

Compensation of Engineers

Sir—I have read with interest the letter of "Engineer" in *Engineering News-Record* of Oct. 17, p. 729, and thoroughly agree with him that the engineers of the country should take the lead in the reconstruction work after the war, rather than bankers, lawyers, politicians or commercial men. As a matter of fact, all must work in harmony, and all the varied activities must be coördinated, in order to attain the maximum right results with a minimum expenditure of energy.

And certainly one of the first problems to be solved is that of labor questions and the relationship and partnership of labor and capital in our industrial and business enterprises.

Now, has the engineer shown himself capable of solving such problems? Has he kept step with the progress of the times? One criterion by which this will be judged is the concrete evidence of his relations with his own employees. How many engineers have taken account of the increased cost of living of their engineering employees? The writer recalls only one instance where the salaries of such employees have been automatically increased to take care of increased living expenses. Most increases are grudgingly granted, as if the employer were granting a favor instead of rendering just compensation for services received. Engineers have been so engrossed in reducing the cost of engineering work that they have failed to observe the cheapening effect of their attitude on their own profession.

There are many engineers and draftsmen now working for the same salaries as two or more years ago, despite added experience and largely increased expenses. Many a man with an expensive college education and five or ten years' experience is receiving less money than a man with a common-school education and two months' experience as a lathe hand. Yet all these engineers are expected to invest in War Savings Stamps and Liberty Bonds, and would be thought unpatriotic if they quit their work to go into other, better paying lines, for their work is very essential.

Again, it is a very common occurrence now for a skilled or semi-skilled laborer, or even a common laborer in some cases, to draw more money on a construction job than the resident engineer who holds his position by virtue of his ability to direct and supervise the entire work and accept the responsibility for its correct execution.

It would almost seem as if education were a handicap rather than an asset—and such viewpoint seems to be a common one among the boys and young men of the country. The future brains of the country are going into better paying lines of work, since the engineering profession at present offers to the great majority of those following it only a very mediocre living for much hard work.

How can the ordinary engineer devote much study and attention to community affairs when his time away from his place of employment is taken up with figuring problems in high finance, such as how to buy Jimmy a pair of shoes, Sally a coat, pay for a small portion of his winter's coal and get a much needed overcoat for himself, with less salary than a garage mechanic commands? How can an engineer receiving a "salary" of $150 per month expect to command the respect of a mechanic who is drawing "wages" of $60 to $100 per week?

This condition has not been caused by the war, although to a certain extent it has been exaggerated by war conditions.

Should not the engineer first reconstruct his own affairs before he attempts to reconstruct the affairs of others? AN EMPLOYED ENGINEER.

A Confusion of Sewage and Water Standards

Owing to momentary confusion of the well known standard of sewage dilution with the recently suggested standard of dilution to avoid burden on water-treatment plants, an error crept into both the article and the editorial relating to the report on pollution of boundary waters by the International Joint Commission, published in *Engineering News-Record* of Oct. 10. In the editorial on p. 653, it was stated that "the standard of dilution proposed by Professor Phelps as an equivalent to the tentative bacterial standard is the same as was devised nearly thirty years ago for Chicago by Rudolph Hering," etc. In the article mentioned, on p. 660, there appeared an extract from the report of the commission, stating that Professor Phelps had suggested a dilution of 4 cu.ft. per second per capita of population. In this statement there was inserted the editorial query, "4 cu.ft. per 1000?" This was an error.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Mnemonic Symbols Show Distribution of Construction Expenditures

ENGINEERING and construction expenditures on the Miami Valley flood-protection work are designated for distribution by mnemonic symbols. By a common-sense classification, and by subordinating the ideal of unlimited capacity for expansion, no symbol becomes unwieldy, although the number of features that are included in the system is large. Ordinarily, two numbers indicate the account, and in no case are more than two numbers and a letter employed, even for complex titles. Thus, No. 1-5 indicates expenditure for soil stripping at Germantown Dam, and No. 200-54b indicates expenditure for gasoline for automobiles employed in general headquarters service.

Construction of the Miami flood-protection work is separated into eleven construction features. Each of the detention dams counts as a feature, and the channel improvement is divided into six sections, each of which is designated as a feature. Each construction feature stands on the books as a separate permanent account. Numbers 1 to 99 are reserved for construction feature symbols. Feature numbers are also assigned to preliminary investigations and to general expense, because these are carried on the books as permanent features. To preliminary investigations is assigned the feature number 100 and to general expense the number 200.

Each feature account includes a number of item accounts. For the 11 construction features proper there are now 94 item accounts which are numbered 1 to 94, inclusive. Preliminary investigation has seven item accounts and general expenses 13 item accounts; these are numbered, respectively, from 101 to 107, and from 201 to 213. Obviously, additions can be made to these item enumerations if necessity arises.

It should be noted that the *feature* numbers in the accounting system are the same as the contract numbers, or job numbers, that have been assigned to each section of work from the beginning of construction plans. Similarly, the *item* numbers are the same in the accounting system as in the contract specifications, in the progress estimate sheets, etc. For example, backfilling, on any job, is item 38 and wherever backfilling is referred to, in the specification, on the drawings, in the schedule of unit prices, or in the accounting system, 38 is its classification number. For example, 4-38 is the account number for backfilling at Taylorsville, 2-38 for backfilling at Englewood, 5-38 for backfilling at Huffman—Taylorsville, Englewood and Huffman being job numbers 4, 2 and 5, respectively.

Besides feature and feature item accounts, provision is necessary for plant accounts and incidental operations accounts. Provision is made for 50 plant accounts and 50 incidental operations accounts. Plant accounts bear the numbers 01 to 050, inclusive, and incidental operations the numbers 051 to 099, inclusive. Item accounts for each plant or incidental operations account are designated by letters.

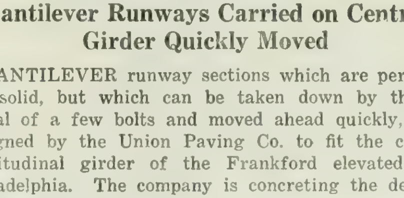
Combinations of the account numbers, briefly stated, designate the distribution of every expenditure. These combinations are simple, as a few illustrations demonstrate: Let it be required to designate expenditure for class 1 excavation for the outlet works for the Englewood Dam. The Englewood Dam has the feature number 2; outlet excavation class 1 has the item number 13; then No. 2-13 designates the account to which the expenditure will be distributed. Again, let it be required to designate expenditure for dismantling dragline excavators working on the Englewood Dam. As stated, the feature number for Englewood Dam is 2. The plant account number for excavating plant is 04: the plant account item letter for dismantling excavating plant is P; therefore No. 2-04P designates expenditure for dismantling excavating plant working on Englewood Dam.

Blueprint schedules furnish all who have occasion for them with lists of the accounts and their designating symbols. Those using them constantly have most of the symbols memorized. The account number scheme is part of the accounting system worked out under the direction of Charles H. Paul, assistant chief engineer, Miami Conservancy District, aided by F. L. Cavis, consulting accountant.

Cantilever Runways Carried on Central Girder Quickly Moved

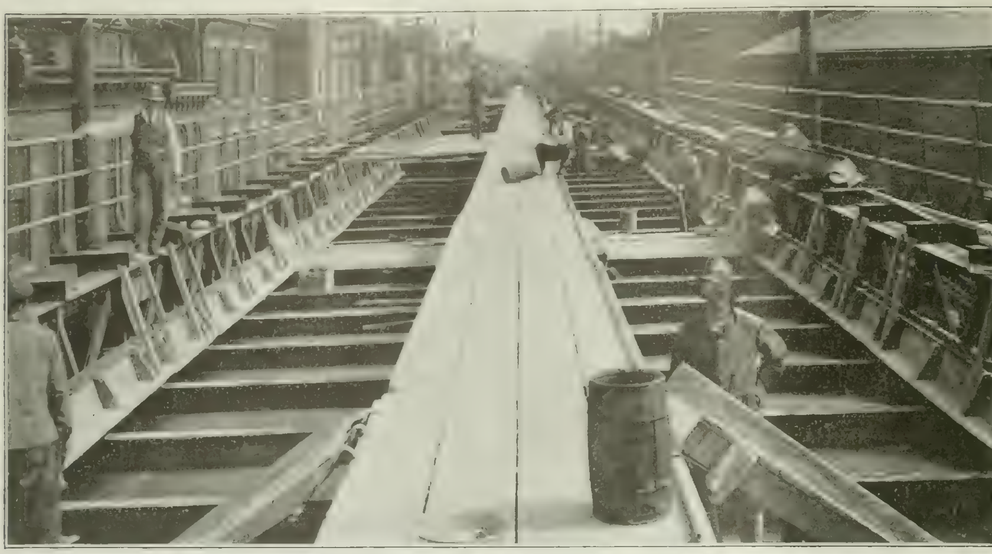
CANTILEVER runway sections which are perfectly solid, but which can be taken down by the removal of a few bolts and moved ahead quickly, were designed by the Union Paving Co. to fit the central longitudinal girder of the Frankford elevated line, Philadelphia. The company is concreting the deck of the elevated line.

There was no room to put runways on the floor of the structure without interfering with the concrete work,



CANTILEVER SUPPORT IS RIGID

and the walkway on the outside girder was not wide enough for the purpose. To build a runway which would have fitted around the brackets of this walkway would have been a big job while at first sight to build



RUNWAYS PASSING SIDINGS AND CHUTES CARRIED CLEAR OF FORMS ON CENTRAL GIRDER

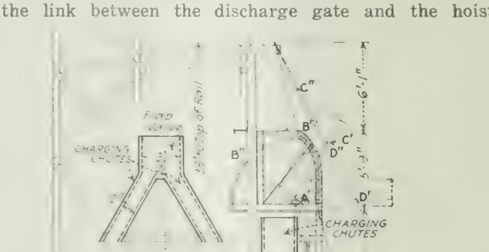
a wide runway on the central girder would also have required a lot of carpenter work every time the sections were moved. This, however, was overcome simply and easily by resting the runway sections directly on the flange of the girder and bolting to the 3 x 6 battens a 3 x 4 on each side of the girder. The 3 x 4 was drawn up tight by a single bolt under the flange of the girder and bearing under the batten a few inches from its outer end. The sections are 16 ft. long, each made up of four 2 x 12-in. planks resting on three of the battens. A 2 x 2-in. guard strip is nailed along each side at the edge.

Where a passing is required, the extra width of planking is supported on joists across to one of the outside girders.

A useful feature of the scheme is the method in which the bolts are put on. They cannot be lost in moving because the heads are counterbored under the decking in the 3 x 6, and the nuts and washers can be screwed on again after the short blocks underneath have been taken off.

Twin Mixers on Traveling Tower Charged Alternately by Forked Chute

BATCH handling was entirely mechanical and largely automatic from charging skip to tower bucket, and thence to chutes to forms, in the traveling mixing plant for concreting the new water-works reservoir at St. Paul, Minn. Cars coming from storage bins brought proportioned buckets and dumped into a charging skip. This skip, a rectangular box open at the top, was hoisted 25 ft. and dumped automatically, occupying successively the positions from A B C D to A′ B′ C′ D′, and finally to A′ B″ C″ D″, as shown in the illustration. A forked charging chute, with a flap valve, received the batches from the skip and delivered them right and left alternately to the $\frac{3}{4}$-cu.yd. mixers. Of the succeeding batch-handling mechanism only the bucket-charging hopper was unusual. This was a narrow box, long enough to embrace the hinged emptying chutes of both mixers and having its bottom inclined three ways to a discharge gate at mid-length. A tilting spout formed the link between the discharge gate and the hoist



SINGLE CHARGING SKIP DELIVERS ALTERNATE BATCHES

bucket. On the drawing the batch-handling mechanism is depicted by heavy lines. The traveling mixer was a part of the plant of the George J. Grant Construction Co., St. Paul, Minn., contractors for the construction of the reservoir.

NEWS OF THE WEEK

New York, November 7, 1918

No Let-Up in Shipbuilding After Peace Comes

Hurley and Schwab Issue Statements Showing 83 Per Cent of Program Yet to Be Completed

That shipbuilding operations would continue on a tremendous scale, without let-up, after peace comes, since 83% of the shipping program is yet to be carried out, is the substance of statements issued Nov. 1 to the workers in the shipyards by Edward N. Hurley, chairman of the United States Shipping Board and Charles M. Schwab, director general of the Emergency Fleet Corporation.

In part, Mr. Hurley's statement follows:

"I wish to reassure and encourage the men in American shipyards, who may fear that their efforts to provide an emergency fleet are limited by the necessities of war.

"The project to build the fleet was conceived in the emergency of war, but it has never been intended, nor is it intended now, that this great movement shall cease when the war is ended.

"We are only now beginning our program of ship construction. The removal of the emergency cannot and will not bring an end to the world's need for ships, nor prevent us from carrying out our program to a successful conclusion. We shall continue to use all the facilities of shipbuilding that business economy will permit.

"I mean by that that all shipbuilders who live up to the expectations placed in them by the Government will be expected to continue to build ships. They will be encouraged to do so. There will be plenty of work for every efficient ya d.

"On the other hand, the Government expects to continue to supply the material and direct the vast energies now devoted to shipbuilding. The end of the war will mean only the removal of the menace which confronted the world's shipping; it will not and cannot mean the immediate elimination of the need for ships.

"The ships must and will be built. The work which the inefficient yards cannot do will fall to other plants. We will look to the West coast to continue the pace it has maintained and to the yards in the East and South and in the Great Lakes region to increase their output.

"So I can say with frankness that our shipyards will be kept going to their capacity and they must not let up. The inefficient plants which have been permitted to operate because of the

(Concluded on page 868)

Reconstruction Commission Bills Introduced in Congress

Weeks and Overman Measures Before Senate—Participation of Business Men a Main Issue

By Wingrove Bathon
Washington Representative of Engineering News-Record

A great fight is about to be staged in Congress, according to the view of well informed Washingtonians, based upon what character of reconstruction commission or agency shall be intrusted with the work of guiding American industry during the period after the war.

Two important bills have been introduced in Congress dealing with this subject. One is a bill by Senator John W. Weeks of Massachusetts, the other a bill by Senator Lee S. Overman of North Carolina. The bill introduced by Senator Weeks, which is in fact a proposed concurrent resolution of Congress, would provide for a Congressional committee on reconstruction, to consist of three senators to be named by the Democratic senatorial caucus; three senators to be named by the Republican senatorial conference; three representatives to be named by the House Democratic caucus and three representatives to be named by the Republican House conference.

No provision is made in Senator Weeks' plan for appointing business men in private life to his proposed reconstruction agency. On the other hand, Senator Overman's bill would establish a Federal Commission on Reconstruction, to be composed of five commissioners, who shall be appointed by the President of the United States. The plan of Senator Overman is known in Washington as the administration plan and is said to have the sanction of President Wilson. Senator Overman's plan, also, it is understood, contemplates the appointment by the President of business men in private life as commissioners, who shall have the authority to employ and consult economists, investigators, special experts, etc., and $500,000 is appropriated to carry out its provisions. In this respect, Senator Overman's plan follows the line of suggestions made by the Washington representative of *Engineering News-Record* in these columns last spring.

Both measures specify the character of the investigations to be made—namely, problems affecting labor; capital and credit; public utilities; the results of the demobilization of industrial and military war resources; foreign trade; the condition of existing industries and the establishing of new industries; agriculture; adequate production and effective distribution of coal, gasoline and other fuels; shipping, including shipyards and the sale, continuance of ownership or leasing of yards and ships; housing conditions and the disposition of houses constructed by the Government; war legislation now on the statute books; technical education and industrial research; the organization of Government departments with a view to putting the Government on an economic and efficient peace basis, etc.

It is pointed out in Washington that Senator Weeks' proposal would place any reconstruction agency formed under his bill in the hands and in control of Congress and that, by reason of the manner in which his proposed reconstruction committee is to be named, it would be difficult, if not impossible, in many cases, to have questions decided upon a basis other than their political merits.

Senator Overman's proposal, on the other hand, contemplates the appointment of business men, who might be expected to treat from a business point of view the problems coming before them.

Los Angeles Plans Harbor Improvements

Bulkhead construction, dredging and land reclamation are included in projects for new shipping and terminal facilities at Los Angeles, Cal. The city's Harbor Department has two proposals planned. One of these is the construction of a rock bulkhead or seawall extending east from the present fish harbor seawall and about 3000 ft. south from the shore of Terminal Island. This will retain a fill of material dredged in widening the main channel. The Harbor Department operates its own quarry on Catalina Island, 18 miles distant, and will spend about $10,000 per month in building this seawall. It is not intended to rush the work any more than is necessary to hold the fill, but eventually this seawall will be extended to the eastern city boundary, about 1¼ miles. The seawall work consists of timber and earth bulkheads on the east and west sides of the west basin, to hold material dredged from the basin.

Three dredging projects are to be

carried out by the United States Government, and appropriations for these have been made. At the west basin a 200-ft. channel, 4800 ft. long and 30 ft. deep, will be dredged westward, at a cost of about $204,000, to provide access to a dry dock which is to be built by the Los Angeles Shipbuilding & Dry Dock Co. For widening the present 500-ft. main channel to a minimum width of 1000 ft., with 30 ft. of water, there is available $150,000. The total estimated cost is $626,000. For dredging the west end of a channel extending eastward to connect with the harbor of Long Beach, there is an appropriation of $130,000. This channel will be 200 ft. wide and 20 ft. deep, and beyond the city limits of Los Angeles it will be dredged by the city of Long Beach.

Grain elevators, coal bunkers, tanks for the vegetable-oil trade, new wharves and sheds, and freight-handling equipment, are among the improvements recommended in the recent annual report of Clarence H. Matson, traffic manager of the Harbor Department. A proposed railway to connect the Atchison, Topeka & Santa Fé Ry. with the municipal terminal railway is not to be built now, as, with Government ownership, all railways can use the existing connection. Mr. Matson states that one result of the $5,500,000 spent by the city on its harbor in the past seven years is that shipbuilding to the value of more than $100,000,000 is now in progress, employing more than 14,000 men.

First Meeting of Development Committee Postponed

The meeting of the Committee on Development of the American Society of Civil Engineers, which was scheduled for Oct. 31 in Chicago, has been postponed to Nov. 14. This will defer the preliminary report of the committee, which was expected Nov. 1. A review of the proposed scope of the work and the program of the committee appeared in *Engineering News-Record* of Oct. 10, p. 658.

Intercity Viaduct Finally Bought by the Two Kansas Cities

Long negotiations for the purchase of the Intercity Viaduct over the Missouri River valley by Kansas City, Mo., and Kansas City, Kan., came to a conclusion by the final signing of a purchase contract on Oct. 24. The last offer of the bondholders in the viaduct company was a price of $1,750,000, and this offer was accepted. Kansas City, Mo., will pay 56% of the amount and its Kansas neighbor 44%. Municipal bonds at 4½%, redeemable in five to 30 years, will pay for the viaduct. Ratification of the bond issues by general vote is necessary to make the purchase finally effective, but little doubt is entertained concerning the outcome. In the meantime, the cities will take over the structure and throw it open to free use.

Brooklyn Rapid Transit Wreck Kills Eighty-Nine

Five-Car Train Run by Substitute Motorman During Strike Jumps Track at Tunnel Portal

Eighty-nine persons were killed and a greater number injured Nov. 1 when a five-car train on the Brighton Beach line of the Brooklyn Rapid Transit Co., New York, was derailed and crashed into the supporting structure of a tunnel at Malbone St., Brooklyn. Because of some construction work under way a sharp reverse curve had been installed at the entrance to the tunnel. The train, striking this curve at high speed, jumped the track, struck a concrete pier at the portal, and continued for some distance into the tunnel, striking a number of columns before coming to a stop. The accident occurred in the evening rush hour, and the cars were crowded. Several of them were old wooden cars and were virtually demolished, few if any of their occupants escaping death or serious injury. There was a down grade to the tunnel, and the motorman is quoted as saying the brakes failed.

A strike had been inaugurated that morning. The company had some time previously discharged a number of employees who had joined the Brotherhood of Locomotive Engineers. Denying its men the right to join this union, the company had tried to persuade them to join instead an association of employees within the company itself. The employees had appealed to the War Labor Board, which on Oct. 28 had handed down a ruling that the men had the right to join the union, and that 29 of those discharged were to be reinstated; the company could refuse to deal with the union, but the procedure of the association of employees should be modified. The company interpreted the order as permitting it to refer the question of reinstatement to the association. The employees interpreted it otherwise, and the strike was ordered.

A dispatcher pressed into service as a motorman was running the train that was wrecked. How much experience he had had as a motorman is under dispute. Some assert that he had had little or none; the president of the company denies this. It is not denied that he had done a day's work as dispatcher before taking the train, and that he was tired.

The motorman and two other employees have been held. Mayor John F. Hylan has instituted proceedings to fix the responsibility. The strikers returned to work the day after the accident.

Niagara Power Companies Consolidate

The Niagara Falls Power Co., the Cliff Electrical Distributing Co., and the Hydraulic Power Co. of Niagara Falls, have been consolidated by agreement effective Oct. 31, under the name The Niagara Falls Power Company.

Irrigation and Dry-Farming Associations Merge

The International Irrigation Congress and the International Dry-Farming Congress were permanently consolidated as the International Farm Congress at the meeting Oct. 17, held in Kansas City, Mo., mentioned in *Engineering News-Record* of Oct. 10, p. 687.

No Let-Up in Shipbuilding

(Concluded from page 867)

war emergency and the immediate need of ships, will, as a matter of business expediency, drop out when the emergency is removed. Efficient yards will be encouraged and supported, because we can depend upon them to carry out their promises and produce ships economically. In this way, we shall be able to compete in the markets of the world with our ships on a price per ton basis, as compared with the ships of other countries.

"The demand for the expert worker will be greater than ever, because the large part of the task of completing our program of ship construction is still before us. More riveters, shipfitters, chippers, calkers, bolters-up, riggers and draftsmen, foremen and executives will be needed after the war.

"There is no ground for any uneasiness of either labor or capital now efficiently employed in producing ships. For many years to come ships, their construction and operation, are to be of absorbing national interest."

At the same time Mr. Schwab pointed out that, while the present program calls for 15,000,000 tons of merchant ships, representing something like 3000 vessels, there have been built only 2,500,000 tons, and the work would therefore not be completed until five times more work had been done. Portions of Mr. Schwab's statement follow:

"Until peace is concluded and until all of our boys have returned to America, it is vital that we keep on building ships with every ounce of our strength and energy. After that we can consider the future. But to permit enthusiasm to lag now might be fatal to our great cause.

"Shipbuilding, from the very start of the war, has been the essential work that would make victory possible.

"Even when peace comes, if it comes within the next year, you will not have completed the job that America set for you. Chairman Hurley of the United States Shipping Board has pointed out the shipping needs of the future. He has studied this question and is competent to speak as an indisputable authority.

"Now, Mr. Hurley says that it is wrong to assume that when peace comes again and the war needs for ships have been met, our great new shipyards will have nothing to do. This is a mistaken assumption. If peace comes soon, we shall not be anywhere near the end of this shipbuilding job— only at the beginning."

Shipping Board Curtails Camden Yard Extension

Radical Change in Troop Transport Requirements the Cause—Parallel to Alameda Case

Further action on the shipbuilding program was announced by the United States Shipping Board Oct. 31. Following the revocation of the contract for the new Alameda yard reported in these columns last week, the decision was reached that the extension of the New York Shipbuilding Corporation yard at Camden, to provide increased capacity for building large transports, should be very much reduced. Details of the curtailment were left to the Emergency Fleet Corporation.

Last April the War Department called on the Emergency Fleet Corporation for the construction of 94 transports of about 12,000 tons each. The troop-ship program at that time in progress was but a little more than half the total tonnage of the Emergency Fleet Corporation work. As existing yards did not appear to have sufficient capacity, two new yards were at once put under construction, an extension of the Camden plant of the New York Shipbuilding Corporation and a new plant adjacent to the Bethlehem Shipbuilding Co.'s yard at Alameda, Cal. The vessels turned out by these yards would not be available for service until 1920, it is stated, and because of the acceleration of the troop-moving program by the War Department during the past year they no longer are important to the prosecution of the war program.

Motor-Truck Parcel-Post Service Proving Successful

Reduction in the cost of milk to consumers from 17c. per quart to 10c. per quart, and the development of a revenue of $16,000 monthly during the eight-month operation of a truck route out of Washington, D. C., are reported by James I. Blakeslee, fourth assistant postmaster general. Seventy lines of motor-truck mail routes have been established and are in operation in the country. All but one of these are east of the Mississippi River.

In giving the above information, Mr. Blakeslee suggested a use for the damaged motor trucks at the battlefront which are of no further use to the Army. These could be sent home, repaired and used in the parcel-post service.

The great advantage of this system of picking up mail and parcel-post matter through the country districts was brought out by a definite incident where milk, which is selling for 17c. a quart in the city of Washington, is being picked up by the mail service and transported directly to the consumer in the city, for 10c. The great expansion possible for the service is shown by the development of a truck route between Washington and Philadelphia, which in eight months has developed a revenue of $16,000 per month, as stated above. Another truck route which started with a monthly business of only 28 parcels now shows a ton of traffic each day.

Experience has shown that operating at night is the most profitable, according to Mr. Blakeslee, and that the typical length of route is about 180 miles, or 90 miles out and 90 miles back. It has also been found that constant operation of the lines produces in a short time a return load, the universal character of the mail service allowing almost anything to be taken, in any kind of weather.

Mr. Blakeslee pointed out that a prime necessity for the service is good roads. If these can be obtained 9000 trucks can easily be used for this service in the country, and possibly as great a number as 66,000. The program indicated for the future seems, he thinks, to be the use of airplanes for the 1000-mile distances, trains for 500 miles, and trucks for 250 miles.

Recruit Men for Army Motor Transport Corps

Highways Transport Committee Assigned Task—Plan Replacing Men in Civil Positions by Women

Assisting in the recruiting of men for the Motor Transport Corps of the Army is the task assigned to the Highways Transport Committee, Council of National Defense, by Gen. C. B. Drake, chief of the Motor Transport Corps. Among the suggestions offered for increasing the supply of men for this service is one which involves the substitution of women for men in civil positions. The training of men whose age makes them unavailable for Army service is also proposed. The approximate size of the force to be recruited is 200,000, with an equipment, beyond that now in the service, to the value of $130,000,000.

In carrying out the above assignment, the Highways Transport Committee will have opportunity to utilize its organization, including the regional directors, the committees organized in its behalf by the state Councils of Defense throughout the country, and their local committees.

In order to prevent the disruption which would follow if tens of thousands of skilled men were taken away from the great organizations engaged in operating and maintaining the industrial transport service of the country, and at the same time to provide an adequate force, it will be necessary to work out some plan to obtain substitutes for those taken away. The training of men too old for Army service and the substitution of women for men in driving motor trucks for industrial service are suggested as means of increasing the available supply. The plan will be carried out on the basis of considering these recruits as volunteers in much the same sense as those who are entering the Army.

Program for Joint Highway Convention Announced

Prominent Speakers Will Address State Highway Officials and Highway Industries Association

Announcement has been made of the programs of the joint convention and closed meetings of the American Association of State Highway Officials and the Highway Industries Association, to be held in Chicago from Monday, Dec. 2 to Friday, Dec. 6. Many speakers of national reputation will make addresses on highway construction, highway maintenance and kindred subjects.

Closed sessions of the highway officials' association will be held in the forenoon and afternoon of Monday, Tuesday and Friday at the La Salle Hotel. The Monday evening meeting of this organization will be open to the public, and on Tuesday evening the annual informal dinner will be held. Open joint meetings of the two associations will be held on Wednesday and Thursday at the Congress Hotel. Thursday evening will be given over to committee meetings, and on Friday the Highway Industries Association will hold an open meeting in the forenoon to discuss "Conditions We Are Facing," and an executive session in the afternoon.

At the open joint sessions on Wednesday the topic and speakers will be as follows: "Highway Control by Federal Government Under War Conditions," by Logan Waller Page, chairman of the United States Highway Council; "The Development of Motor Parcel Post Routes," by the Hon. James I. Blakeslee, fourth assistant postmaster general; "Highways—A Neglected War-Time Necessity," by the Hon. James M. Cox, Governor of Ohio; "A Suggested National Highway Policy and Plan," by E. J. Mehren, editor of *Engineering News-Record;* "Highway Transportation, Present and Future," by Roy D. Chapin, chairman of the National Highways Transport Committee, and "Highways a Military Necessity," general discussion. On Thursday two open joint sessions will be devoted to the following topics: "The Underlying Principles of Laying Out, Marking and Maintaining a State Trunk Highway System," by A. R. Hirst, state highway engineer of Wisconsin; "Proper License Fees for Motor Vehicles and Drivers," by H. Eltinge Breed, first deputy commissioner of highways, New York State: "Motor-Truck and Trailer Transportation Essentials—Regulation of Speed, Weight, Width and Height Necessary, But Should Not Restrict Their Expanding Use," by George M. Graham, chairman of the motor truck committee, National Automobile Chamber of Commerce and "American Highways for Tomorrow" by H. G. Shirley, secretary of the Highway Industries Association. The open meeting of the highway officials' association on Monday evening will have illustrated talks on "Notable American Highway Construction," by

P. St. J. Wilson, Office of Public Roads; "Recent Damage to Eastern Highway Systems," by W. G. Thompson, state highway engineer, New Jersey, and "Convict Labor in Road Work," by T. J. Ehrhart, state highway commissioner, Colorado.

Four general subjects will be discussed at the closed sessions of the Association of State Highway Officials on Monday. They will be (1) "The Present Situation and How We Are Meeting It," summarized for their localities by Col. W. D. Sohier, chairman of the Massachusetts Highway Commission; John N. Mackall, chief engineer of the Maryland State Roads Commission; W. O. Hotchkiss, secretary of the Wisconsin Highway Commission; W. S. Keller, state highway engineer, Alabama; Ira R. Browning, state road engineer, Utah, and Charles T. Stern, California State Highway Commission; (2) "Ways of Doing Construction," various methods discussed by A. W. Dean, chief engineer of the Massachusetts State Highway Commission; Charles M. Upham, chief engineer of the Delaware State Highway Commission; F. F. Rogers, state highway commissioner of Michigan, and T. J. Ehrhart, state highway commissioner of Colorado; (3) "Materials of Construction," by Clinton Cowan, state highway commissioner of Ohio; Prevost Hubbard, United States Highway Council, and Clifford Older, chief highway engineer of Illinois; (4) "Engineers for Highway Work," by John H. Mullen, deputy commissioner of highways of Minnesota.

The subjects presented on Tuesday will be: "Coördinating State Highway Systems," by C. M. Babcock, state highway commissioner of Minnesota; "Snow Removal from County Highways," by G. H. Biles, acting chief engineer of the Pennsylvania Highway Commission; "Preparing for After We Have Won the War," by S. E. Bradt, state superintendent of highways of Illinois; "Regulation of Horse-Drawn Vehicles," by H. C. Beard, chairman of the Iowa State Highway Commission; "Eliminating Grade Crossings with Railroads," by W. S. Gearhardt, state highway engineer of Kansas; "Proper Engineering Treatment of Necessary Railroad Grade Crossings," by Rodman Wiley, commissioner of public roads of Kentucky, and "The Maintenance of Sand Roads," by George A. Duren, state highway engineer of Texas.

Civil and Mechanical Engineers Will Discuss Steel Conservation

Conservation of steel will be discussed at a joint meeting of the American Society of Civil Engineers and the American Society of Mechanical Engineers, to be held in New York on Nov. 20. The present urgent demand for iron and steel and feasible methods of conserving the available supply will be considered.

William A. Lydon, Harbor Contractor, Dies in Chicago

William A. Lydon, president of the Great Lakes Dredge & Dock Co., died at his home in Chicago Oct. 28. He was ill several months. As engineers and contractors, few men have left so indelible a record on the maritime development of the Great Lakes. Hardly a port from Buffalo to Duluth and Chicago is without an example of his work, either as designer or builder, for the

WILLIAM A. LYDON

services of William A. Lydon as an advisory engineer for works which his contracting firm did not build were as frequently in demand as he was as an actual builder. Much of his professional work was for the United States Government. Perhaps no man knew the construction conditions of all the Great Lakes waters better than did Mr. Lydon, and his death marks a distinct loss in the engineering and construction experience and ability available for the performance of maritime construction tasks involved in the industrial and commercial development of the Great Lakes ports and harbors.

Shortly after his graduation from Lehigh University in 1887, Mr. Lydon obtained employment in the engineering corps of the city of Chicago, with which he worked until 1890. He was a member of the surveying party which during this period conducted the original surveys for the main drainage channel of the Sanitary District of Chicago. Mr. Lydon's preference was, however, for the construction side of engineering, and he left straight professional work to organize the firm of Lydon & Drew, contractors. Besides doing general river and harbor work, this firm constructed the Lake View intake crib and the Hyde Park tunnel for the water-supply of the city of Chicago. In 1904 Mr. Lydon organized the Great Lakes Dredge & Dock Co. In 14 years this concern has acquired a place among the largest river and harbor works contractors of the United States, with a floating plant of great magnitude and an enormous variety of equipment. Its works have included ship locks, dry docks, dredging, wharves and docks, bridge piers and subaqueous structures.

Mr. Lydon was born in Buffalo, N. Y., in 1863. He went to Chicago as a boy, attended the public schools and entered Lehigh University, from which he received the degrees of civil engineer, engineer of mines and bachelor of metallurgy. He was a member of the American Society of Civil Engineers, of the Western Society of Civil Engineers and of the Illinois Structural Engineers' Association. He is survived by Mrs. Lydon, two daughters and a son.

New Emergency Power Bill

Some months ago a bill was introduced into the House of Representatives, and later passed by that body, authorizing the appropriation of $200,000,000 for emergency power purposes. The bill is now before the Senate Commerce Committee for further consideration, and seems to be permanently blocked. On account of the urgent necessity for more power, however, another emergency power act was introduced in the Senate Oct. 28 by Senator Fletcher of the Committee on Commerce. This is a joint resolution authorizing the War Industries Board to aid in equipping and expanding power plants to carry on the manufacture of war munitions and the construction of ships during the war, and to advance money for that purpose to owners and operators of private plants, on terms and conditions to be prescribed by the War Finance Corporation. For this $50,000,000 is to be appropriated.

No City Contracts for Aliens

The city commission of Trenton, N. J., has decided not to award contracts to contractors and builders who are not citizens of the United States, this action being decided upon after complaint that citizens were unable to obtain contracts on city buildings when awards were made to noncitizens.

ENGINEERING SOCIETIES

The Engineers' Club of Philadelphia will be addressed at the regular meeting Nov. 19 by George W. Braden, former Y. M. C. A. director of athletics and recreation for the Italian Army. Mr. Braden will speak on "Overseas Experiences in Italy," his talk being illustrated with lantern slides. Italy's place in the war, her man-power and industrial mobilization, the needs of recreation in her army, and the results of the introduction of American recreational sports in raising the morale of the army will be outlined.

During the summer the club instituted a series of Tuesday noon luncheons. Maj. Gen. L. W. T. Waller, U. S.

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

M. C., spoke on "The United States Marine Corps" at the luncheon Nov. 5. Philip Francis Nowlan, of the Philadelphia *Public Ledger* staff will speak on "Sales Engineering" at the luncheon to be held Nov. 12.

The Albany Society of Civil Engineers was addressed at the meeting Oct. 29 by Maj. E. Harold Cluett, Troy, N. Y., who spoke on "Personal Experiences in France."

Personal Notes

COL. JAMES G. STEESE, Corps of Engineers, assistant to the Chief of Engineers, has been detailed to the General Staff and appointed executive officer of the Personnel Branch, recently organized to handle personnel matters for all branches of the service.

N. L. ARBUCKLE, assistant engineer maintenance of way, the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Indianapolis, Indianapolis Terminal division, has been appointed acting engineer maintenance of way at the same point, succeeding I. M. Brown, deceased.

WILL M. LEE, of the Morrison Construction Co., Des Moines, Iowa, and formerly county engineer of Winnishiek County, Iowa, has been appointed district engineer for the sixth district of the state, succeeding H. L. Phelps, now in military service. Mr. Lee's headquarters will be at Cedar Rapids.

W. N. HALL, drainage engineer, Bureau of Public Roads, Washington, D. C., has been transferred to Clemson, S. C., for the purpose of making investigations of drainage, under a coöperative agreement between the drainage investigations bureau of the Office of Public Roads, and the State College of Agriculture of South Carolina.

ROBERT E. KLINE, Dayton, Ohio, who a year ago gave up his duties as vice-president of the Barkelew Metal Products Co., of that city, to become supervising engineer for the Emergency Fleet Corporation, has been appointed United States district engineer for the Emergency Fleet Corporation with jurisdiction over New England shipyards.

S. A. JORDAN, assistant superintendent of the Baltimore & Ohio R.R. at Brunswick, Md., has been appointed engineer maintenance of way, with office at Baltimore. He succeeds J. B. Myers, assigned to other duties.

JULES R. BREUCHAUD, secretary of the Underpinning & Foundation Co., New York City, has been commissioned in the Construction Division with the rank of captain, and temporarily assigned to duty in Washington, D. C.

T. J. WASSER, county engineer of Hudson County, New Jersey, has been appointed to the executive section, Highways Transport Committee, and assigned to the work of keeping the New Jersey section of the Buffalo-Baltimore Army route clear during the coming winter.

MAJ. DALE BUMSTEAD, Ordnance Department, formerly manager of the Chicago office of the E. I. DuPont de Nemours Co., has been promoted to the rank of lieutenant-colonel.

L. B. ELLIOTT, acting engineer maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Indianapolis, Peoria & Eastern division, and R. B. Stokley, acting engineer maintenance of way at Springfield, Ohio, have exchanged places.

V. BERNARD SIEMS, formerly assistant engineer, Baltimore City Water Department, and recently water engineer at Camp Meade, Maryland, has been appointed principal assistant engineer of the Baltimore City Water Department.

CHARLES SAVILLE, director of sanitation, Department of Public Health, Dallas, Tex., has been made director of the recently organized department of industrial development of the Chamber of Commerce and Manufacturers' Association.

J. L. KIRBY, division engineer of the Seaboard Air Line Ry. at Atlanta, Ga., has been appointed engineer maintenance of way, with office at Norfolk, Va., succeeding J. C. Nelson, deceased.

JOHN G. LAVERY, city engineer of Summit, N. J., has resigned to enter the service of the United States Housing Corporation, with headquarters at Pittsburgh.

W. B. RIGBY, Maquoketa, Iowa, has been appointed county engineer of Jackson County, succeeding Charles M. Fisher, resigned.

Obituary

LIEUT. PAUL H. CORDES, 30th Engineers, was killed in action Sept. 12 on the western front. Lieutenant Cordes was 31 years old. For the past five years he was sales engineer in the Chicago office of the Worthington Pump & Machinery Corporation.

LIEUT. EDGAR M. WHITLOCK, 102nd Engineers, is reported killed in action. He was 27 years old and a graduate of Cornell University.

CLARENCE COLEMAN, United States engineer, Duluth district, died in Duluth, Oct. 24, in his 70th year. Mr. Coleman entered engineering work in 1873 as a rodman for the Houston & Texas R.R., remaining in railroad work, in the service of various companies, until 1890, when he resigned as chief engineer of the Santa Fé Southern Ry. to enter private practice at Roanoke, Va. Later he became city inspector of buildings of Roanoke. In 1894 he was appointed United States assistant engineer on breakwater work at Marquette, Mich., and three years later he became secretary of the board of civil service examiners, at large, for the United States Engineer Department. Mr. Coleman had lived at the head of the great lakes for the past 24 years and had been in charge of construction and improvement work in the Duluth-Superior harbor.

CLYDE D. GILBERT, associate editor of *Concrete* since April, 1915, died of pneumonia in Allentown, Penn., Oct. 18, while on a trip of inspection in the Lehigh Valley cement-manufacturing region. Mr. Gilbert attended the University of Vermont for two years, and was afterwards employed by the Van Guilder Double Wall Co. of Rochester, N. Y., previous to his association with the editorial staff of *Concrete*.

CHARLES RIDGELY HANSCOM, who was in charge of the building of the steamships "Minnesota" and "Dakota" at Groton, Conn., in 1913-14, died Oct. 31 in New London, Conn., in his 69th year. Mr. Hanscom was born in Portsmouth, N. H. He was associated with the Navy Department in Washington in 1880-1890, and the following six years was general superintendent of the Bath Iron Works, Bath, Maine.

HOWARD J. KLINZING, contracting engineer, Pittsburgh-Des Moines Steel Co., died at his home in Pittsburgh Oct. 23, at the age of 31.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Manufacturers' Export Association Stands for Broad Coöperation in Foreign Trade

Assistance to Reconstruction Pledged and Creation of Merchant Marine Urged at Ninth Annual Convention

The building up of foreign trade on a plane of broad-gage assistance to the allies, who have suffered more through the war than has the United States, to give assistance for the rebuilding of Belgium and France, the restoration of a large American merchant marine, were the paramount themes of the ninth annual convention of the American Manufacturers' Export Association held last week in New York City. The convention was the largest ever held by the association, more than a thousand manufacturers and their representatives attending, and it is reported that the banquet was the largest ever held in New York.

Resolutions were passed at the executive session, on the opening day, pledging the association to render every possible assistance in the rehabilitation of France and Belgium at the earliest possible moment after victory shall have been attained.

Changes in the constitution of the association were effected, and the convention elected its former president, George Edward Smith, of the Royal Typewriter Co., to head the association for the ensuing year. A new board of direction was also chosen.

Assistance to Export Trade

The association went on record as unqualifiedly in favor of adopting means whereby the financial assistance necessary for the furtherance of American export trade shall be expedited. Resolutions to that effect, passed by the finance committee and adopted at the executive session, are as follows:

"Resolved, that in connection with financing exports from the United States, this association believes it imperative that prompt attention and action be given to: (1) Coöperation with such agencies as will quickly make available proper and adequate credit information on foreign buyers; (2) development of the use of the dollar acceptances of American banking institutions, giving, for the purchases of American goods, the authorization of foreign buyers for their local banks; (3) broadening the American market for American dollar, bank and trade acceptances, through encouragement of the Federal Reserve Board, and through propaganda; (4) assisting in every way possible the study of foreign languages and financial customs on the part of a sufficient number of members of each American banking and export organization; and (5) it is the opinion of this association that the present facilities of American banking institutions are able to finance our present and future foreign trade, and that full development of these facilities can be accomplished only by a complete understanding on the part of the financial management of exporting houses of the very complete advantages now provided by law for their benefit."

Trade Education Advocated

In discussing the educational facilities which are at present afforded to the young men of the nation to prepare themselves for the field of international commerce, it was the opinion of the convention that the inauguration of a system of education in the training camps afforded the best means of furnishing the trade with expert operators immediately on the conclusion of peace. The association adopted the following resolution:

"Resolved, that the Secretary of War be respectfully and earnestly requested to utilize at the earliest possible moment the officers of his Commission on War Camp Activities, the Y. M. C. A and other available agencies connected with our military operation at home and abroad, in assisting the imperative national need for education for foreign trade service."

The above resolution was adopted after the reading of a paper prepared by the president, George Edward Smith, who advocated the converting of the American Expeditionary Forces into the pioneer legions which are to uphold American future in all trades after the war. In this connection Professor John Erskine, of Columbia University, and chairman of the American educational commission, who was in this country on

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Only One Copy of Export Application Forms Required

The War Trade Board, in a recent bulletin, explains that, in submitting applications for export licenses, only one copy of form X, also of any supplemental form, is required. The only documents of which more than one copy is required are the lists of commodities which in some cases are attached to form X in answer to question five. These lists must be furnished in triplicate.

New Priority Regulations Governing Production

New rules and regulations governing priority and production have been issued in supplement No. 2 to circular No. 4 issued July 1, by the War Industries Board, Priorities Division. Class C, which was mentioned in recent bulletins regarding export licenses, is more amply defined.

It states that Class C comprises all orders and work other than those covered by priorities certificate issued by the Priorities Committee, and automatic rating in accordance with provisions of sections 7, 7A, 7B, 8 and 8A, which orders and work are placed by and are to be utilized in connection with an industry or plant appearing on preference list No. 2. It states that these rulings cover orders and work which are to be utilized in furtherance of one or more of the following purposes or uses:

1. Maintenance of existing equipment for the supply of heat, light, power and sanitation. 2. For necessary supplies and essential repairs (not extensions or replacements) to existing buildings and manufacturing plants. 3. Operation of machine shops and blacksmith shops. 4. For wire cloth for screening buildings. 5. Nails, screws, rivets, bolts, nuts and washers used for any purpose. 6. For all necessary repairs to equipment, vehicles, implements, machinery of every nature whatsoever. The bulletin also gives automatic ratings for War, Navy and other departments of the Government which may apply, and for certain repairs. The instructions include interpretation of term "materials and equipment," alternative procedure for obtaining automatic ratings, limitation on use of automatic ratings, priorities for jobbers, industry priority certificates, priority on export orders, rule regarding delivery dates, and instructions for obtaining the ratings.

Industrial War Service Convention Planned for December

The Chamber of Commerce of the United States has just announced plans for a convention to be held at Atlantic City, Dec. 4-6, representing the Industrial War Service Committees, more than 300 in number, now operating in the United States. The convention is called mainly to establish reconstruction programs. According to the announcement given out, the main purposes of the conferences will be the determination of practical methods whereby industry may coöperate still more closely with the Government, through a centralized scheme of organization.

Annual Meeting of National Industrial Traffic League

The National Industrial Traffic League will hold its annual meeting at the Hotel Sinton, Cincinnati, Ohio, Thursday and Friday, Nov. 21-22. The notice states that the docket for the meeting will be distributed about Nov. 10, giving in detail the subjects to be considered. Many of these subjects, it is said, will be of considerable importance, and every member is urged to arrange his appointments so as to be able to attend this meeting, and it is desired to invite to the meeting traffic representatives of organizations or individual concerns not members of the league.

It is requested that lists of names of such representatives be sent to E. F. Lacey, assistant secretary of the league, 413 Tacoma Bldg., Chicago, Ill., who will supply them with copy of the docket and invitations to attend. It is suggested that the official invitation extended to them by the secretary be supplemented by personal invitations.

Procedure Governing the Export of Steel to Italy

The War Trade Board announces that licenses for the exportation of steel to Italy will be granted only upon the receipt of evidence that the steel will be transported at a rate of freight not exceeding that of $67.50 per ton of 2240 lb., or 40 cu.ft., ship's option, on pieces and packages not over 4480 lb., as established by the United States Shipping Board. The rate applies to the following: Structural iron and steel, iron and steel shapes, plates, nails, bolts, nuts, sheets, plain and corrugated, plain and barbed wire, billets, bars, rails and fastenings, pig iron, and pipe.

It is stated that this ruling does not apply to applications for licenses to ship steel purchased by the British, French or Italian Government.

Factory Adopts Measures To Fight Influenza

In an effort to combat the spread of the Spanish influenza the S. F. Bowser Co., oil tank and pump works, Fort Wayne, Ind., has established stations about its plant for the free treatment of its employees. Every employee is requested and expected to have his or her nose and throat sprayed at least twice daily. Specially instructed attendants for the spraying are on hand. Bulletins have been prepared and posted regarding the disease, the care of the nose and throat, and necessary precautions against dust and other dangers. As a further measure, certain employees have been sworn in as deputy health commissioners, with full power to enforce all rules and laws of the Health Department. It is their duty to take action — drastic if necessary — to prevent the spread of the disease through spitting, coughing and sneezing, and to report all cases of sickness.

Renewed Diversion of Labor From Less Essential Work To Be Made by War Industries Board

Drastic Measures To Be Effected Told by H. B. Swope, of the War Board, at Manufacturers' Export Convention

That within a month, a gigantic diversion of labor and materials from the less essential pursuits to war work will be carried out by the Government was the statement of Herbert Bayard Swope, member of the War Industries Board, at the banquet of the American Manufacturers' Export Association in New York Oct. 31. Mr. Swope, who is the assistant to Mr. Baruch, chairman of the board, said that the point has been reached in our war production for the allocation of labor according to need, rather than desire. He announced that plans have been completed for active coöperation between the War Industries Board and the provost marshal general so that a wholesale diversion of labor may be effected before it becomes necessary to tap the industries themselves. It is planned to take over into work that will contribute to the war program more than 300,000 able-bodied male citizens who are now engaged in non-war work. Plans have been completed for a corresponding substitution of women for the men thus taken from their present employment. He named a few of the lines of employment which are to be affected, including those of waiters, chauffeurs, servants, elevator attendants, and certain classes of retail salesmen.

Less Essential Plants Affected

Mr. Swope said that likewise certain of the less essential industries will be stripped of their male employees as far as the substitution of women will permit. As an illustration, he mentioned the making of metal bedsteads, saying that women would have to be relied upon to do practically all the work in such industries.

He said that through the withholding of raw materials a still further pressure would be brought to bear upon manufacturers of less essential articles, in the Government's determination to let nothing stand in the way of maximum war production.

Continuing, Mr. Swope said:

"Wars are fought and won or lost on the land, on the water, in the air and in the workshops. It is not enough to mobilize the nation's military strength; there must be a mobilization of her full financial, economic and industrial resources. These must be organized, coördinated and commanded with the same strategy that governs the operations of the purely military arms of service.

"The prodigious strain upon the world's productive capacity must be met and balanced to provide the means of warfare and to maintain the civilian population, as well as to preserve the economic fabric.

"The responsibility for the control and regulation of industry in all its direct and indirect relations to the war and to the nation has been placed by the President in the hands of the chairman of the War Industries Board. This board is charged with the duty of procuring an adequate flow of materials for the War and Navy Departments, the Emergency Fleet Corporation and the Railroad Administration. Also, the board provides supplies necessary to the military needs of our associates in the war, and those commodities required by neutrals in exchange for materials essential to us.

"Finally, and of paramount importance, the board, in alliance with the food, fuel and labor administrations, provides for the country's civilian needs, the protection of which is a particular duty of the organization.

"It stimulates the production of those materials essential to the war program and, at the same time, depresses and curtails the production of those not of a necessitous nature. This is done by regulation of the basic economic elements (a) Facilities; (b) materials;

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Project Involving 1,000,000,000 Feet of Lumber Launched

Plans for the cutting of 1,000,000,000 ft. b.m. of lumber have been made by New York interests, backed by the United States Government. Offices have been established in Charlotte, N. C., and the project will include the cutting of 5,000,000 to 6,000,000 railway ties. It is expected that the work will require 50 sawmills. The area to be cut over amounts to about 250 square miles in North Carolina, South Carolina and northern Georgia.

Motor trucks will be used to convey the timber to railway points, and it is expected that approximately $750,000 will be expended in building roads, mainly concrete highways. The company expects to produce about 50 carloads of timber materials per day, and says that the United States Government will take all that will be produced for at least a year to come.

Japanese Commercial Museum in Singapore

There is about to be established in Singapore a commercial museum under the direction of the Japanese Department of Agriculture and Commerce. The object will be the promotion and extension of Japan's trade during and after the war. The necessary arrangements in this connection have been intrusted to the South Sea Society, the

funds for the establishment and maintenance of the museum to be supplied by the Japanese Government.

With regard to this enterprise the Japanese Minister of Agriculture and Commerce stated that the proposed commercial museum at Singapore is designed to serve as a central base of Japan's commercial operations in the Pacific Ocean islands. The functions of the museum will be divided into a number of sections. Merchandise will be exhibited and investigations made relating to trade and commerce. It will also serve as a medium for Japanese exporters and foreign importers to form more intimate relations.

It is understood that similar institutions are contemplated for other places, including one at Harbin.

Manufacturers' Export Convention

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a short visit from the western front and who is returning with a large staff of trained educators and an equipment of American text books and educational material, told of the great work now in progress and plans for the education of our student soldiers. Mr. Erskine stated that orders have been issued by General Pershing providing that, as soon as fighting has ceased, the boys in the American Army shall have six hours a day instruction under Army auspices. This is to be followed by a finishing course of three months' intensive training in the leading technical and commercial schools of France and Great Britain, where arrangements have been completed for placing our own teachers alongside the faculties of these institutions. The commission has already begun its work by offering educational facilities to the soldiers during their rest periods, and these offers have been eagerly accepted by a large number of the boys. More than 200,000 enrollments have been recorded in the French classes, and classes are now being conducted in Spanish, Portuguese, commercial geography, natural resources and manufactures of the different countries. Mr. Erskine told of the great eagerness with which a very large number of the soldiers are taking to the educational facilities offered, and predicted that after the conclusion of the war and the return of our men to peaceful pursuits a great army of young Americans would be ready to lead us in commercial life and worldwide industrial development.

To Investigate Training for Foreign Trade

In view of the interest in education for foreign trade that is developing in many directions, and the immediate need of centralized effort in its behalf, the association passed resolutions advocating the establishment, under Federal control, of adequate forces of instruction in preparation for foreign trade, and that the committee of fifteen appointed by the United States Commissioner of Education be supplied by Congress with powers and funds to investigate and report on training for foreign trade and a national policy in regard to it.

A paper on "A Genuine Department of Commerce," was read by B. S. Cutler, chief of the Bureau of Foreign and Domestic Commerce. In it, after explaining the financial limitations of his bureau, he advocated adding a division of industrial practice to aid in the elimination of waste, a division of material valuation for studying the original sources, the handling and the grades of foreign and domestic materials, a division of information in interior waters and railways, a division of distribution economy and a division of cost-finding methods. After hearing this paper the association passed resolutions asking Congress for increased appropriation to carry on this important work.

Mayor Preston of Baltimore addressed the convention in behalf of the Southern Commercial Congress, and urged the attendance of the members in Baltimore next December. This was followed by a practical demonstration of the filling of a foreign order, from the receipt of the order in the language of that country to the actual delivery of the goods. The demonstration was made by Frank Waterman of the staff of the L. E. Waterman Co., and was illustrated by actual orders, goods, packing cases, etc. Mr. Waterman pointed out the difficulties that have arisen from the payment of insufficient postage on foreign mail, and showed how his company is successfully avoiding mistakes in this matter through the use of different colored envelopes, providing not only colored envelopes for all foreign mail, but having various colors to denote the amount of postage required.

United States Army Packing Service Explained

Capt. H. R. Moody, representing the packing service of the United States Army, gave a talk on what is being accomplished in the way of conserving space in transport through the scientific packing of goods for export. He told how, as a result of the study of a shipment of motor trucks and the working out of a standard form of packing, five trucks are now shipped in the steamer space formerly required by one. He outlined the object of the Government packing service, and stated that assistance would gladly be given to any American shipper in working out a standard form of case or package for oversea shipment if they would address "Packing Service, United States Army, Washington, D. C." It is the purpose of the Government to give all American shippers the benefit of its scientific studies in connection with Army shipments. He explained that in Army shipments specifications for packing are now made part of the orders, and that failure to comply with these specifications entails a penalty.

"[illegible] After the War" was discussed under several heads, such as "Our Mercantile Marine." Frank B. Mackey, vice-president of the Barber Steamship Line, and Joseph Hodgson, traffic manager of the New York and Cuba Mail Steamship Co. (Ward Line) outlined, from their experience in the handling of merchant ships, the possible handling of our merchant marine after the war. Joseph J. Schlechta, traffic manager of Gaston, Williams & Wigmore, under "How Shall We Have a Real Merchant Marine?" treated the subject from an economic point of view, and pointed out the necessity for a reciprocal policy if the United States is to retain the friendships formed abroad by the war and which will be necessary in the prevention of a "war after the war." John Meigs, of the Harriman Steamship Line, in discussing the urgent need of port and terminal improvements, pointed out that these facilities should be a function of the Federal Government.

Application of Webb-Pomerene Law

Gilbert H. Montague, of the New York bar, and counsel to the special committee of the association in support of the Webb-Pomerene law, gave a brief of his paper on "How Different Types of Selling Organizations May Obtain the Benefits of the Webb-Pomerene Law." He explained the several methods whereby competing companies may unite under the law for the purpose of foreign selling, and cleared up many points on which the law was misunderstood. He illustrated some of the many ways by which the branch house, the export house, the house selling through local dealers, the house selling through travelers, as well as the joint selling organization, all may obtain the benefits of the Webb-Pomerene law. He concluded by saying: "If the Webb-Pomerene law is sympathetically utilized by the business community, and is sympathetically applied by the Federal Trade Commission, and as occasion arises is intelligently broadened by further legislation, it will certainly prove one of the most effective agents in the upbuilding of American export trade."

The sessions of the convention closed with a paper by the Hon. John Walsh, chief counsel for the Federal Trade Commission, on "The Webb-Pomerene Law as it is Being Administered."

He said that, although a number of industries filed the necessary papers under the law there was none actually engaged in foreign trade under its provisions. He indicated the manner in which the Federal Trade Commission could aid in the work.

At the banquet, which was the final event of the convention, Herbert Bayard Swope, of the War Industries Board, conveyed a message from Mr. Baruch, chairman of the board, and told of the drastic steps soon to be taken by the War Industries Board in diverting all available labor from those industries deemed less essential to actual war work. Mr. Swope's message is given in another article in this issue.

Diversion of Labor

(Concluded from page 873)

(c) fuel; (d) transportation; (e) labor and (f) capital. The method of control is through a preference list on which are placed those industries whose output is essential to the war's progress, and the priority indicated by the preference list is the master key to the six elements named.

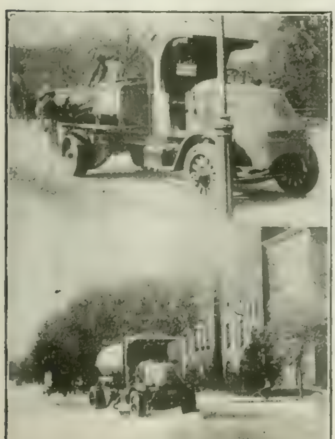
"Furthermore, the board regulates all and controls certain other industries of first-rate war importance; it fixes prices; it creates new and converts old facilities; it clears the national business requirements, and it leads in conservation, which is needed to bridge the gap between the extraordinary demand and the available supply—a gap which exists in almost all the great commercial staples.

"The abnormal conditions of the war demand sacrifices. It is the price of victory. Only actual needs, not fancied wants, should and can be satisfied. To save heavy and long privation, temporary deprivation must be the rule. America's willingness to accept these conditions marks her ability to quicken the end of the conflict."

In concluding his address, Mr. Swope read a message from Mr. Baruch, chairman of the War Industries Board, in which he commended the spirit of American business in making itself an effective and willing force in the nation's life.

Increased Municipal Efficiency in Convertible Motor Trucks

Increased efficiency in municipal street work is obtained through the use of motor trucks, the chassis of which can be converted from summer to winter use. The New York street-cleaning department has a number of Mack trucks fitted with tanks, with flusher and sprinkler attachments for the summer street-cleaning service. When freezing weather prohibits the sprinkling of streets these chassis are converted into automatic dump trucks, with steel, inclosed, sanitary garbage and earth collection bodies.



CITY TRUCKS IN USE ALL YEAR

It is pointed out that a saving is effected by obviating the necessity for laying up flushers and sprinklers during the winter, representing, as it does, a loss on the truck investment, since by the use of these interchangeable chassis the trucks are made an all-year truck investment. These machines are manufactured by the International Motor Co., New York.

OBITUARY

FRANCIS R. CRISPEN, secretary and director of the Traylor Engineering and Manufacturing Co., and of the Traylor Shipbuilding Corporation, died of pneumonia, following an attack of influenza. He was born in Lock Haven, Penn., in 1882, was graduated from Girard College in 1898 and was admitted to the Philadelphia bar in 1906. In 1908 he took a position as private secretary and counsel to Samuel W. Traylor, from which position he advanced to the position of secretary and director of the Cement Gun Co., Inc., and secretary, treasurer and director of the Dewey Cement Gun Co., acting as counsel for all these companies at the same time.

L. R. GULLEY, general manager of the Burr Co., foundry and machine shops, Champaign, Ill., died Oct. 22. Mr. Gulley was 32 years of age and had been associated with the Burr Co. since his graduation from the University of Illinois in 1910. He took the civil engineering and mechanical engineering courses in four years.

WILLIAM M. HUSBANDS, vice-president and one of the organizers of the Standard Metal Co., Indianapolis, died a few days ago at his home in Indianapolis. He distinguished himself in the selling end of the metal trade, and for 42 years traveled over the same route, calling upon the shops and foundries in his territory. He was one of the oldest members of the United Commercial Travelers of Indianapolis.

BUSINESS NOTES

The Lakewood Engineering Co., Cleveland, O., announces the opening of its own offices in New York City at 111 Broadway, with George S. Hedge, district manager, in charge.

The W. J. Crouch Co., Inc., and Rownson, Drew & Clydesdale, Inc., announce the amalgamation of their respective organizations under the name of Rownson, Drew & Clydesdale, Inc, with general offices at 68 William St., New York, N. Y. P. G. Donald is president; I. Smullyan, managing director; John J. Smart, in charge of engineering division; John H. Allen, assisted by M. Greenberg, purchasing agent.

The Patterson-Kelley Co., manufacturers of feed-water heaters and hot-water heaters, announces the removal of its Philadelphia office to the Harrison Bldg., 15th and Market Sts. It is in charge of F. E. Glenn.

The T. A. Scott Co., Inc., marine wreckers and contractors, announces the removal of its offices from 400 Border St. to 113 State St., corner of Broad St., Boston, Mass.

J. A. Currey, Portland, Ore., local manager of the Truscon Steel Co., has been named Federal Commissioner of Building Permits.

The Universal Construction Co., Ltd., Victoria, B. C., has been incorporated for $250,000, to enter general contracting business.

TRADE PUBLICATIONS

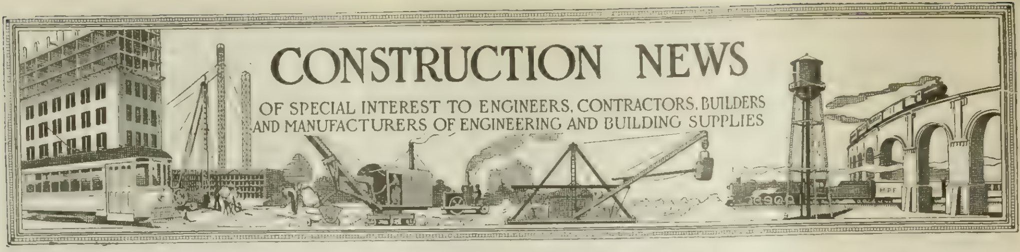
"Jeffrey Belt Conveyors" is the title of an 80-p. catalogue issued by the Jeffrey Manufacturing Co., manufacturers of coal-mining machinery, electric locomotives, etc. It is illustrated with half tones and line cuts and contains tables and other engineering data collected from belt-conveyor practice. The information covers the field from early types of belt conveyors to the latest output of the Jeffrey Manufacturing Company.

The Armstrong Cork & Insulation Co., Pittsburgh, has published a 37-p. catalogue entitled "Linotile Floors."

"Lock Joint Reinforced-Concrete Pipe" is the title of a 64-p. 8 x 11-in. catalogue issued by the Lock Joint Pipe Co., 165 Broadway, New York.

Giant trucks, manufactured by the Chicago Pneumatic Tool Co., Chicago and New York, are illustrated and described in a 34-p. 9 x 12-in. catalogue, numbered 344.

The Thew Automatic Shovel Co., Lorain, Ohio, has issued Industry Bulletin No. 29, illustrating and describing the Thew shovel for underground work. It contains cost and power data as well as cuts showing the shovel working under various conditions. The New York office of the company is at 30 Church Street.



Prices Will Be But Slightly Affected by Early End of Hostilities, It Is Believed

Except Ammunition, Many Supplies Are Needed for Lengthy Period Before and During Return of Troops

The effect of an early cessation of hostilities on the general financial situation and prices is the subject of wide inquiry and study. It is believed, however, that, owing to the long period that must necessarily intervene between the actual end of fighting and demobilization, a large amount of war supplies, except shells and explosives, will be required for the maintenance of the Army overseas. It is probable that the armies will be maintained in the field until the allied governments have sufficient assurance to guarantee a permanent settlement, and, although comparatively small in comparison to the total numbers now under arms, a certain number of troops will be held in Europe to assist in reconstruction. Reconstruction activities which will commence at once will also require increasing amounts of materials.

Further Bond Issues Probable

On the other hand, the tremendous load on the financial structure of the country due to war expenditures (amounting to more than $20,000,000,000 to date) points to heavier taxation and more bond issues. It is estimated that more than $3,000,000,000 of of the Fourth Liberty Loan has already been spent, and at the present rate of expenditure the remainder will last less than six months. The effect will be felt in every branch of business, and especially in the banking situation, with especial reference to money rates. It is estimated that since the United States entered the war the Federal reserve banks have issued more than $2,000,000,000 in notes, in addition to expansions caused by their loan operations, and that there is less than $1,500,000,000 for further expansion. At the present rate, this limit of expansion will be reached in less than a year. Though it is not believed that the United States will allow the banks to reach this condition, it would bring the financial situation into so tight a shape as to make a financial shock dangerous. Every curtailment of credit for nonessential purposes would therefore be necessary; this, in turn, would have its effect on the money supply—and money supply, it is well understood, has a direct effect on prices. This country is already the heaviest creditor in the world, and the lowness of the stocks of money in the European countries will have its effect on foreign trade. In other words, until the different nations arrive at the point where they can pay off the debt in commodities rather than money, the extension of further credit to pay for reconstruction material, etc., will be difficult.

Financial Situation Complex

The bankers of the country mention these factors to show the complexity of the situation and point to an element of danger that exists, in ever-increasing quantity, toward expansion among the industries supplying direct and indirect war materials.

Although a curtailment of the money supply will bring about lower prices, the adjustment that will be necessary in the business world will be of such disturbing character, bankers point out, as to offset any advantage that will accrue from lower prices.

The steel shortage is such as to indicate that it will extend well into 1919, although a certain measure of relief has been obtained for the present by reallotting steel from the railroads and shipyards to those plants feeling the shortage most acutely.

Plates have been furnished for shipbuilding faster than the rate of consumption, and the Railroad Administration has curtailed its demands for the purpose of the allotment. These measures, together with the large margin of safety which was allowed in making up the estimates, will tend toward meeting the demand.

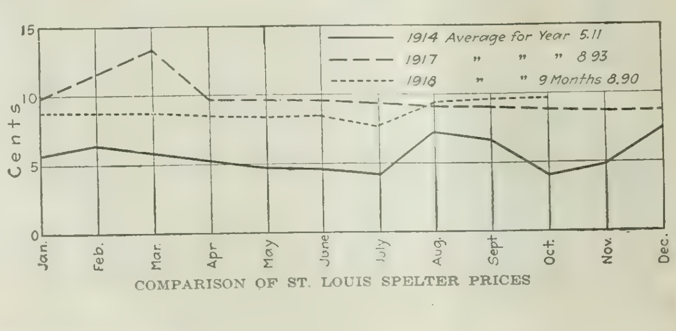
A shortage of brass has developed in the past two months, according to figures compiled by Everett Morse, chief of the nonferrous tubing section of the War Industries Board. The shortage in the copper and tin supply is largely responsible for this situation, since there is no shortage in zinc. Also, many articles heretofore made of brass can be supplied in zinc.

The Price-fixing Committee has announced an agreement made between the producers of copper and the committee fixing the same maximum price of copper (26c. per pound) for the period from Nov. 1 to Jan. 1, 1919, as that of the previous period. The agreement stipulates measures necessary, under the direction of the War Industries Board, to prevent the supply from falling into the hands of speculators, who might increase the price to the public, should the supply be such as to create such a contingency; and requires a pledge to exert effort necessary to keep up the production of copper, so as to insure an adequate supply as long as the war lasts. At present, practically all of the refined copper produced is absorbed either directly or indirectly by the Government, and the business done outside is negligible.

Zinc Prices Compared

A comparison of zinc prices for the past two years with those prior to the beginning of the war shows that the price in 1918 will fall below that of 1914 if the comparison is made according to the ratio of the money in circulation in the two periods.

Production of lumber will be restricted to the filling of essential requirements, under regulations issued by the War Industries Board. The control of the output will be exercised by the board through the allotment of priority of labor, material and equipment. Essential purposes for which deliveries of lumber may be made include Government or allied requirements, and needs of the public in which lumber is essential to war work.



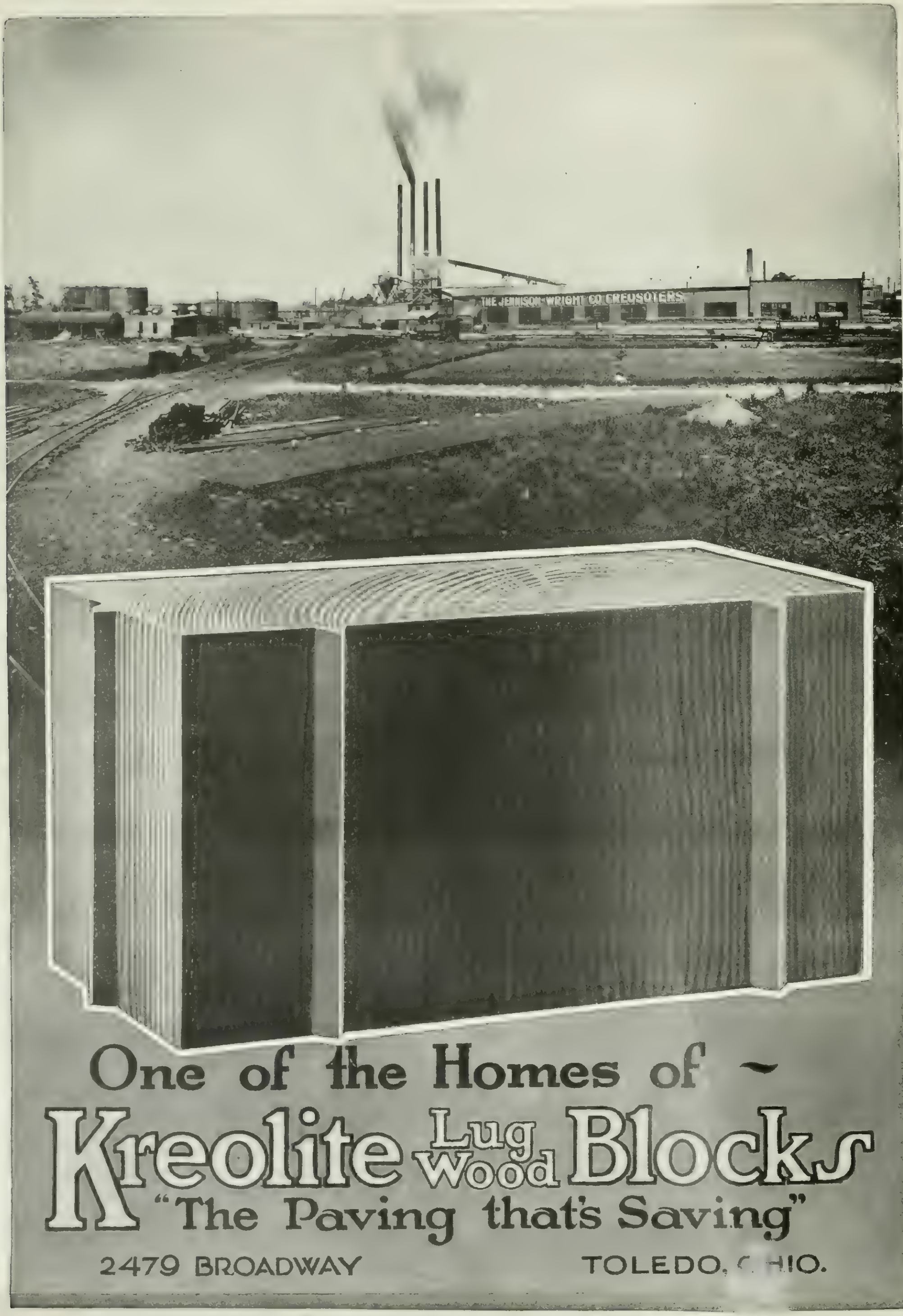
COMPARISON OF ST. LOUIS SPELTER PRICES

Engineering News-Record

November 14, 1918

Devoted to Civil Engineering and Contracting
McGraw-Hill Company, Inc.

Heavy Precast Inclined Slabs Driven for California Sea Wall


THE JENNISON-WRIGHT CO. CREOSOTERS
One of the Homes of
Kreolite Lug Wood Blocks
"The Paving that's Saving"
2479 BROADWAY
TOLEDO, OHIO.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, NOVEMBER 14, 1918 — Number 20

Peace

PEACE has come and the country has gone delirious with joy. The first jubilation, following a false report, did not dampen the enthusiasm for this week's celebration of the actual event. And well might we celebrate twice; the spectacle of a peace-loving people returning to the arts of peace after a terrible war is an event we shall not witness again. Yes, we pray that our children's children unto many generations shall not see such a day.

We are glad peace has come. It is here sooner than expected, but it is on our terms—unconditional surrender of the enemy, and the destruction of the autocratic power which caused the war. We have gained that for which we fought—the triumph of the democratic ideal, a purpose to which we had dedicated, if there were need, our last dollar and our last drop of blood.

What are the results of the conflict? What is the gain for the tremendous price the world had to pay?

International peace for a long time, possibly the elimination of war for conquest forever—that is, the first and greatest result. To expect such a gain would be chimerical were it not that we have destroyed the incubus that has led to war—the power of a single, unscrupulous individual or of a ruling clique to control a whole nation. The theory of the right of kings to enthrall a people, to use them as dupes, is dead forever. It passes with the execrated Hohenzollern line and with the memory of their unscrupulous accomplice, Bismarck. The autocracies of Germany, Austria and Russia have been cleansed from Europe, and what monarchies remain will vie with republics in their democracy.

This surely is gain.

France and England, as is to be expected, have gained more than we. They deserved more, for theirs has been the greater sacrifice. Both countries had been displaying distressing signs of decadence—the weakening of the moral fiber in every rank of life. They have been remade. The flabbiness has been burned out. The blindness that characterized their political life has given way to light. They have heavy reconstruction problems, social and economic rather than material, but their people see with the clarity of those who have suffered grievously and have been brought face to face with death.

Germany, too, though the horror of her crime is still too near us to treat her with sympathy, has gained much. She will have the opportunity to turn to arts of peace the talents which for fifty years have been subordinated to a military ideal. She will have an opportunity to establish herself as a civilized nation, and to remove the stigma of the Hun which now rightly is upon her. For this opportunity of setting herself at one with the civilized world she has had to pay a terrible price—but she can reckon it as clear gain.

As for ourselves, how shall we appraise our return? Our part in the war has been a brief one, too brief to indicate clearly the moral and social results. We have not been called on to make sacrifices to the extent of our European allies. We have not received a severe chastening. We do not belittle our casualties—the loss of even one life would be regrettable—but we have lived in comparative ease while other nations have suffered.

The one clear gain for us is the evidence that we are truly a nation, that Americanism means something, that it has sounded a common note in the breasts of the heterogeneous peoples who came to our shores, and has made them really one.

That new consciousness of our truly national character is heartening for the future. We shall have internal difficulties, but they shall pass and we shall work out a destiny commensurate with our already brilliant achievements, commensurate with the greatness of the resources of our country. Moreover, we have learned the lesson that we cannot afford to lag in the Americanization of those we receive into our midst. Never again can we tolerate the adherence to old-world sympathies that gave us cause to fear disturbances from Germans or citizens of German origin at the beginning of our entry into the war.

We are the gainers, too, in having acquired international sympathies. And that result has been reciprocal; Europe has a new and a better appreciation of our ideals and our mettle.

In social and economic ways we have much for which the war is accountable. Part of it, the major part, is progress and gain, but some of it is out of harmony with the individual initiative and freedom for development which is the basis of whatever progress this country has made. In England, where the lines are tightly drawn between employer and employee, there has been a chastening that favors a solution in which reason will prevail. Here there has been no chastening. The forces of labor, come recently to tremendous power, have not, as we see it, developed a sympathy for the conditions under which the employer labors. On the other hand, the employers have awakened to the need of more intelligent handling of the labor problem, despite the unreasonableness of labor so frequently displayed during the conflict. On the employer's part,

then, though there will not be quick forgetting of the unreasonableness, there will be a disposition to deal more openly and fairly in matters affecting the welfare of the worker. Nevertheless, we must look for trials and difficulties; what we have been spared by the early termination of the war, we shall in part at least suffer in the reconstruction. But bloodshed, happily, will be absent.

For our part in the war while we were in it, we may well feel satisfied. History may be less lenient with our delay in entering. Once in, we demonstrated that American initiative, American versatility, American virility, could be turned into war channels with no less success than into those of peace. We made mistakes, but the fault therein lies not so much in the making, as in the perversity of those who refused to admit the errors when pointed out and tried to discredit and punish those who disclosed them.

We must not forget, though, that while we were in at the finish, and performed a very necessary—an essential—part, the major part of the fighting and sacrifice have fallen on our allies. They have stood between us and the Hun, they have borne the brunt of battle, almost to the point of exhaustion. We have succored them only at the very end, when succor was sorely needed, it is true, but the battle has nevertheless been theirs. For this we can never be adequately grateful; the debt we can never repay.

So in this day of victory, while we give full praise to our own gallant sons, we will not forget what we owe to those millions of men of the British Empire, France and Italy who have laid down their lives for us no less than for their own lands.

In the hour of victory we salute them, the allied comrades in arms living in victory or triumphant in death, who have fought the good fight. They have made humanity their debtors. They have made the world "safe for democracy."

Highway Policies To Be Crystallized

THERE was assurance, even before this week of peace, that the highway convention under the joint auspices of the American Association of State Highway Officials and of the Highway Industries Association, set for Chicago, Dec. 11-12, was to be a most important event. But its importance has been immensely increased by the coming of peace. Under the war cloud there were problems enough, but enthusiasm for the future was necessarily subordinated to the grim work of war. Now, with peace at hand, we are faced with the need of determining our highway course for the great future that is dawning. It is just the sort of problems that are vital at the moment, too, that are set for discussion—broad questions of policy, such as Federal control and parcel-post-route developments, the underlying principle in laying out a state-trunk-road system, uniform motor-truck legislation, the requirements of the highways of tomorrow and the future national highway policy and plan. Moreover, as the convention will be under the auspices of the highway officials' association and following immediately on their annual meeting, attended from all parts of the country as a matter of administrative necessity, there is assured the presence of all the leading highway engineers and officials of the country. Added to that is the impetus which has been given to the post-war highway drive by the authorization of the big bond issues in Pennsylvania and Illinois. With peace here, with the call for a big highway program coming from all parts of the country, with the stage set at Chicago by the nation's highway officials for the discussion of the big problems and policies, no one who is actively engaged in highway work or concerned with highway transportation can afford to absent himself from the convention. It is not too much to predict that it will be epoch-making.

Who Will Follow These Good Examples?

SELDOM is engineering literature enriched with so interesting and valuable a sketch of the development of an important device as is given on p. 880 in the article on high-pressure gates in dams. The author's long and intimate connection with the development and use of these gates adds to the value of his discussion. From the relatively simple gates in the Sudbury dam to the hydraulically controlled balanced valves in the Arrowrock and other Reclamation Service dams has been a succession of long steps. As announced at the head of Mr. Cole's article, a supplementary paper, on experiences with large-capacity reservoir outlets, will be given in a later issue. The two contributions to the literature of engineering design and operation might well stimulate other engineers to prepare similar readable sketches of engineering progress in highly specialized fields.

Post-War Highway Drive Begins

PENNSYLVANIA and Illinois, both by heavy majorities, have approved their large highway bond issue proposals. Pennsylvania's was for \$50,000,000 and Illinois' for \$60,000,000. Thus do the people of two great commonwealths record their views on highway improvement. They consider good highways essential to their welfare and are glad to pay the bill.

The sentiment in Pennsylvania and in Illinois is merely that of the country at large. The people everywhere *will have* roads. In fact, they have thought more solidly than highway officialdom at Washington; they have sensed—even if as individuals they cannot make court proof of it—the essential nature of highway construction as a war, as well as a peace, measure. True, the bonds authorized in Pennsylvania and Illinois are to be sold only after peace is established, but the former strong highway sentiment has been immeasurably strengthened by the demonstration of the highway's service in war transportation.

There are rumors that even before these votes had been polled some members of the United States Highway Council had begun to see the light. We hope that the full effulgence will strike them now, and that while war-control continues some semblance of construction leadership will replace the past repressive policy.

It is too much of course to expect from Washington, either as a war or a peace measure, that strong type of leadership which befits one of the greatest constructive programs the country has ever known. The Federal

road administration has too long been in a subordinate capacity, lost in a department—that of Agriculture—whose main interests are foreign to road work. The time has clearly come for setting up a Federal agency commensurate with the highway future of this country—a commission with the autonomous standing of the Interstate Commerce Commission, the Federal Trade Commission or the Tariff Board. No other plan is adequate for the leadership which the Federal government should furnish in the tremendous highway development we face. The Pennsylvania and Illinois bond authorizations are but straws in the wind. A dozen or more other states will kick into the ring with issues ranging up to $50,000,000 in the next two years, while Congress, when the present Federal-aid period expires, will be thinking not in terms of $85,000,000 of aid but in half-billion allotments. And Congress will merely be harkening to the voices of the people—voices of which the Pennsylvania and Illinois expressions are but the first.

The first guns in the post-war highway drive have been fired—and to Pennsylvania and Illinois belongs the honor.

Greatest of Contractors' Meetings

NEXT week the general contractors of this country will assemble in Chicago for the most important meeting they have ever held—that for the organization of the National Association of General Contractors. It behooves every general contractor who can possibly attend to be there and to lend his support to the movement. He will receive much more than he can give. As a cold matter of business, he cannot afford to remain outside the organization.

Briefly, the object of the association, no matter what the actual wording of the constitution, is the stabilizing of the contracting business. If there is any industry in which the "competition of incompetence," the competition of the man who does not know what he is doing, has had more serious consequences we do not know what it is. It has defrauded the public, made hard sledding for legitimate contractors, and has resulted in the development of an attitude of suspicion on the part of the public that has caused grievous losses to the contractor, through contractual provisions lacking mutuality and imposing conditions that encouraged poor rather than good work.

The new organization will establish standards that will force the elimination of this type of business man—against whom the Federal Trade Commission has so strenuously objected, the type of man who, until he goes down in inevitable ruin, is a menace to the whole industry.

As to the detailed work of the association, it does not require much imagination to realize the large number of questions on which uniform practice is desirable and others in which the public, both private builders and Government agencies, city, state and Federal, needs enlightenment.

The wonder is that this organization has not come sooner. Now that the launching is at hand, no contractor of standing should be absent. If he cannot attend, his application should be there to swell the indorsement of this greatest movement in the contracting field.

A Call for Efficiency

A CALL has been sounded to combine efficiency with speed of production. It comes from the Shipping Board and is addressed to our shipbuilders. But the message goes with equal directness to all others engaged in the high-pressure activities on which the nation's power is concentrated. Speed has been attained. We may not slacken in rate of output. But the drive for speed alone must now be transformed into a drive for the full measure of efficiency compatible with fullest measure of output.

For nearly two years every man and every tool in the country have been engaged in producing at the highest possible rate. An undreamed-of production has been realized. Inevitably, in this drive all considerations were cast aside except that of speed. Cost—economy of effort and material—could not be thought of while the production machinery was being brought up to fullest performance. It was vital that every engine of production should be worked to its limit; if three men working to indifferent advantage could make the facilities at hand yield something more than could two men, or but one, the three were set to work. Top speed has been reached in this process. We are now at a stage where more can be accomplished if there is less waste, less inefficiency of effort.

Producers themselves, those who saw clearly, knew that consumption could not long continue at the same rate, and that sooner or later efficiency must again become dominant—certainly with the approach of post-war conditions. But even during the campaign for maximum output both man-power and material supply have proved to set limits to production. The time for return to efficiency is already at hand, it would seem; Mr. Hurley's call is the expression of this new purpose.

Scores of shipyards whose work is fully organized are even now engaged in rearrangement of their procedure to systematize production on a more efficient basis. The Shipping Board head now voices the need for a stronger and more general drive on efficiency in order to forward the ship program.

In the application of this call to each one of our present intensive production activities—not to shipbuilding alone—lies its broad importance. Each one, as it was speeded up, reached a limit of production not in floor space or in tool capacity but in organization and in supply. The next advance must be made through curtailment of losses, of inefficiencies.

That this will be a direct preparation for post-war industry is obvious, for if production then is not capable of meeting competition it may soon find itself halted. So much the more striking that the present call for efficiency arises from war needs alone. Out of the war service itself grows our preparation for the industrial future.

It may well be that in the years to come productive efficiency will command a premium far greater than before the war. The meaning of waste, known to us now by distant contemplation, is likely to impress itself unforgettably on all minds as we labor in the repair of that world-wide destruction. If that prove to be the case, the early impetus toward those higher demands for efficiency will surely be a lasting benefit to ourselves and to the world.

High-Pressure Gates in Dams for Water-Works and Irrigation Reviewed

From the Sluice Gates in the Sudbury Dam of the Boston Water-Works Through the Various Stages of Gate Development in the High Dams of the United States Reclamation Service

By D. W. Cole

Senior Engineer, United States Reclamation Service, Boise, Idaho

Originally presented at an Idaho conference of engineers early in 1918, this paper has been in such constant and increasing demand by engineers who have heard of it that the author decided to make it available to the entire engineering profession. It will be followed by a supplementary but independent résumé of experiences with irrigation reservoir outlets of large capacity, by James M. Gaylord, electrical engineer, United States Reclamation Service.—Editor.

The control and regulation of large streams of water through gates and conduits under high pressure is an art of recent development. Ancient hydraulicians were able to accomplish within their limitations some remarkable control of water both in small and large quantities by means of dams, sluices, canals and conduits, all operated under low heads. But the development of modern mechanics and particularly modern machines and materials of construction had to be awaited before extensive regulation of water at high velocities under pressure heads of 50 ft. and upwards could be undertaken.

During the past fifty years, pressure pipes and gates have reached a high stage of development in city water-works practice. Such works brought about the use of two principal types of valves or gates, one being the bronze-mounted cast-iron circular gate, both of the single and double disk form, which is commonly used in all large cities, up to 48 in. and occasionally as high as 72 in. in diameter, for pipe lines carrying pressures ordinarily from 50 to 200 lb. per square inch. The other type, used chiefly for deep reservoir regulation, is the rectangular sluice gate of varying dimensions, up to 4 x 8 ft., usually fitted with bronze bearing seats both on the gate frame and on the gate leaf.

Power-plant and irrigation installations began about where municipal practice left off, both in circular conduit gates and in sluice-gate construction. Where sluice gates were necessarily of larger capacity, they were commonly required to operate under less head, and this led to the invention of the Tainter or radial pressure type of gate for sluiceways up to about 12 x 12 ft., while the Stoney or roller-bearing type was designed for very large sluiceways under both high and low heads. In pressure pipe lines a more limited variety of valves has been employed, usually starting with the typical city water-works gate built to standard patterns by a number of manufacturers, and leading, in the most advanced practice, to valves of which the Johnson balanced hydraulic valve is a type of recent invention.

It has remained, however, for irrigation reservoir outlet practice to develop perhaps the greatest variety

GATE-VALVE DISCHARGE FROM WORLD'S HIGHEST DAM AT ARROWROCK, IDAHO, ON THE BOISE PROJECT OF THE UNITED STATES RECLAMATION SERVICE

Ten 58-inch balanced valves operating under 105 foot head, each discharging about 1000 second-feet of water which then falls about 150 feet to the river bed. About 90 feet below there is a similar set of valves and at the river bed there is a set of rectangular sluice gates for operation under low head to draw off water to the reservoir bottom. The Arrowrock Dam has a maximum height of 348 feet from its lowest foundation point to its crest, or 354 feet to the top of the parapet walls.

of effort to control water in very large quantities and under high pressure. Up to the time of beginning such work by the United States Reclamation Service, about 12 years ago, it had been feasible in municipal works, and even for power plants, either to limit the head on the gates and secure the volume of required delivery by means of multiple gates discharging at intervals of elevation through outlet towers from the reservoir, or to limit working pressures and velocities in pipe lines and secure a balancing of head by means of bypasses around the large valves, so that it was not a necessary practice to carry water through such valves with unbalanced head or in large quantities discharging into open air.

One of the most difficult problems encountered by the Reclamation Service in all its work has been the development of efficient and safe high-pressure gates with their operating mechanism. The entire problem was precipitated suddenly in the beginning when it was realized that relatively much greater quantities of water were required for irrigation, and must be regulated through larger outlets from deeper reservoirs, than had ever been attempted. Illustrating this point, it may be noted that the largest city water-supply conduit in the world, the new Catskill Aqueduct for New York City, with a daily capacity of 500,000,000 gal., a tube 17 ft. in diameter and nearly 100 miles long, has only about one-third the water-carrying capacity of one of the large Reclamation Service project main canals, such as the Boise Canal. In order to get the water out of deep reservoirs in the lavish quantity required for irrigation it devolved upon the Reclamation Service to devise large-capacity gates, which may be operated under 200-ft. heads, or practically four times the head commonly dealt with in the largest municipal storage reservoirs.

Sudbury and Wachusett Experiences

To enumerate a few of the typical difficulties in high-pressure gate practice we may begin with the Sudbury reservoir of the Boston water-works, where 3 x 5 ft. sluice gates were operated under 65-ft. head. I had the privilege of installing this battery of nine gates, and, knowing that the job was done in the very best manner, I was much concerned some years later to learn that there had been serious erosion, or disintegration, of the handsome cut-stone sluiceways below the gates, and dangerous pitting of the cast-iron gate frames, resulting from discharging even the moderate quantities of water required for little old Boston under this pressure, which 20 years ago was recognized as about the limit for that sort of installation. Recently this gate system has been entirely changed so as to utilize the energy of the discharged water in power development instead of permitting it to waste its force in the erosion of that excellent cut-stone and iron work.

About the same time, in the Croton reservoir outlets for New York City the engineers were encountering difficulties and serious wear and tear in the cast-iron gates of the new gatehouse for supplying both the old and the new Croton aqueducts.

A little later, in fact about a dozen years ago, the standard heavy form of cast-iron, bronze-fitted, pipe valves having been installed in the Wachusett Dam, which at that time was up to the minute in engineering

LOOKING DOWNSTREAM THE UPPER SET OF ARROWROCK GATE VALVES MAY BE SEEN
The last line of the valves was being installed when this view was taken

science, it was found that under variable head, up to 81-ft. maximum, there was damaging vibration in the 24-in. valves, either partially or fully opened, when discharging freely into larger open pipes below the dam. The chief engineer reported that "while this method of controlling the flow was in operation there was a constant jar and loud noise in the building and the effect upon the piping was rather serious. The lead was jarred out of several joints, brick and concrete piers supporting the pipes were cracked and shattered, nuts were jarred off of bolts with which the pipe flanges were bolted, and some of the bolts were broken." Examination disclosed pitting and wear of the pipes below the gates to a depth of ¾-in. into the solid cast iron. Replacement had to be made and regulation of discharge in this manner was necessarily abandoned, with substitution of operating the gates in series one above the other, with the head on each limited to 33 ft., at which pressure there has been no further difficulty.

High Dams of Reclamation Service

An instance showing the infeasibility of operating standard circular pipe gates under high head, with free discharge at a velocity of 120 ft. a second, was exhibited at the Shoshone Dam of the Reclamation Service, where 30-in. gates at the outlet end of 42-in. pipes through the dam were operated for a short period under the full reservoir head of about 230 ft. These pipe-line valves were of standard, double-disk, heavy, bronze-mounted, cast-iron construction, thoroughly well made according to city water-works specifications by an established manufacturer. It was planned to use them always either wide open or fully closed so as to avoid the severe vibrations when they were operated partly open, but it

was found that even in the process of opening these valves to full bore there was such strain on the parts as would put them out of commission, and it was necessary to abandon their use entirely.

At the Roosevelt Dam in Arizona the first attempt at control gates was in the form of specially designed and well-constructed Stoney type of roller-bearing sluice gates mounted after careful planning and attention to details of installation. But here again, under heads of less than full reservoir, there developed serious vibrations and damage to the outlet tunnels, which necessitated abandonment of this method of primary control. Circular hydraulic balanced valves were afterwards substituted.

Installations a little later were those of the Pathfinder and Shoshone Dams, where an extra heavy, special design of sliding rectangular sluice gate was put in to be operated under a maximum head of about 220 ft. These gates were provided with a heavy and efficient type of hydraulic cylinder operating device. The installation at Pathfinder was found to work successfully under full pressure, but the results on the tunnel lining below the gates were disastrous, owing to the tremendous vibration, which broke the fastenings and tore off the steel lining plates of the tunnel, and attacked the granite bedrock in the abutment of the dam through which the tunnel was driven. Attempts were made to reline the tunnel and reinforce the points of weakness, but the damage was repeated, and it was finally decided to install a different type of outlet control. Only minor damage was done to the Shoshone installation of identical construction, but here, too, changes were made in the methods of control.

ARROWROCK VALVES ARE OPERATED FROM GALLERY

One man, by manipulating hand wheels which control reservoir pressure in 4-inch pipes can, within 10 minutes, open or close one or all of the 58-inch hydraulically-operated valves shown in the preceding views

Experience with these Wyoming reservoir gates developed a feature of such work which had not previously been much understood or provided for in outlet regulation, and it was thereby realized that it was one problem to impound a lot of water in a deep prison and quite another and more difficult problem to let go of it safely when you wanted to. This special feature was the powerful suction effect of huge jets of water issuing from such gates and producing a partial vacuum surrounding the jets, which set up almost irresistible pulsations of air, alternating with overwhelming shocks of water, in any restricted passage below the gates. If the confinement of the water is complete on all sides of the conduit below the gate, then the result is a pitting, disintegrating or raveling of materials of the ajutage, whether of cast iron or stone, in a manner similar to that experienced in high-head turbine installations where the metal parts are eaten away at points subjected to vacuum effect. It is now believed that much of the pitting or honeycombing and wear and tear on gate castings, pipes, and granite walls, and such phenomena observed in the Eastern water-works dams, were induced by this suction or vacuum effect, rather than by the impact of water jets as was at first supposed.

Difficulties with the several standard types of gates gave rise to many suggestions and trials of new types. Among these was the hydraulically-balanced cylindrical gate or valve installed in the Lahontan Dam of the United States Reclamation Service. This operates under a maximum head of about 100 ft. A gate of almost identical design was adopted at about the same time for use in the Panama Canal locks, operating under 60-ft. head. With some modifications, the same type was adopted for the Sherburne Lake reservoir in Montana and the Lake Keechelus reservoir in Washington.

Essentially the design is a cast-iron cylinder ($8\frac{1}{2}$ ft. in diameter at Lahontan), open top and bottom, suspended by a stem from the top of the gatehouse and enclosed in a hood or dome which is supported on legs as high as the stroke of the cylinder valve and submerged in the bottom of the gate chamber. The water, admitted through guard gates and standing at reservoir level in the gate chamber, is retained therein, or its discharge regulated, by the cylinder, which in effect is a plug movable up and down within its hood, with small peripheral clearance, and seating on its circumference against the bell-mouthed opening forming the bottom of the chamber at the head of the outlet conduit. The pressure of the water acting diametrally on the periphery of the cylinder, or plug, is balanced and when the plug is raised the water escapes underneath it and falls into the bell-mouthed outlet after dissipating its jetting energy by the converging impact of its particles. With the cylinder plug hydraulically balanced in this manner there is no sliding friction on gate seats as in rectangular vertical gates, hence the only resistance encountered in opening and closing is the weight of the cylinder with its attachments independently of the head of water against it.

A simple type of high-pressure reservoir gate was designed for the Oakley Dam, Idaho, consisting merely of an open cylinder movable up and down in the gate chamber opposite inlet ports—almost like a circular slide valve in a steam engine. In this case, with the valve at any opening, the water jets into the chamber from all sides of the gate tower through these ports and then falls to a water cushion in the bottom of the chamber which discharges into the outlet conduit in the tunnel.

Quite a different type of balanced valve, known as the Ensign valve, was designed for the Reclamation

Service and, after trial in several of its dams, was perfected and installed in the Arrowrock Dam. This also is a cylindrical valve, placed horizontally, however, and moving into and out of a closed hood or case attached to the dam and submerged in the reservoir at the head of the outlet tubes 58 in. in diameter through the dam. The end of the movable cylinder protrudes into the outlet tube and terminates in a conical point to form a needle nozzle similar, on a large scale, to a standard needle valve in high-head impulse wheel control. In this case, the pressure of the water being balanced on all sides of the plug, there is no resistance to be overcome in the movement of the valve under pressure against a sliding seat. This valve, moreover, is ingeniously devised to operate by utilizing the reservoir hydrostatic pressure differential against the opposite ends of the plug.

In the common type of rectangular sliding gates under high pressure various compositions of bronze have been tried for relieving the tendency to scoring or abrasion of the surfaces of the gate seats. Modern practice has been reduced to using two compositions of bronze of different hardness for the two faces of the gate seats.

At the Sudbury Dam the old type of geared gate hoist, manually operated by crank or lever, was improved by the introduction of ball bearings, thereby reducing friction in revolving the nut on the main stem. This improvement has been generally adopted for geared gate hoists under any considerable pressure.

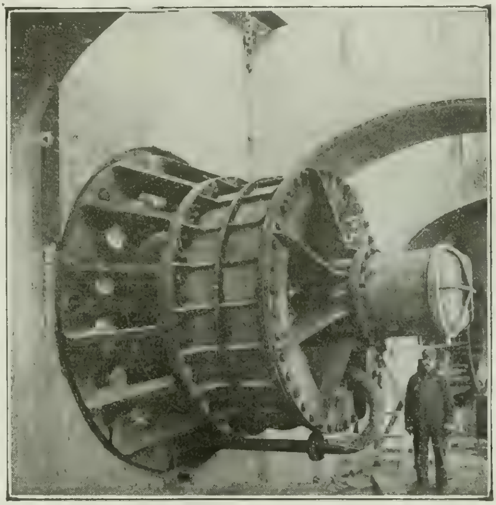
The Roosevelt Reservoir Stoney gate installation was one of the earlier plants to employ the oil pressure hydraulic cylinder for a jack, in lieu of gearing, to open and close the gates.

This device, built in a very rugged and perfect manner with bronze-lined cast-iron cylinders, brass piping, and electrically-operated pumps, was later worked out for the Pathfinder and the Shoshone high-pressure gates. The cylinders were made to operate up to 600 lb. per square inch with oil pumped by Gould triplex high-pressure pumps fitted with safety valves and automatic electric cutoff switches. The gate installation at Shoshone Dam was described and illustrated in *Engineering News* of Jan. 2, 1908, p. 8.

At the Lahontan Dam the set of 14 sliding and two balanced cylinder gates are operated by oil-pressure cylinders or jacks 16 in. in diameter and of a length equalling the stroke of the gate, varying from 2½ to 8 ft. The Deming triplex oil pump is belt-driven from an electric motor and works under pressure up to 400 lb. per square inch, controlled by pop valves, and under close observation by means of pressure gages both on the switchboard and on each cylinder. An overhead traveling crane in the gatehouse is available also for gate operation as well as for handling any heavy parts in the process of repair or replacement.

Air and vacuum effects, important phenomena which were not much taken account of in gate installations 15 or 20 years ago, have recently been dealt with in a way which promises to afford a means of relieving the vacuum disturbances due to cavitation in streams issuing around the obstructing valve supports.

Experience at the Roosevelt and Pathfinder Dams large streams issuing at very high velocities into a tunnel closed by the water below the gates so as to prevent entrance of air or admit it only in tremendous pulsations. In the Pathfinder case the disturbance was so violent as to shake the granite cliff abutment of the dam, produce thunderous noises, and its force was exhibited by the tearing out of heavy steel-plate tunnel lining and a general breakdown of parts around the gates. That the vacuum was responsible has been shown soon called attention to the powerful suction effects of



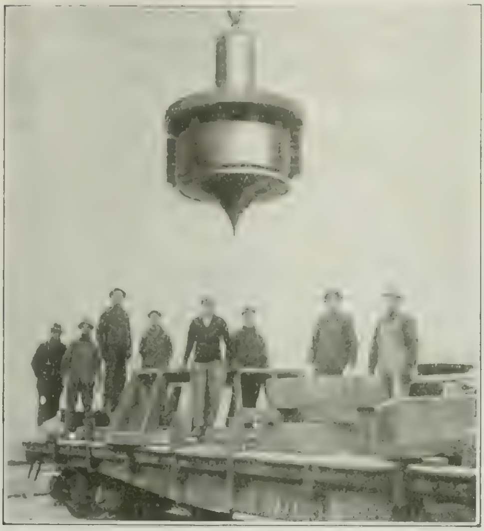
ONE OF THE LOWER SET OF 58-INCH VALVES IN THE ARROWROCK DAM

The piston is closed against the seat at the head of the 52-inch tube which extends through the dam

by the fact that these same gates may be operated singly or together so long as the tunnel below them is not sealed by the water, and, therefore, allows free entrance of air to the issuing jets.

At the Lahontan Dam the first definite and deliberate effort was made to provide air conduits leading from the atmosphere at the top of the gatehouse directly to the circumference of the outlet under the cylindrical valve where the issuing stream of water spouts into the outlet conduit. The importance of this air inlet was immediately shown when the gates were first operated and a powerful suction of air was induced down the 2 x 3-ft. air shaft. This air supply, while making considerable noise, yet serves to relieve the vibrations or pulsations of water which are encountered when this air flow is shut off and thereby compels indraft of air along the outlet conduit adversely to the flow of the water therein.

Likewise, at Lahontan, it was found that the partial vacuum induced within the hood of the balanced cylindrical valve must be overcome by admitting free air through a pipe into the dome of the hood. For this purpose a 12-in. spiral riveted standpipe, 100 ft. high, was placed, and when the gate is operating there is powerful suction of air through this pipe, which relieves the previously noted tendency for the valve to jerk or



A 58-INCH NEEDLE-PISTON FOR AN ARROWROCK VALVE

pulsate up and down according to the momentary intensity of the vacuum within the hood.

At the Arrowrock Dam, in the positive-control balanced valves which are operated at partly open stages, provision is made for inleting air around the needle nozzle, where the vacuum effect has in other installations produced pitting or corrosion of the metal parts. Experience seems to indicate that air admission to these critical points will cure the trouble.

At the Elephant Butte Reservoir air inlet passages were also provided, and the powerful suction in them was unhappily exhibited in 1917 when two men, one after the other, were drawn in against the opening and killed by the pressure; the probability being that one man passing along the inspection gallery first was pulled over against the opening and the other, in attempting to free him, completed the blocking of the passage, so that both were exposed to the full intensity of the draft. Their bodies could not be dislodged until the water gates were closed and the suction was stopped.

Power Plant Gates

A modern type of penstock valve is the Johnson valve, which is essentially a double-cone plunger, hydraulically balanced in an enlarged section of the penstock, or conduit, and is readily operated by a simple piping system utilizing the differential in conduit pressure above and below the plug. This valve has been successfully used under heads up to 164 ft. in the penstock. A description may be found in *Engineering Record*, June 13, 1914, p. 631.

Some of the recent immense power installations are developing extreme requirements in gates. For instance, a recent design for one of the Carolina plants includes a set of Stoney gates on roller-train bearings, operated by worm-gear electric drive. These gates are to be 16 x 18 ft. operated under a 102-ft. head, and the penstock is to be designed against a water hammer produced in stopping the flow of 5400 sec.-ft. in two seconds under 190-ft. head. These are prodigious figures to deal with, but apparently modern design, in the light of recent experience, will be able to solve these problems.

The extreme high-pressure hydraulic work encountered in the 1000- to 4000-ft.-head power plants employing impulse wheels is a unique class of practice, but in this the quantities of water are quite limited, and it becomes merely a question of making the moderate-sized pipes strong enough to withstand the pressure which is controlled by means of the well known and standardized needle valve. The problem of very large flow under high head, which is peculiarly the problem of irrigation reservoir practice, does not enter.

In all reservoir practice it is of prime importance to secure ample strength and extreme simplicity of gates and their operating devices. With important gates and parts entirely concealed, submerged and inaccessible, and with the vital necessity of being able at pleasure to empty or fill a reservoir or discharge any desired stream of water from it, it is of the utmost importance that the gate system should be adequate and as nearly fool-proof as possible.

Supplementing this fundamental requirement for strength and simplicity in deep-reservoir controlling apparatus, it must also be an accepted condition that the various mechanical devices, at their best, in deep reservoirs and large conduits under potentially destructive pressures, demand intelligent, careful and capable attention to keep them in working order.

Therefore, it is apparent that these important plants —for power, for irrigation, or for city water-supply— on which thousands of lives and millions in property are dependent, must be completely taken care by a class of skilled men trained for that purpose.

Precast Plates Form Shell of English Concrete Barge

In an experimental shipyard recently started in England with the coöperation of the Controller General of Merchant Shipbuilding, a new system of concrete barge construction is being utilized, in which the shell is formed of precast reinforced-concrete plates erected on the frames and tied together with interlocking reinforcement and poured concrete joints. When the plates are put in position, the extending bars in each plate are interwoven and locked around a pair of other bars in the intervening space. These bars form part of the reinforcement of a transverse frame extending along the bottom, up the sides and under the decks of the vessel. After the bottom and the side plates have been laid and secured in position, the reinforcement of the frame is assembled, and the main longitudinal reinforcement, consisting of 2-in. diameter bars, is fixed in place. When the reinforcement for the bulkheads and the center keelson has been similarly assembled and secured, everything is ready for the final operation of concreting, which is a comparatively simple matter, owing to the large proportion of precast work. The experimental ship which is being built is a 1000-ton tow barge.

Some Heavy Fitting-Out Cranes—I. Fixed Cranes at Kearny and Hog Island Yards

One Hundred-Ton Trolley Bridge Spanning Slipway Supplemented by Portal Cranes—Platform Derrick of Unusual Capacity and Reach Uses Single-Motor Hoisting Engine of Hell Gate Arch-Erection Plant

[Passed by Publication Approval Committee, Emergency Fleet Corporation]

HEAVY lifts at large reaches formed the main requirement for the cranes serving the fitting-out berths of the large shipyards carrying out the emergency shipbuilding program. After a hull is launched the interior fittings must be put in place, while the uncompleted ship is lying at a wharf-side or pier in the shipyard. Boilers and engines or steam turbines represent very heavy single weights, ranging as high as 60 or 80 tons maximum lift. In special cases other heavy weights must be provided for, which is the reason that led some of the yards to count on a maximum lift of 100 tons. To pick up such a load from the wharf or from a barge and lower it through a hatch on the center line of the ship requires a long reach. In some of the yards an extraordinary length of reach was specified so that the heavy members could be lifted from a barge lying on the far side of the ship, or so that two ships could lie abreast alongside the fitting-out wharf and equipment could be placed in either. The diverse solutions of this problem found at the various shipyards present features of most ingenious engineering in choice of type and detailing of the machines.

For the lighter service, locomotive cranes (preferably seated on gantry towers) are generally depended upon, as typically illustrated by the Hog Island fitting-out basin. The gantry substructure of these cranes brings the boom near to its working level, the deck of the ship. While a large number of light parts must be placed, only three or four heavy lifts are required for each ship. Therefore, the light cranes are arranged to move along the entire length of the fitting-out berth so as to reach any part of a ship's length and have access to all the ships lying along the wharf at a given time. For the heavy lifts, however, a single machine suffices, and some of the yards use a fixed crane, to which the ship is moved when the few parts in question are to be placed.

Radically different types of heavy-lift crane are found at the Kearny yard of the Federal Shipbuilding Co., the Hog Island yard of the American International Shipbuilding Corporation, the Bristol yard of the Merchant Shipbuilding Corporation, and the Newark Bay yard of the Submarine Boat Corporation. Data concerning them were made available through the courtesy of the officials of the yards, the manufacturers and the Emergency Fleet Corporation.

Crane Bridge Spans Ship at Hog Island

At the American International Shipbuilding Corporation's yard at Hog Island, Penn., the fitting-out berths in the wet basin are served by locomotive portal cranes, ordinary locomotive cranes, and a heavy crane bridge spanning the ship to deal with the few heavy lifts. The berths are connected with a number of railroad tracks and have a motor-truck driveway on each pier of the group constituting the berthing space. Like the hull-constructing part of the shipyard, the fitting-out basin is laid out for high capacity at all points, with a view to permitting intense concentration of work.

In a general way, the arrangement of the fitting-out basin may be understood from the sketch in Fig. 1, a plan of part of the basin. Seven piers, each 1000 ft. long by 100 ft. wide, spaced 266 ft. in the clear, and the adjoining wharf afford sufficient space for laying up 30 of the largest ships to be built at the yard. Back of the piers the wharfage space behind the bulkhead wall carries a belt of railroad-supply tracks connected by spurs with a series of warehouses. Turnouts from the main lead of these wharf tracks connect with tracks running down the individual piers.

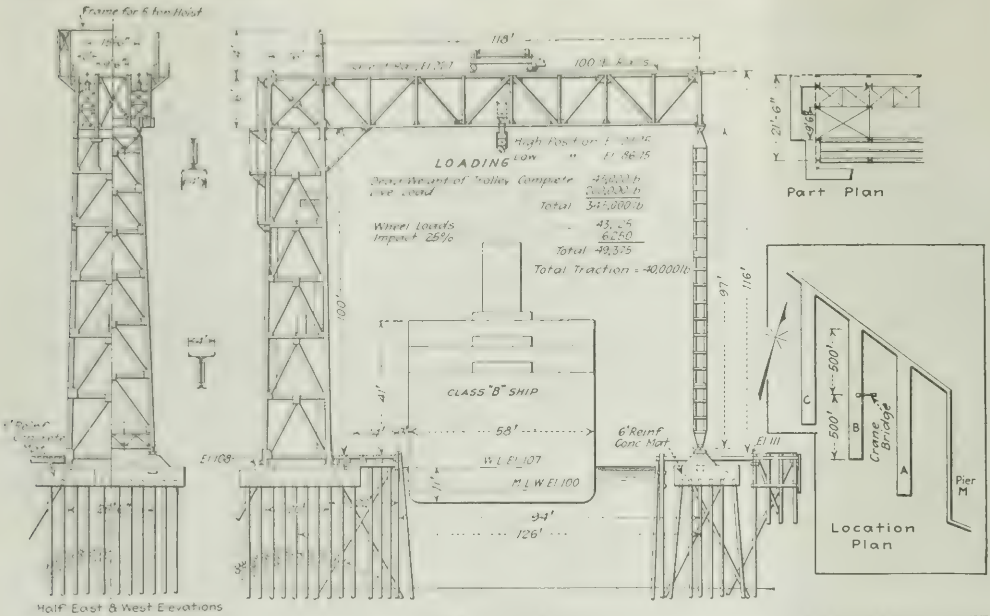
Fitting-Out Piers Carry Tracks and Motor Roadway

Each pier carries four standard-gage tracks, two on each side. In the middle is a plank roadway for motor-truck traffic. Much of the lighter equipment and supply handling from warehouse to ship is being done over this road. The outer track on each side of the pier is laid between the rails of a gantry track 16 ft. wide. Locomotive portal cranes run on the wide-gage tracks, cars passing under them. Numerous locomotive cranes, which also pass under the gantries, have been provided to do the light work. Two types of portal crane are used, light and heavy (Fig. 3). Each of six piers will be equipped with four of the lighter gantries, machines 33 ft. high with 55-ft. boom and capable of handling 5 tons at 50-ft. radius. One pier will have four heavy gantries, 43 ft. high to the turntable, with boom of 70-ft. maximum reach, and capable of handling four tons at 70-ft. radius. These machines, designed and built by the Myler-Interstate Co., Bedford, Ohio, are rated at 25 tons and 35 tons, respectively.

Pier B, which has the heavy gantry cranes, is to be used for all the heavy fitting-out work. At mid-length of this pier a crane bridge is erected, spanning between a support on the pier and an outboard pedestal built on a pile cluster in the water. This bridge supports a 100-ton trolley, capable of lifting from the bottom of the hold of a loaded ship, about 13 ft. below mean tide level, to about 104 ft. above high tide.

The choice of this crane bridge as the heavy-lift machine of the fitting-out work was determined, after a number of crane types were considered, by cost and quick availability, in combination. Early inquiries by the corporation showed that crane machinery of large capacity would be scarce and slow in delivery; but a 100-ton trolley was found available at the Alliance, Ohio, works of the Morgan Engineering Co. The further design of the crane was developed accordingly.

As built, the bridge represents the resultant of six or eight different designs, all involving the arrangement of a trolley track extending out from a support on the pier to an outboard support. The design adopted,



PLAN OF PART OF WET BASIN

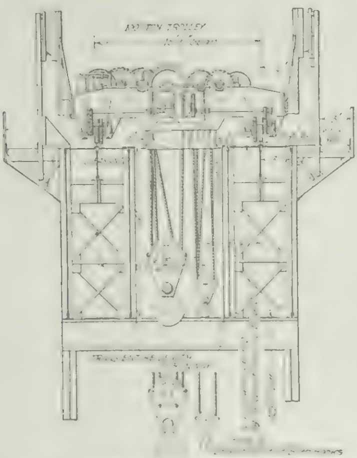


FIG. 1. CRANE BRIDGE AT HOG ISLAND CARRIES 100-TON TROLLEY

shown in Fig. 1, is that which at lowest cost gave the desired structural flexibility to permit automatic adjustment of the bridge to slight settlement.

Soft bottom throughout the fitting-out basin made pile foundations necessary. It was found that piles 55 to 60 ft. long brought up hard and could be counted on for 15 tons working load. For adequate stiffness of the concentrated cluster piles of the main tower foundation and the pedestal foundation, riprap deposit was used to brace these, in addition to a number of batter piles. The loading was held down to nine tons, in spite of a capacity of 15 to 20 tons per pile. These precautions were taken with special regard to the security of support of the crane bridge structure. The pier piles were also designed for a working load of nine tons but were not stiffened with riprap.

Spanning 116 ft. between column centers, the crane bridge commands a clear water width between the faces of pedestal fenders of about 80 ft., and gives a vertical clearance of 100 ft. above the pier tracks, or 111 ft. above mean tide level. The largest ship being built at Hog Island under present contracts is an 8800-ton vessel 58 ft. wide, but the crane is capable of serving a vessel 76 ft. wide, so that it would be possible to outfit or load large transport vessels.

Material will be brought to the crane on the outer pier track, which passes the main tower and thus is under the bridge. The supporting framing under this track is part of the pier structure, and with its pile support is independent of the tower foundation.

Completely rigid construction was not thought advisable, partly in view of temperature expansion of the bridge and partly in view of the possibility of differential settlement of tower and pedestal foundations. For this reason the outboard support was made a rocker bent The main support is a four-post tower to which the bridge is rigidly braced.

Both foundations have reinforced-concrete mats carried on the piling. Under the main tower the mat is 5 ft. thick and is arranged in the form of a hollow square; low footing piers rise above the level of the mat. The water leg has a similar mat 6 ft. thick, carrying footing piers 3½ ft. high spaced 25½ ft. apart.

The structural arrangement as well as the bracing are clearly shown by Fig. 5. Concerning the proportions of the plant, it may be noted that the maximum load on the two inner columns of the main tower is

540,000 lb., and that on the two rear columns 253,000. Each of the two rocker posts carries a maximum load of 406,500 lb., or a maximum uplift of 126,000.

The trolley in Fig. 1 has a wheel gage of 15½ ft. Both main and auxiliary drums are longitudinal. The machine is driven by alternating-current electric motors (although the gantries and locomotive cranes are steam-operated).

The stresses in the structure were computed on different assumptions for tower and bridge. The bridge was proportioned as if the truss were simply supported at both ends, and the loading on the outboard leg was determined on the basis of this same assumption. The tower, however, was designed on the assumption of rigid connection between truss and tower. A 30-lb. wind load was taken into account.

A hoisting speed of about 8 to 10 ft. per second is obtained with the main hoist of the trolley, under full load. The auxiliary hoist gives a lifting speed of about 30 ft. per second. In both hoists the two ends of the rope wind on the drum simultaneously, the middle of the rope being becketed over a small sheave to equalize.

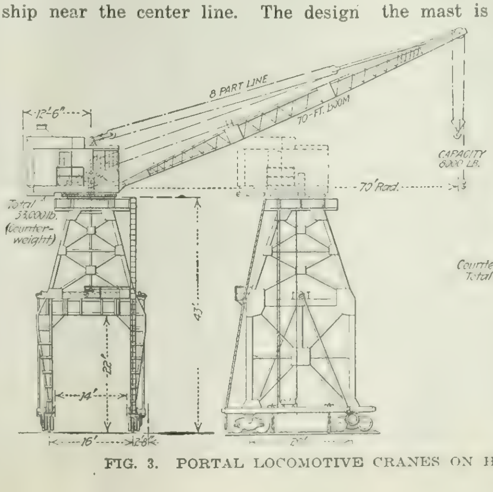
H. M. Boyajohn, structural engineer of the plant department of the American International Shipbuilding Corporation, under whose supervision the design of this bridge was developed, gives its steel weight as about 300 tons and the cost of the crane, including foundations, bridge and trolley, as about $150,000.

Huge Derrick on Steel Platform Serves Federal Fitting-Out Basin

Simplicity in adapting the available resources in materials and machinery to the lift and reach requirements dictated the solution adopted by the Federal Shipbuilding Co. At this yard vessels are fitted out while lying alongside a timber wharf or dock. A lifting capacity of 100 tons was desired. To span the full deck width of the largest ship likely to be berthed at the wharf required a reach of 55 to 60 ft. outboard of the bulkhead line; to reach across the ship and lift from a barge beyond, 80 to 100 ft. A large reach was also desirable in order to cover a considerable length of the ship near the center line. The design problem was worked out on the basis of these requirements by O. E. Hovey, assistant chief engineer of the American Bridge Company. As in the case of the ship-erection derricks of the Federal yard, derrick equipment and hoisting engines proved the most quickly obtainable of all the lifting devices which were considered. Derrick rigging and machinery that had been tried out thoroughly in the erection of the Hell Gate arch bridge was available, suiting the required service with but little change. The possibility of controlling a long-reach boom with maximum load was known from that work, though the slewing was there done by side falls (a 180° swing sufficed) while for the large arc of slewing required at the fitting-out basin a bullwheel had to be resorted to. In view of the importance of getting the crane built and into service quickly, it was decided to take over the hoist, blocks and other equipment of the Hell Gate derrick, and with minor changes in these parts to build the rest of the crane to suit.

Under these conditions, the structure was designed as a boom derrick with pillar-crane mast, having a reach of 92 ft. 10 in. from mast center or 10 ft. less from face to dock wall, and a lifting capacity of 100 tons with boom horizontal, the whole mounted on a platform about 42 ft. above ground spanning the supply tracks. The platform has a triangular ground plan, with the forward point, where the mast is set, 10 ft. inshore of the bulkhead, and the sides of the triangle extending back at angles of 45° to the bulkhead line. The three legs of this platform are supported on large pile foundations (about 80 piles at the front leg and 50 at each of the rear legs) surmounted by concrete pedestals, which in the case of the rear foundations serve also as counterweights, being engaged by long anchor bolts.

In working out the details of the structure practice in building steel-erection equipment was followed closely, but for permanence of service lower stresses were used and bearings and oiling arrangements were developed more elaborately. The working stress in the steel was fixed at 16,000 lb. per square inch (reduced by the A.R.E.A. formula for compression); under maximum load conditions a 30-lb. wind was assumed, while a 50-lb. wind was figured for the unloaded structure. Both boom and mast were proportioned for combined compression and flexure, the extreme-fiber stress governing. Both are made of two ribs latticed; the mast is parallel-sided while the boom is tapered at both ends in the vertical plane and at the outer end in the horizontal plane. The pillar-crane arrangement of the mast was resorted to because of its



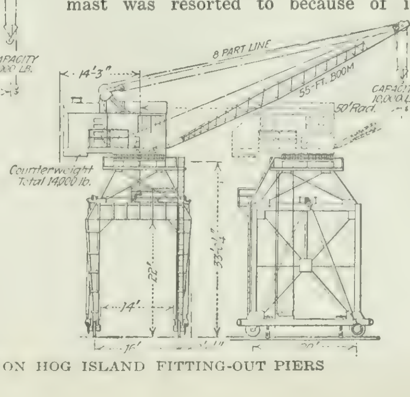


FIG. 3. PORTAL LOCOMOTIVE CRANES ON HOG ISLAND FITTING-OUT PIERS

advantage in making the upper bearing a pure ring bearing, and therefore simplifying oiling as well as allowing easy renewal of both bearings. It required a very special structural detail at the top to transfer stress centrally from the upper collar bearing of the mast to the stiffleg. A thick horizontal gusset plate surrounding the upper half of the upper bearing at mid-height engages two short

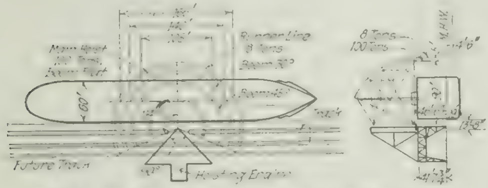


FIG. 4. REACH DIAGRAM OF ONE HUNDRED-TON FITTING-OUT DERRICK

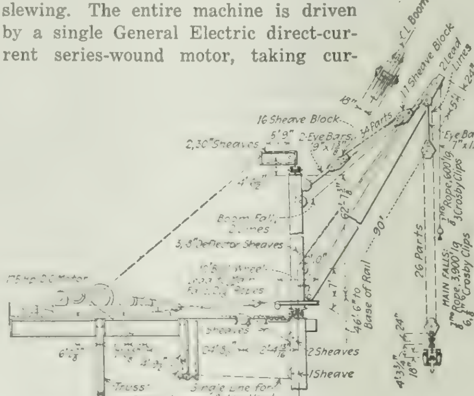
riveted horizontal struts of such width as to fit between the pairs of gusset plates at the upper points of the two stiffleg triangles.

The lower half of the step bearing at the foot of the mast contains a bronze step ring and a bronze cylindrical liner, taking weight and thrust. The horizontal thrust is taken from the bearing to the top chords of the platform trusses by two struts pin-connected to the bearing and the truss chords. The bottom of the bearing casting, turned to the shape of a spherical segment, is seated in a spherical socket in a pedestal casting attached to the main column of the derrick platform. Rotation of the bearing casting in the spherical pedestal socket is prevented by overlapping lugs on the two castings. The spherical bearing was provided because calculations of the mast bending showed that the angular deflection might amount to as much as 17′, sufficient to make a rigid bearing bind or seize. The spherical seat, machined on both faces, is oiled by three radial grooves connected by a ring groove.

The upper bearing of the mast is a simple collar bearing lined with bronze, the two castings, however, being so shaped as to form an oil reservoir surrounding a central hole through which passes the topping-lift rope.

In the Hell Gate bridge erection, derricks with a 26-part load hoist and a 40-part boom hoist were used, the boom hoist being arranged with two ropes, of which the four ends were taken on two drums each divided by a middle flange. The present derrick has the same load rigging, namely, 26 parts, but the boom hoist has 34 parts, made of a single rope whose two ends go to the same drum. A partition at mid-length of the drum keeps the two sets of windings apart. The load hoist also has its two ends led to the opposite ends of a single drum.

The hoisting engine, a four-drum Lambert machine, is the same as that of the Hell Gate derrick. Of the four drums, that in the rear takes the single line of the auxiliary hoist (eight tons). The second drum from the rear, which handles the topping lift, has been jacketed to larger diameter for increased hoisting speed and fitted with a central flange to separate the two windings. The third drum, also slightly modified by jacketing and by adding a central flange, takes the main hoisting rope. The front drum has been removed, and outside short drums attached, with independent clutches and brakes, for swinging the derrick. With this arrangement, in swinging the derrick it is always possible to keep the swinging rope tight by holding the paying-out drum on the brake while slewing. The entire machine is driven by a single General Electric direct-current series-wound motor, taking cur-



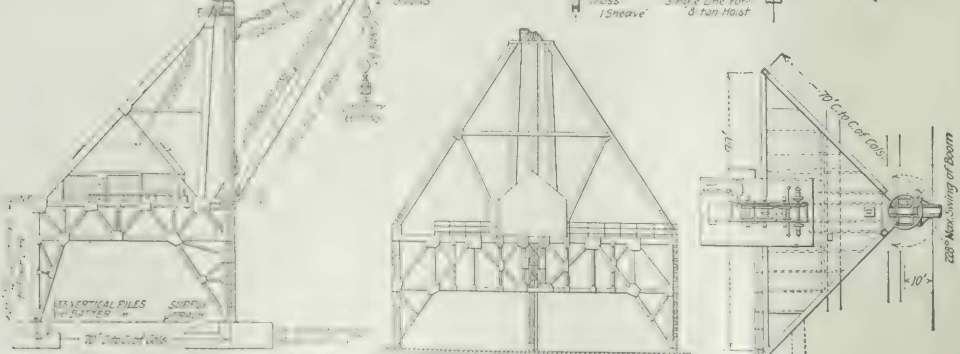
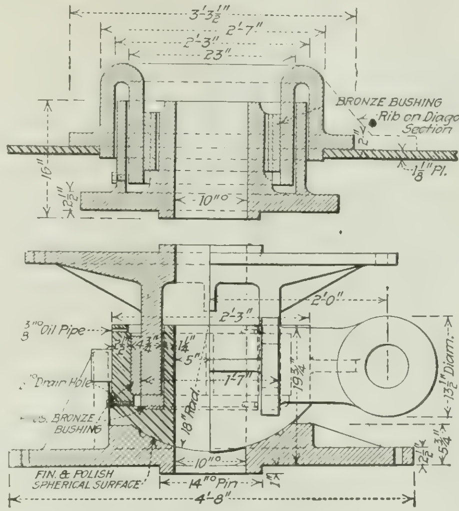


FIG. 5. FEDERAL FITTING-[illegible] ON FIXED PLATFORM SPANNING SUPPLY TRACK

rent at 230 volts; it is rated at 230 hp. and 425 r.p.m. Automatic-acceleration control is provided.

The auxiliary hoist, at the end of the boom, 5 ft. beyond the center line of sheave of the main hoist, can be operated as a single line, but to give better control of the lowering a lower block, giving three parts, is used.

The entire machine is designed for ⅞-in. rope, the same size of rope as was used in the Hell Gate erection work. The main hoist has a one-piece upper block, but a five-part lower block. The latter has five separate hangers, pin-connected to an equalizing girder. A rocker girder pin-connected to eyebars depending from this equalizing girder supports by pins a saddle strap in which is mounted a roller-bearing turntable from which the hook is hung. A four-prong hook is used. The main hoist-block sheaves and all other full-speed sheaves are 30 in. in diameter. The main blocks of the boom hoist are 20 in. and 16 in. in diameter in the groove. The operating speeds of the principal motion are approximately 12½ ft. per minute hoisting speed at maximum load, and 8 ft. per minute inhaul for the topping lift under most adverse conditions.



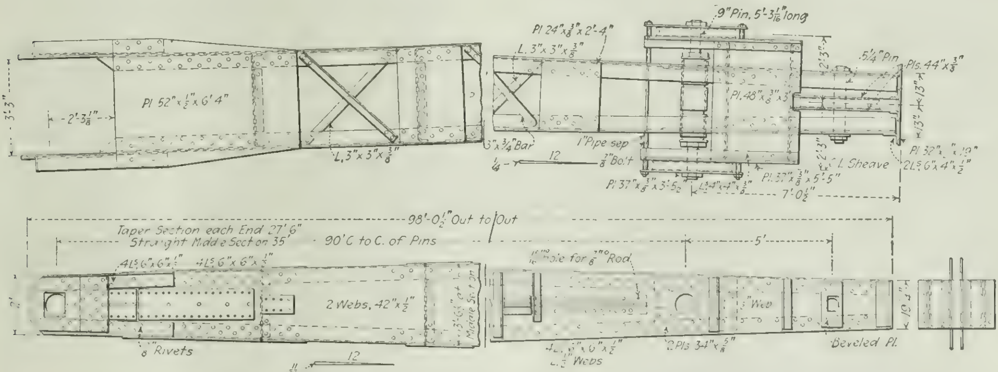


FIG. 6. SPECIAL MAST BEARINGS AND BOOM DETAILS OF LARGE DERRICK

As the designer wished to secure a high degree of rigidity in the supporting structure of the derrick, the platform was braced with unusual thoroughness, as may be gathered from one of the views of this derrick, though a large part of the bracing does not appear in the drawing.

A duplicate of the Federal crane has just been built for the Chickasaw Shipbuilding Co., Mobile, Ala.

Welfare Work for Employees in the Shipyards at Seattle

Living quarters at reasonable rates for women employees, apartments for employees' families, and a $1000 life insurance policy, gratis, for every employee, are some of the features of welfare work recently undertaken by the Skinner & Eddy Co. of Seattle. The apartment houses are being built near the yard at a cost of about $300,000, and will be rented for $25 or $30 per months for 3- and 4-room apartments. The six units involved are arranged in a hollow square, the interior of which will serve as a park and playground. Each of the six units is named after a vessel launched at the shipyard. Accommodations are provided for 180 families, and if this is not enough four more units can be added conveniently. To accommodate the women employees, the company obtained five-year leases on three structures in the high-class Capitol Hill residence district. In these buildings living accommodations are provided at cost. Meals are obtained elsewhere. Space for 300 persons is included in the three structures, some part of which space is still occupied by the previous tenants. The company now has only about 240 women employees, but this number is being rapidly increased, as it is planned to replace men with women wherever the latter are found to do the work as well as the former.

Costs of Hetch Hetchy Railroad

SIXTY-EIGHT miles of railroad connecting the Hetch Hetchy dam site with the Sierra Railway have been completed to the extent that material has for some time been delivered over the line. The construction was not unusual, considering the rough, mountainous region traversed, but opposition on the part of mining companies became an important factor in the progress and cost of the work. As the road is built for freight traffic only, sharp curvature was used to avoid heavy cuts wherever possible; curves from 18 to 26 deg. are numerous, the maximum being 30 deg. Most of the climb for ingoing freight will be on 3 to 4% grades. For nine miles between Hog ranch and the dam site the roadbed width is 22 ft. at subgrade. The remainder of the line has a 16-ft. roadbed with slopes on embankment of 1½ to 1.

Of the million cubic yards of excavation necessary, about one-quarter was in rock. In the surveys the material was classified as granite, solid rock, soft rock and earth. Alternate bids were invited for this classification and for a flat rate of 68c. per cubic yard, regardless of classification. The latter was chosen by the successful bidder.

Several owners of mining claims along the line who objected to the construction made resort to condemnation proceedings necessary. A price of $100,000 was demanded by the owners of one claim, despite demonstration by the city geologist that the claim was of little value. After long court procedure, the city finally obtained the claim by condemnation, the court allowing the owners $160 as the fair value.

In other cases, where opposition was on the ground of depreciating the value of mining prospects by dumping excavated material, the city was unable to settle the matter so satisfactorily. In the Tuolumne Cañon, for example, the line passes just above a series of placer claims on which excavated material was certain to fall. In the confines of the narrow cañon no alternative disposal of material was apparent, until the city hit on the plan of building up dry rubble masonry retaining walls above the mining claims. This plan worked well. In this cañon on one claim alone there was built up 1500 ft. of wall averaging 15 ft. high. Rubble masonry retaining walls on other sections of the line range in height up to 30 feet.

Including the steel bridge of 220-ft. span with three 40-ft. plate-girder approaches, and about half a million feet of lumber in trestles across small streams, the total cost of the completed line, including ballasted track, was about $2,000 000, or an average of $29,400 per mile.

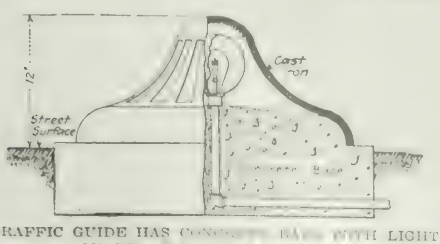
The railroad was built by the City of San Francisco as a part of its new water-supply system, under the direction of M. M. O'Shaughnessy, city engineer.

Propose Less Dangerous Traffic Guide

A TRAFFIC guide which is said to be less dangerous than those in ordinary use is recommended by the Director of the Bureau of Mines, Department of the Interior. It is designed to replace the common 6- to 8-ft. iron post with electric light which is used to mark the center of intersections and to divide the right and left traffic.

High traffic posts at intersections are a source of danger from collision, and many accidents have occurred from this cause. The light at the top is too high for the ordinary line of vision of the driver who is watching the surface of the street, and when a collision occurs the rigidity of the post causes great damage to the vehicle.

Many advantages are claimed for the device shown in the illustration. Chief among them is the fact that, extending only 12 in. above the surface of the pavement, it is large enough to be visible in the daytime and when lighted in the night, without endangering the lives of passengers in a vehicle which by accident passes over it. At the same time its 12-in. height is enough to hit the axles of ordinary motor vehicles and keeps them from running the risk. The cast-iron top is so arranged that under violent collision it will be forced from its base. A suitable color makes it readily visible in the daytime, while the electric light inclosed in the slotted cast-iron top affords visibility at night.



TRAFFIC GUIDE HAS CONC[illegible] WITH LIGHT GUARD OF SL[illegible]

Several different shapes of top were experimented with to determine the effect of wheel impact, and the general shape shown in the illustration was found to give the best results. Otto H. Mohr, of the Bureau of Mines, is the originator, and upon application will give further information and blueprints.

Jerusalem Has New Water-Supply

Following closely upon the occupation of Jerusalem by the British, investigations for a new water-supply were begun by the Royal Engineers. Four days later a scheme was outlined. This was on Feb. 14, but shortage of transportation facilities and bad weather put off the beginning of construction until about the second week in April. On June 18 water was being delivered. The supply is pumped from springs to the city. According to a short note in the London *Surveyor*, of Aug. 16, many miles of pipe have been laid, and the supply is being delivered directly to hospitals, to "standpipes in every quarter of the city" and also to cisterns, the latter on condition that the cisterns be cleaned out to the satisfaction of the water authorities before they are filled. The daily yield of the springs is about 400,000 U. S. gal. The water consumption of the city is said to be about ten times what it was formerly. The *Surveyor* reports that the "beneficial effects upon the health of the city has been instant and widespread."

New Factory Designed to Increase Production Efficiency

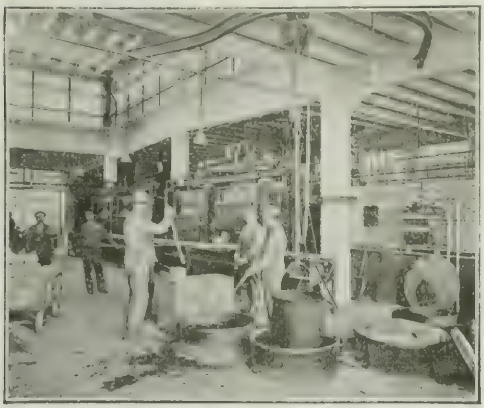
Permits Effective Utilization of Working Space And Contributes to Better Working Conditions of Employees

CONSIDERATION of the best possible working conditions for employees, and a layout of buildings and equipment which would facilitate production operations, were the primary objects in view in the design of the new factory of the Diamond Chain & Manufacturing Co., in Indianapolis, Ind. The plant, which comprises two adjacent buildings, was built on a new site, and when completed was taken over as a whole, the old factory being abandoned. It consists of a four-story building 60 ft. wide and 460 ft. long, and a one-story building 80 ft. wide and 300 ft. long, the two being separated by a courtyard 20 ft. wide and connected by two passageways at the street level. Both structures are of reinforced concrete. Preliminary to the making of the design, it was decided that the following ideas and policies would have to govern in laying out the new plant: Production must have logical sequence. The buildings must be so built as to be easily extended or added to. They must be of standard design or construction, so that they could be converted into other types of manufacturing than that for which the company intended to use them. The construction must be economical both as to the structure itself and to the use of ground. The whole plant must have a good appearance. Careful attention must be given to daylight lighting and to the elimination of disagreeable conditions of heat, odors, etc., which might be expected from the type of manufacturing to be carried on.

As a result of these, the main manufacturing building was designed as a four-story building with flat-slab floors, 60 x 460 ft. in clear area, and with all service necessities in projecting wings or towers, so that the manufacturing operations on each floor could have the advantage of the clear space of the main-floor area. Two of the accompanying views show how this space is utilized effectively. Flat-slab construction was adopted not only because of the structural advantages, but because of the greater cleanliness of ceilings and less obstruction to light. It was considered that the psychological effect of a clear ceiling on the work people would be advantageous. The width of 60 ft. was selected because it was the maximum width in which practically even lighting could be secured clear across all the floors from the side windows—which, incidentally, occupy practically all of the inter-column space of the wall. The tower and wing additions contain the toilets, drinking fountains, stairways, wash rooms, and, on one floor, the kitchen. Transportation inside the building was made a special point in the planning. All the heavy moving is taken care of by the truck system shown in one of the views, in which a small electric motor truck of

UPPER—IN DIAMOND CHAIN AND MANUFACTURING COMPANY'S NEW PLANT—NARROW BUILDING WITH PROFUSION OF WINDOWS PERMITS WORKING UNDER BEST POSSIBLE CONDITIONS. LOWER—OVERHEAD BEAMS CARRY MOVING CHAIN HOIST FOR MATERIAL DISTRIBUTION TO SPECIAL METAL TABLES LINING AISLES

the baggage-moving variety is slid under a platform truck provided with two forward wheels and two rear standards. To carry these motors, practically all the floors are of No. 1 factory maple, laid upon creosoted sleepers embedded in concrete placed upon the concrete floor-slabs. In some parts of the building I-beams are



FURNACE ROOM IN CHAIN MANUFACTURING PLANT IS CLEAN AND WELL LIGHTED

hung by special clips to wood stringers fastened to inserts in the ceiling, and are used as tracks carrying a traveling chain hoist. One view shows such I-beams carrying a dumping can along an aisle lined with tables which take the parts emptied from the can. Another view shows a similar installation of the overhead I-beam carrier in the furnace room of the one-story building described later.

All the ceilings in the building had inserts placed at approximately 3-ft centers. Every bay has a uniform spacing of these, so that shafting can be shifted from

FREIGHT AND EQUIPMENT ARE MOVED BY SMALL TRUCK WHICH RUNS UNDER A MOVABLE PLATFORM, THE TWO FORMING A MOTOR [illegible]

one bay to any other and meet the same conditions. Longitudinal wood beams are bolted to the inserts, and cross-beams carrying shaft hangers are then bolted to the longitudinal beams. This plan gives practically the same ready control of shaft positions as is offered in a wooden building.

The one-story building is used for the furnace and the heat-treating operations. On this account it was made only one story, so as to reduce the ventilating difficulties. The building consists of three transverse bays with two rows of interior columns and longitudinal stringers with transverse cross-beams, carrying a monitor roof along its entire length. The lighting here is remarkably effective, as the view of the furnace room herewith will show. The contrast between this orderly, well lighted shop and the old-time dirty and dark furnace room is remarkable. In this section, where extra-heavy trucking is required and where the heat of the forgings comes very near the floor, a brick floor was used instead of the wood floor used in the main building.

In order to assist the illumination due to the wide and frequent windows, and to help also the artificial illumination that is effected by the use of frequent ceiling incandescent bulbs, the inside of both buildings is painted white.

The views show, too, the cleanliness and order of the working floors in the main building as well as in the one-story shop. Special metal working tables are provided for most of the sorting operations. The welfare of the work people, in addition to the provisions for better working conditions, is taken care of by a hospital and a restaurant in the building.

Feed Canal Over Divide Saves Irrigators

But for the timely construction of the feed canal from an adjoining watershed the Orland Irrigation Project of the United States Reclamation Service in California would have been affected disastrously this year. As noted in *Engineering News-Record* of June 20, p. 1186, the feed canal has 200 sec.-ft. capacity and was constructed for just such emergencies. As it is, the supply was short, and irrigators have had to be restricted to $1\frac{1}{2}$ acre-ft. per acre. East Park reservoir holds 51,000 acre-ft.; the hold-over from last season was 2500 acre-ft., and the run-off from the watershed above the reservoir was 16,000 acre-ft. Without the 24,400-acre-ft. diversion by the feed canal the storage would have been depleted by July 15. On some indifferently leveled land, on gravelly soils and on areas where water was applied carelessly, only two crops of alfalfa have been cut.

In general, throughout the project three crops were realized, and on many ranches four. All orchards have had more than sufficient water as well as other crops on reasonably well-prepared ground, properly irrigated and cultivated.

The water users of the project took the prorating to $1\frac{1}{2}$ acre-ft. per acre in good spirit. At a recent meeting a proposed appeal on this account to the Government for a suspension of this year's construction costs was voted down by a large majority.

New York Central Relocates Lines to Cross Barge Canal at the Tonawandas

Detour Two Miles Long Around Hearts of Cities at Once Combines Two Bridges Over Waterway and Solves Difficult Problem of Eliminating Grade Crossings and Occupation of Main Business Streets

By B. S. Voorhees
Engineer of Grade Crossings, New York Central Railroad

A NEW line about 10,300 ft. long is being constructed by the New York Central R.R., as a new location for its combined Niagara and Tonawanda branches, at the cities of Tonawanda and North Tonawanda, N. Y., in order to cross the westerly terminus of the New York State Barge Canal by one bridge instead of two and accomplish at the same time the elimination of 13 dangerous grade crossings and the lengthwise occupation of the cities' principal business streets. The improvement involves the building of a double-track elevated roadbed on earth embankment, the construction of a bascule lift bridge over the Barge Canal and 11 bridges over streets, and the relocation of the Tonawanda and North Tonawanda stations and facilities.

The New York State Barge Canal finds its western terminus about 10 miles north of Buffalo, at the point where Tonawanda Creek flows into the Niagara River. On the northern and southern banks of Tonawanda Creek at this junction are situated the twin cities of Tonawanda and North Tonawanda. The old Erie Canal is located along the southern bank of Tonawanda Creek, as it approaches this locality from the east, until it reaches a point near Main St., Tonawanda, where it leaves the river and passes in a southwestern direction within its own banks. The Tonawandas constitute the third largest industrial center in the State of New York.

Railroads at the Tonawandas

These railroads serve the Tonawandas:

The Niagara branch of the New York Central, which connects Buffalo and Niagara Falls, enters the city of Tonawanda from the south on two main tracks, and runs lengthwise in Main St. to Young St., intersecting seven cross streets at grade in Tonawanda; thence by a single track and on a fixed bridge it passes over the Erie Canal and Tonawanda Creek and enters Webster St., intersects four cross streets in North Tonawanda at grade, and extends to a Y junction at the termini of the New York Central's single-track line from Lockport and its line from Batavia known as the Tonawanda branch. This branch enters the city of Tonawanda from the east on its own right-of-way, and consists of two main tracks to a point about 700 ft. southeast of Tonawanda Creek, where it crosses at grade two parallel tracks, one of the International Ry., the other of the Erie R.R., and thence continues northerly on a single track on a fixed steel bridge over Tonawanda Creek and two adjoining streets. In the 1600 ft. from this crossing to the Y junction are two street grade crossings.

The Erie R.R. and the International Ry. run from south to north through the Tonawandas, and cross Tonawanda Creek on a common fixed bridge about 400 ft. east of the New York Central's Tonawanda-branch crossing.

In addition to the regular New York Central traffic, Michigan Central trains run over the Niagara branch and Lehigh Valley trains run over the Tonawanda branch. At the railroad junction point in North Tonawanda, and for about 2000 ft. north, are situated railroad yards which provide interchange facilities between the various railroads and lead to the various industries, chief of which are large lumber mills west of the railroads along the Niagara River front and on Tonawanda Island.

Immediately west of the Niagara-branch crossing of Tonawanda Creek is the vehicular and pedestrian bridge connecting Main St., Tonawanda, and Webster St., North Tonawanda, which are the principal business streets of these cities.

Reasons for Change of Alignment

These Niagara frontier cities have aspired to a large industrial and commercial development in conjunction with the Barge Canal improvement, and by their combined efforts succeeded in obtaining from the Federal Government a 23-ft. depth of channel from Lake Erie to the Tonawandas to accommodate the largest vessels of the Great Lakes. They also obtained recognition by the Barge Canal Terminal Commission of the adaptability of Tonawanda Creek as a harbor for the docking of lake vessels, and consequently the continuation of the deep channel into the canalized creek—a project which necessitated lift bridges to replace the existing fixed bridges, as well as the planning of proper docking and terminal areas along the shores of the creek.

To meet the requirements of Barge Canal navigation only, it would have been necessary to rebuild both the Niagara-branch and Tonawanda-branch railroad bridges, as well as the Main-Webster St. bridge, which bridges interfered with the canalization of the creek by reason of their restricted vertical and horizontal clearances. To have raised the Main-Webster St. bridge and the Niagara-branch railroad bridge to meet these requirements would have been not only very expensive, but ruinous to traffic and the adjoining property and streets, particularly as there already existed a hump in the track over the creek at this point with approach grades of about 1 and 1.5 per cent.

The First Solution

Naturally, the first solution of the problem that presented itself was the reconstruction of the Barge Canal bridges into movable bridges at their present locations. There was a very serious objection to a movable bridge on the Niagara-branch railroad crossing of the creek, where there was a stretch of single track in a double-

track railroad, heavily traveled, and which under such conditions would create a situation that would have been suicidal to successful railroad operation. It was proposed to overcome this objection by filling in the gap of single track by the laying of a second track through Webster St. and the construction of a bascule double-track lift bridge. Negotiations were carried on between the state Barge Canal authorities and the railroad on this basis, and a mutual arrangement resulted by which the expense was to be shared by both parties.

Many objections developed, however, to the occupation by the railroad of this important street, from the points of view of the city of North Tonawanda and the business establishments, as well as from the point of view of railroad operation. With about one hundred regular train movements per day and many switching movements, making a train movement about every 11 min. along the streets and over the crossings on the Niagara branch, the conditions were exceedingly dangerous to street traffic and particularly annoying to operation, since they necessitated the imposition of speed restrictions on train movements.

The idea was then evolved of relocating the Niagara and Tonawanda branches so as to carry them over the canalized creek on one bridge on a location removed from Main and Webster Sts., and thereby not only overcome the objections above mentioned, but also eliminate the grade crossings and lengthwise occupation of streets through the city and make unnecessary the construction of one bridge through which lake boats would have to pass to reach the Barge Canal harbor. On the basis of the negotiations that had already been carried on with respect to the Niagara-branch bridge at Main and Webster Sts., substitution of a single bridge for the two bridges not only meant the creation of better conditions for shipping interests, but a consequent saving to both the state and the railroad and the releasing of many dollars which could be applied to the realignment project.

Choosing the New Location

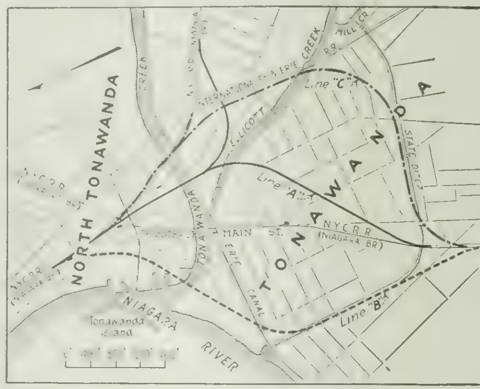
Three basic plans for the new location were proposed; they are designated on the sketch as lines A, B and C.

Line A relocates both branches and combines them in one bridge crossing at a point about midway between the two existing crossings. This location would accomplish the desired purposes and was the most satisfactory from the standpoint of railroad operation, but traverses the heart of the residential section of Tonawanda so that enormous property damage would result, and intersects the Barge Canal terminal areas which had been established by law and could not be obstructed. Before these terminal areas had been established, making highly undesirable if not intolerable a crossing at the location of line A, several variations of this direct and ideal alignment were studied, but all had to be abandoned because of the prohibitive right-of-way costs.

Line B was proposed by the city authorities and contemplated the relocation of the Niagara branch west of its present location. The line was to follow along a state ditch west of Main St. in Tonawanda, crossing Tonawanda Creek near its junction with the Niagara River and leaving the location of the Tonawanda branch unchanged. This state ditch leaves Mill Creek near its outlet into Ellicott Creek, in the southeastern part of Tonawanda, flows westerly until a few hundred feet west of Main St. and then turns northwesterly to the Erie Canal. Its location also has an important bearing on the projection of line C.

Line B could not be given serious consideration, because it did not eliminate one crossing of the Barge Canal and because it involved the serious objection of introducing an obstruction to navigation at the very point of its entrance into the Niagara River, so that all boats entering and leaving the harbor would have had to pass through this bridge.

Line C is the location that has been adopted for the new alignment. It relocates the Niagara branch in a sort of belt line, skirting the edge of the residential



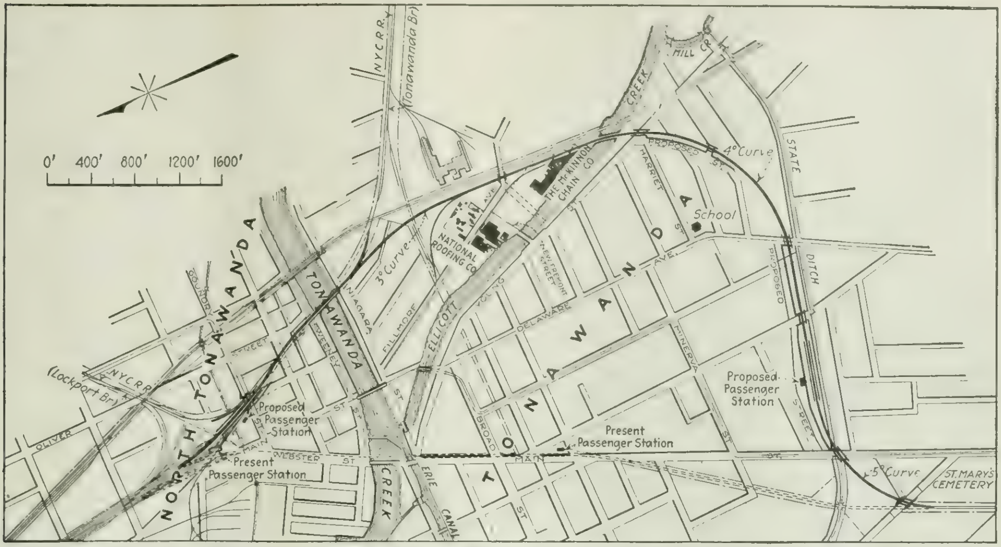
THREE ROUTES WERE STUDIED—LINE C WAS ADOPTED

section of Tonawanda along the state ditch east of Main St., and crossing Tonawanda Creek on a common structure with the Tonawanda branch near the point of the existing crossing of that branch, the alignment of which it follows approximately to the North Tonawanda junction.

This location introduces a rather poor railroad alignment, but accomplishes the desired purposes, and does so by confining the points of departure from the original alignment within the nearest possible limits and at the same time overcoming the objections to the other suggested locations.

Details of Location Adopted

The point of crossing the canalized Tonawanda Creek was chosen so as just to clear the eastern limits of the Barge Canal terminals. In order to avoid excessive curvature on the Tonawanda side of the crossing, and serious street and property damage on the North Tonawanda side, it was desirable to adhere as nearly as possible to the existing Tonawanda-branch alignment, which made an angle with the Barge Canal of about 68°. It was likewise very desirable to adopt a right-angle superstructure, as that was the basis of the negotiations with the state authorities at the Niagara-branch location, and would afford a lift bridge of simpler construction and operation. It was found that to keep the substructure at the water surface parallel to the canal, the bridge seats could not be skewed far enough



TWO MILE DETOUR SIMULTANEOUSLY SOLVES GRADE-CROSSING AND BARGE-CANAL-CROSSING PROBLEMS

to meet the direction of the existing Tonawanda-branch alignment, but that the maximum departure from normal was about 15°, which fixed the direction chosen for the alignment over the creek.

From the creek crossing south the new alignment was projected parallel to and adjoining the Erie right-of-way as far as Ellicott Creek, in order to avoid cutting into the large industries of the National Roofing Co. and the McKinnon Chain Co. From Ellicott Creek southwest the new alignment was located on a 4° curve to keep as far as possible from the built-up section, make a desirable intersection at the junction of Young and Harriet Sts., stay far enough away from the schoolhouse at Delaware Ave. and Harriet St. and meet a tangent projected along the north edge of the state ditch, a desirable location because it was removed from the developed land and because as a barrier it would be less objectionable where a natural barrier—the state ditch—already existed. It was necessary to introduce a 5° curve to swing into the old alignment at the south point of departure because of the limitations imposed by the location of St. Mary's Cemetery along the east side of the railroad at its entrance into Tonawanda.

Throughout the improvement the ground and street surfaces are generally flat and so low that the depression of streets was impracticable from a drainage standpoint; therefore the new grade had to be established at an elevation sufficient to pass over the existing street surfaces with a minimum underclearance of 13 ft. for ordinary street traffic and 14 ft. for street-railway traffic. This elevation is high enough to meet the Barge Canal vertical-clearance requirements at the crossings of Tonawanda Creek and Ellicott Creek, a branch of the Barge Canal improvement.

There are eight structures carrying the new double-track alignment over the streets in Tonawanda and three in North Tonawanda, and one fixed through truss bridge of about 200 ft. span over Ellicott Creek, besides the bridge over Tonawanda Creek, which consists of one 100-ft. bascule-lift span over the channel, another fixed span of about a similar length north of the lift and supporting the counterweight, and shorter spans to carry the tracks over South Niagara St. on the south and Sweeney St. on the north.

At four street crossings in Tonawanda where the necessary elevations could be obtained, the railroad is to be carried over the streets on reinforced-concrete arches with a view to reducing the amount of steel to a minimum on account of its nonavailability at this time of national need. The concrete masonry structures will have to be supported on wooden-pile foundations, as the subsoil is a wet, yielding clay.

For the crossing over Ellicott Creek it was found feasible to utilize a 200-ft. steel truss span which was to be removed at a point where the West Shore R.R. crosses an abandoned part of the old Erie Canal, and where the old canal could be filled in and the tracks carried on embankment.

Lift Span at Tonawanda Creek

The lift span at Tonawanda Creek is a double-track single-leaf Strauss heeled trunnion structure, that particular type being chosen on account of its simplicity, easy maintenance and operation, and the vertical lift was chosen on account of the objectionable interference of an ordinary swing bridge with vessels lying at the dock. The fixed span which supports the counterweight is a simple A-truss. This departure from the ordinary method of supporting the trunnion on a separate pier was made in order to afford another clear channel adjoining the northern dock wall of the harbor.

In addition to the structures and the railroad roadbed, which will require about 500,000 cu.yd. of embank-

ment, there are involved the relocation of the two passenger stations, one at Tonawanda and one at North Tonawanda, the rearrangement of the North Tonawanda freight-yard facilities, the construction of about 3500 ft. of new street to eliminate and simplify street structures, and of about 3000 ft. of low retaining wall, besides the restoration of the street surfaces in Main and Webster Sts., where the old location will be abandoned.

The Tonawanda station will be located at the southern end of the improvement, as near Main St., where electric cars run, as the curvature will permit. A new street will be constructed from Delaware Ave. to Main St. to facilitate access to the station. The North Tonawanda station will be located near its present site, on the north side of Goundry St., on which there is an electric line. Both stations will be of modern construction, with pedestrian subways and stairways leading to platforms on either side of the tracks to obviate the dangerous crossing of tracks by passengers.

An effort was made in developing the plans for the improvement to separate the grades of the Tonawanda-branch crossing of the International Ry. and the Erie, but the proximity of the new canal crossing to the canal crossing of the International and the Erie, and the fact that both of these river crossings are only about 500 ft. away from the railroad crossing, involved such difficulties in gradients as to make the expense of separation unwarranted, when the train movements over the Tonawanda branch are considered.

Erie's Industrial Connection

Another difficulty which arose was the fact that the new alignment, paralleling the Erie right-of-way and adjoining it on the west at about 10 ft. higher elevation, would cut off the Erie's industrial connection into Fillmore Ave., which served the two large industries of the National Roofing Co. and the McKinnon Chain Co. It was finally conceded by all concerned that a direct connection either at the grade of the new alignment or under it was impracticable, and the difficulty was overcome by an agreement in which the New York Central contracted under a special arrangement to switch cars for the Erie to the industries in the territory from which they were cut off.

At this point complications were also involved on account of cutting through the eastern part of the McKinnon Chain Co.'s plant. This houses an important industry engaged in Government contract work. A satisfactory solution of the problem resulted in the rearrangement of the plant, the relocation about 250 ft. north of Fremont St. and the bridge carrying it over Ellicott Creek in order to permit extension of the plant in that direction, and the reconstruction of the buildings and machinery for a reverse movement in the process of manufacture. All this added an expensive but unavoidable damage item to the cost of the improvement.

An interesting feature is the treatment of the state ditch at its head and at the point where it is crossed by the new elevated railroad roadbed at Main St., Tonawanda. The Barge Canal improvement lowers the waters of Tonawanda Creek and Ellicott Creek about 3 ft., so that by the removal of an earth dam in Mill Creek just below the state ditch, and the construction of another earth dam at the head of the state ditch, the waters of Mill Creek have been diverted from the state ditch to Ellicott Creek. This operation reduced the flow of the waters of the state ditch to such an extent that it was necessary only to construct a 4-ft. arch culvert to carry the surface drainage under the new railroad embankment and Main St., where otherwise a structure about 20 ft. wide by 400 ft. long would have been needed. A considerable saving in the cost resulted. The change in dams at the head of the state ditch necessitated the construction of a bridge to carry Mill Creek Road over Mill Creek, in place of the embankment which had formed the dam.

Negotiations consumed so much time that the difficulty arose of performing the construction work on the new alignment in time to meet the opening of Barge Canal navigation, which was set for May 15, 1918, and which would require a 12-ft. depth of water, with a minimum channel 50 ft. wide at the new location of the crossing, as well as at the old location near Main and Webster Sts. It was found impossible, on account of the unusual conditions of material and labor caused by the war, to complete the new alignment to carry traffic so that the old crossing could be abandoned in time to meet the opening of the Barge Canal navigation. This difficulty was overcome, however, by carrying the Tonawanda-branch track on a wooden trestle detour about 50 ft. west of its original crossing, and sliding one of the old half-through girder spans on skidways to the position of the detour, in which position it was supported on temporary cribbing surrounded by steel sheet piling in such a way as to afford the proper canal channel. The Niagara-branch track was retained in its old location and Barge Canal requirements were met at the bridge by substituting a second-hand through girder span for one of the deck spans and reinforcing and protecting the piers with concrete and timber falsework.

Status of the Work

The negotiations leading to the beginning of construction were very difficult and tedious because it was necessary first to agree with the state Barge Canal authorities and execute a contract with them, then secure the consent and franchises of both cities, and finally take the matter under the railroad law before the state Public Service Commission, which, after holding the various public hearings that were necessary, issued an order June 6, 1917.

The general contract covering the entire improvement was let to the New York State Dredging Corporation Mar. 17, 1917. The construction work was begun in July, 1917, and in spite of the material and labor difficulties the project is well under way. About 90% of the necessary new right-of-way has been acquired, several of the concrete arches and the substructure for the bridge at Tonawanda Creek are almost complete, and the embankment is being placed between Main St. and Delaware Avenue.

The work is being carried on under the direction of George W. Kittredge, chief engineer, and J. W. Pfau, engineer of construction.

Drive Inclined Precast Concrete Slabs for Sea Wall

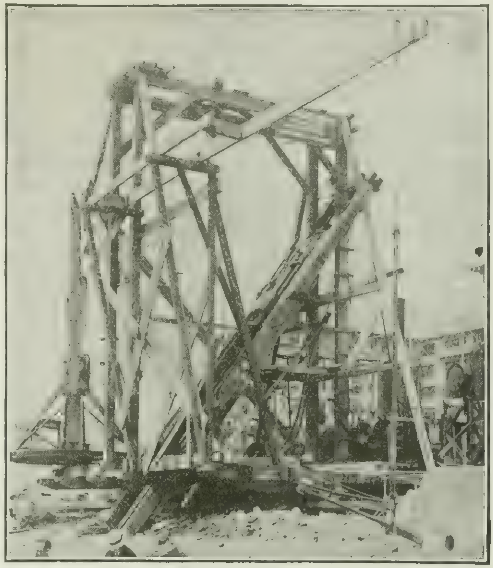
Novel Type of Beach Protection at Long Beach, California, Replaces Old Vertical Concrete Wall

REINFORCED-CONCRETE precast slabs driven to form an inclined sea wall have recently been used by the City of Long Beach, Cal., to replace a vertical protection wall built about 1915. It is believed that material improvement over the design of the old wall, described in *Engineering News* of Apr. 15, 1915, p. 720, was made in working out plans for the new structure. With the vertical wall, excessive vibration was transmitted to the nearby structures when the impact of the waves was heavy, and the maintenance of the sidewalk behind the wall was excessive because the sand backfill washed out through open joints between slabs of the sea wall. In designing the new wall it was the purpose to provide adequate protection from the waves without vibration and to make a sightly, economical structure that would leave the beach unobstructed.

The structure consists of a continuous row of interlocked concrete slabs driven at an angle of 53° with the horizontal. The old sea wall was still in place for a considerable part of the length, and the inclined slabs were therefore located so as to bring their tops approximately 18 in. outside the old sea wall. The inclined and the vertical walls were then bonded together by a parapet wall extending 7 ft. above the top of the inclined slabs and having a minimum thickness of 12 in., reinforced with ⅜- and ⅝-in. bars. The sidewalk behind the parapet, 30 ft. in width, rests on a sand fill. Before placing of the fill a triple line of columns and beams parallel to the parapet wall was placed so that the sidewalk would not be dependent entirely upon the sand fill for support. These beams and columns were not considered necessary by the engineers, but were put in at the request of the property owners. Ornamental lighting standards were cast in place, using an aggregate which would pass an eight-mesh sieve. All of the other concrete on the job was mixed in proportions of 1: 2: 4.

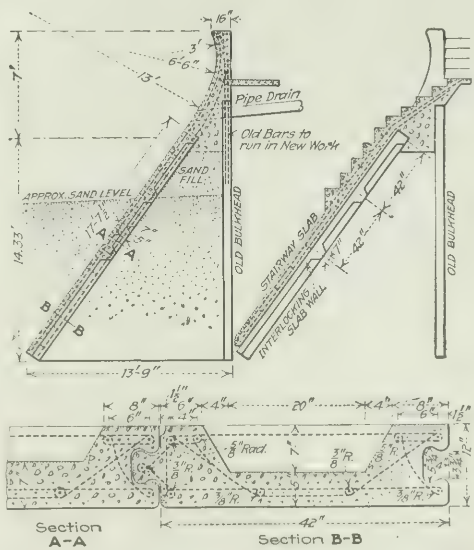
PRECAST CONCRETE SLABS USED IN SEA WALL

The interlocking slabs are each 42 in. wide, 17 ft. 7½ in. long and 5 in. thick in the panels. Horizontal beams bringing the total thickness up to 12 in. were placed at the top and at 42 in. and 82 in., respectively, below the top. For the most part the slabs were driven through a vertical depth of about 10 ft., of which the last 18 in. is a clay stratum for about 75% of the length of the wall. The slabs were placed by a special driving rig using steam hammer and water jet and provided with leads inclined at an angle of 53° to the horizontal. A detached hoisting engine was used in bringing up the slabs, and they were then handled and placed by means of a standard hoisting engine mounted on the rig. The jetting was carried on by the use of four 3-in. jets, nozzled to 1-in., the supply being from city mains carrying a pressure of 60 lb. per square inch.



IMPROVISED RIG IS USED TO DRIVE HEAVY SLABS

Backfilling was done in part with a ¾-yd. clamshell, the boom of which was mounted on one corner of the driving rig and operated by a separate turning and



TYPE OF SEA WALL AT LONG BEACH, CAL., HAS PRECAST CONCRETE SLABS AS MAIN INCLINED MEMBERS

hoisting engine. A portion of the backfilling was done by means of a 6-in. centrifugal pump, belt-driven by electric motor, which brought sand from the ocean at points near the front of the wall. The entire driving rig was moved along as the work advanced, on 6-in. wooden rollers.

The demolition of the old parapet wall was carried out by blasting with small charges of powder placed in holes drilled in the face of the concrete near the sidewalk line. A battering ram used for completing the work of demolition is shown in the illustration suspended from a traveler built on the driving rig. The old wall was broken up just in advance of the placing of the slabs

The design was prepared jointly by the city engineer of Long Beach and Henry Schlueter, Los Angeles, who has patented the concrete slab construction used. The work was started Feb. 10, 1918, and completed July 22, at a cost of $111,775 for 1706 lin. ft., or $65.45 per linear foot. The contract was held by the Ross Construction Co., Sacramento, Cal.

Fire-Resisting and Wood Offices Built At Same Time

Government Gets Relative Figures on Cost of Buildings Put Up Under Direction of Army in Washington

OPPORTUNITY for comparing speed of construction and cost of wood-frame temporary office buildings with those of reinforced-concrete buildings was afforded this spring and early summer in the construction simultaneously of three additional office buildings to the large group which now extends along the Mall in Washington, between 4½ and 8th Sts. The buildings were put up by the Construction Division of the Army on force account, and accurate cost figures were kept. The wood-frame buildings approximated $2.45 per square foot, whereas the reinforced-concrete and tile buildings cost about $3.48 per square foot.

The three buildings, to be used by the Signal Corps, the Surgeon General's office, and the Ordnance Department, are in Henry and Seaton Parks in Washington. They have a total floor area of about 850,000 sq.ft., provide office space for 6250 persons and in an emergency for 8000. Each of the buildings is three stories in height. No general contractor was employed. The whole work was supervised by officers of the Construction Division, under the direction of Col. (now Gen.) R. C. Marshall, Jr. Contractors were used on some subcontracts. Skilled and unskilled labor was obtained through the Civil Service Commission, and little difficulty was found in keeping the supply sufficient. The main reason for erecting the three buildings by direct labor was to provide the division with a measuring stick for gaging the work done by private contractors under the so-called cost-plus form of contract with fixed maximum fee. It is stated that the officers are satisfied that this form is fair to both Government and contractor. The total cost of the buildings will be well within the $2,377,500 appropriated.

Building E for the Signal Corps was completed June 2, thirty-nine days after being started. It is three stories in height, of wood-frame construction, with a cement plaster exterior and plasterboard interior partitions. The total floor area is 330,000 sq.ft. The building is divided into eight separate wings by firewalls with automatic fire doors, and has a complete system of fire protection—fire extinguishers, chemical fire engines, automatic and hand-operated fire alarms—and a fire and police system. In the construction of the building there were used 2,500,000 ft. of lumber, 650,000 ft. of wall board, 5000 bbl. of cement, 1500 squares of roofing and 25,000 yd. of plaster. The total cost of the building was $782,500, or $2.40 per square foot. A maximum of 1700 men was employed in the construction, the average number per day being about 1112. Mechanics were paid on an average 70c. an hour and common labor 35c. an hour.

Building F for the Surgeon General's department is identical in its detailing with Building E, and the labor rates during its construction were the same. It was started Mar. 22 and finished May 1; that is, 39 days, with 24 working days, omitting Sundays and days lost by reason of inclement weather. The average number of men employed was 939, and the maximum at any one time was 1500. The building is divided into seven wings by firewalls, and has the same complete fire protection as Building E. In the construction there were used 2,000,000 ft. of lumber, 450,000 sq.ft. of plasterboard, 4500 bbl. of cement, 1200 squares of roofing, 1500 sq.ft. of metal lath and 18,000 yd. of plaster. The total cost was $674,500 for the 275,000 sq.ft., or about $2.46 per square foot.

Building G was used for the engineering division of the Ordnance Department, is of beam-and-girder reinforced-concrete frame, concrete and tile floors, tile walls with stucco-plaster exterior and sand-coat-finish plaster interior. It was begun on Mar. 21 and the building was ready for occupancy June 2; that is, in 72 days. The average number of men employed per day was 620, the maximum number being 1100. The building has a total floor area of 242,000 sq.ft., and its total cost was $842,900, or $3.48 per square foot, the same rates of wages being paid to laborers and mechanics as in the other two buildings. Except for a sprinkler system, it has the same complete fire protection as the other two. In the construction of the building there were used 180 carloads of building tile, 16,000 bbl. of cement, 10,000 yd. of sand and gravel, 500,000 ft. of lumber, 450 tons of reinforcing steel, 900 squares of slag roofing and 37,000 sq.yd. of plaster Steel window sash was used throughout.

Heavy Mallet Locomotive For Norfolk & Western

A Mallet locomotive with a weight of 535,000 lb. without tender or 747,000 lb. with tender has been built for the Norfolk & Western Ry. There are eight drivers on a side, with a total driving wheel base of 57 ft. 4 in. The weight on the drivers is 472,000 lb. The weights on the leading truck and trailing truck are respectively 28,000 and 35,000 lb. The total wheel base is 92 ft. 11¼ in. The tender, which weighs 212,000 lb., has a water capacity of 12,000 gal. and a coal capacity of 20 tons. The locomotive has a tractive effort of 104,300 lb. compound or 135,600 lb. simple.

Construction Plans Developed for the Bronx River Parkway Reservation

Designs of the Park Commission Contemplate Development of 1400 Acres by Grading and Planting—Numerous Structures Are Proposed—Work To Be Done by Day Labor

By L. G. Holleran
Principal Assistant Engineer, Bronx Parkway Commission

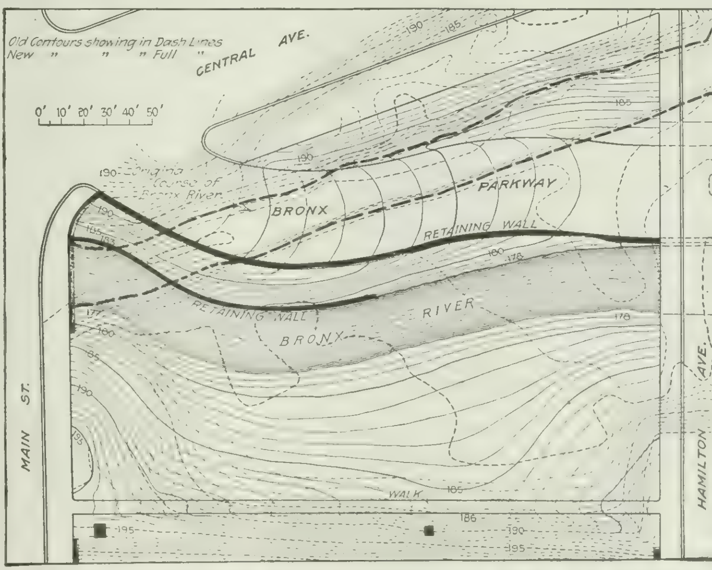
THE development of the Bronx River Parkway Reservation, covering an area of 1400 acres and extending for 15 miles along the river in a northerly direction from the New York City limits, contains many interesting problems. The main features of the scheme contemplate the relocation of the river, with regulation of its flow, and regrading and replanting the entire area. The magnitude of the work may be seen when it is stated there will be, when completed, 20 miles of automobile driveway 40 ft. wide, 35 miles of footpaths, 28 bridges, three viaducts, 69 foot bridges and six dams. To design and carry out this work properly, extensive topographical, grading and planting plans were developed. Nurseries holding 60,000 young trees and shrubs at one time were started to provide for replanting, and special machinery was provided to carry on the work. After extended inquiry, it was decided to do the development work by force account, and let the structures only by contract.

During the ten years previous to 1907, officials and citizens of New York City, and also of Westchester County, considered with increasing concern the problem presented by the polluted condition of the Bronx River, the longest river within the city limits and the most picturesque. It was recognized that the purity of the stream and the beauty of its surroundings could not be preserved without comprehensive measures of protection and preservation. Various suggestions were made for conducting the entire river through enormous conduits, but this was found to be impracticable owing to the difficulty of building a conduit large enough to carry the flood run-off, and also on account of the huge cost, estimated to be in excess of $10,000,000. With the passage of time, however, this problem began to press more urgently for solution, and in 1907 an act known as Chapter 594 of the Laws of 1907 was passed by the legislature of the State of New York. It provided for the appointment of a permanent commission to acquire the necessary lands to carry out the parkway project. The act also set aside for public use an area extending for about 15 miles along the banks of the Bronx River from the northerly boundary of Bronx Park in the City of New York to the city's lands acquired for water-supply purposes at Kensico Reservoir in Westchester County, including principally the low lands on either side of the river, varying in width from 200 to 1200 ft., with an average width of 600 ft. This area, with the public streets and other public lands within or along the reservation, and the water-supply lands below the Kensico Dam, aggregates about 1400 acres.

The terms of the act provide that three-fourths of the cost of this project shall be paid by the City of New York, and one-fourth by the County of Westchester. Commissioners were appointed by Governor Hughes in 1907, and in June, 1913, after some amendatory legislation had been passed, the first appropriations for the acquisition of the lands were made available. About two-thirds of all the lands were acquired by private purchase, and the remainder are being taken by condemnation.

The engineering and construction activities of the commission can be classed under the following heads, each of which will be briefly discussed: Surveys; preparation of landscape development plans; preparation of grading plans; preparation of planting plans; river regulation and its relation to other features of the development; design of structures; work of construction

The property within the reservation which it was



OLD AND NEW CONTOURS AND NEW LOCATIONS OF RIVER AND PARKWAY SHOWN ON GRADING PLAN

found necessary to acquire contained about 1300 separate parcels. These parcels are shown on 30 real estate sheets 24 x 36 in. in size, to a scale of 1 in. = 100 ft. As the commission had only the nucleus of an engineering organization when preparation of property maps was started, it was deemed best, in order to push the work forward as rapidly as possible, to employ local engineers and surveyors to make property surveys and prepare the original maps.

By the time the property surveys were completed the commission had organized a small engineering force and topographic as well as all succeeding surveys have been made by this force, which has been increased from time to time as the work under way demanded. In order that the succeeding grading and planting plans could be laid out with the required accuracy, it was decided to plot the topographical maps on a scale 1 in. = 20 ft. horizontal, with 1-ft. contours. Contour and level shots were obtained by the transit and stadia methods, and the location of trees, walls, fences and buildings was made by the transit and tape.

The experience gained in preparing grading and planting plans leads to the conclusion that if topography, grading and planting had been plotted to a scale 1 in. = 40 ft., with 1-ft. contours, the resulting slight decrease in accuracy would have been more than counterbalanced by the increased convenience in use of the maps in field and office, as with a scale as large as 1 in. = 20 ft. a comparatively small area can be shown on the largest-sized maps which can readily be used.

As the topographical plates were completed, they were turned over to the commission's landscape architect and forester, who, in conjunction with the engineering forces, made a careful study for the relocation of the Bronx River, which in many places flows along the margin of the reservation; the location of the parked automobile driveway which will extend throughout the length of the reservation; the location of paths, bridges, viaducts and other miscellaneous structures. In locating these features special care was taken to preserve existing trees as far as possible.

On the basis of these studies, colored development plans to a scale 1 in. = 100 ft. were prepared by the landscape architect, showing the general features of the development and an outline of the reforestation and planting. A reproduction of one of the commission's development plans is shown.

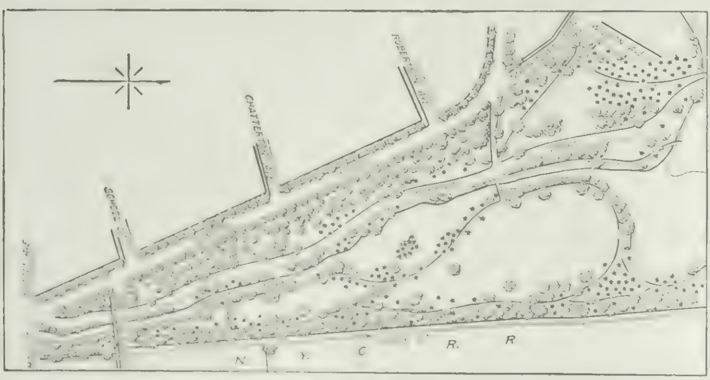
Grading Plans

After landscape development plans had been completed tentative grading plans were prepared which showed the changes in contour necessary to carry into effect general features of the development work. These plans were made to a scale 1 in. = 20 ft. horizontal with 1-ft. contours, the same as the topographical plates. These tentative grading plans were then studied with reference to the availability of grading material.

The earth-work quantities were estimated, and, following approximately the procedure used in railroad and highway work, mass diagrams showing balances and deficits between cut and fill were plotted. As a result of this analysis, grading plans were revised until an efficient balance, which would eliminate long hauls, was secured. An important purpose of these studies was to avoid, as far as possible, the borrowing of grading materials beyond the reservation limits. Final grading plans, showing finished contours and all landscape features, were then prepared, from which construction work was staked out by the field parties. A reproduction of one of the grading plans is shown.

Planting Plans

The reforestation of denuded areas is of the first importance, and the efforts of the commission will be directed to the restoration of the native beauty of the valley by replacing, as far as possible, the original flora of the region. Nurseries have been established on the reservation, and about 60,000 young trees and shrubs are growing in them. During the past season a large number of the young trees have been removed and planted in various places where grading was sufficiently advanced to make such planting possible. Much screen planting will be required along high railroad embankments and in other unsightly sections, but indiscriminate mixtures will be carefully avoided in the planting. When the grading plans for any section were completed, the skeleton work of such grading plans, showing the location of the river, driveway, paths, etc., was traced, and the existing trees, which had previously been located on the topographical plates, were plotted on these skeleton plans. The new planting was then filled in according to the general planting procedure outlined above. Tabulations on separate sheets were also made, showing the number of each species required for the area to be planted. When these plans were completed, they were turned over to the planting force, which obtained the necessary young trees from the nursery and carried out the planting.



LOCATION OF TREES, SHRUBBERY, DRIVES AND RIVER SHOWN ON PLAN

A reproduction of one of the planting plans is shown in the cut.

The Bronx River is the fundamental feature which controls the engineering and construction problems and to a large extent the physical improvement and landscape development of the reservation. The flooding of the marginal lands and low-lying sections of the reservation is typical of the problem offered by many rivers. To avert destruction of property and large losses, the conservancy district idea has been evolved and applied; as, notably, on rivers in the Middle West.

Somewhat analogous is the Bronx River Parkway Reservation, which may be considered as a conservancy district on a small scale. The river flows through Bronx and Westchester Counties, and through various municipalities. It would be quite useless to improve it in any one section and neglect the others. It was, therefore, necessary to study it throughout its entire length, and one basic object of the work of river regulation was to prevent frequent flood overflows. In order to prevent the intermittent flooding of marginal lands, except at periods when such flooding would cause little or no injury—as in the very early spring when the reservation will be little used—the best solution for the Bronx River is, unquestionably, the deepening and widening of the channel and using of the dredged materials for raising the banks.

IMPROVEMENTS IN BRONX RIVER

Jurisdiction over the river throughout its entire length enabled the commission to adopt comprehensive plans. The details of these plans vary with the topography of different sections, but, in general, the river is being widened and lowered by deepening the channel, removing obstructions, and, where necessary, lowering the crests of existing regulating dams. Studies were made of all available stream-flow records of the Bronx River, and long term stream-flow records of the Croton River. The latter records were considered to be applicable, since the Bronx River and the Croton River have similar watersheds, rainfall and other characteristics. Gaging stations and stations for taking stream-flow records by current meter measurement were also established by the commission, and measurements were made at various stages of the river level and flow.

From these studies the proper profile for deepening the channel was determined at all points, as well as the normal water-surface elevation, and when the river improvement has been completed the water will be held at nearly constant levels during the greater portion of the year.

The purely æsthetic element was also kept in mind. Natural slopes and banks were left undisturbed where possible, since straight slopes and a canalized channel would not in any sense be appropriate in park development. These river channel improvements will serve three purposes: First, the reclaiming of low lands by eliminating flood overflow; second, the securing of a sufficient depth of water for the development of swimming pools and water sports, and, third, the obtaining of sufficient material for use in grading the marginal lands in order to supply the proper landscape development.

IMPROVEMENT ADJACENT TO RIVER ATTAINED BY GRADING AND PLANTING: BEFORE AND AFTER

RIVER PROBLEM CONSIDERED

There is a fall in the river of about 150 ft. between Kensico Dam and Bronx Park, so that in order to provide stretches of slack water for canoeing, swimming and other water sports it will be necessary to construct occasional low dams with spillways of sufficient length to carry the flood flow. The use of automatic crests which will operate under flood conditions has been considered, and tentative designs have been prepared, but no satisfactory solution of this problem has yet been reached.

In the development of the reservation, designs have been prepared, or are in course of preparation, for about 20 miles of automobile driveway. For the greater part of its length this driveway will be 40 ft. in width, but in some locations it will be separated into two 20-ft. drives or one 30-ft. and one 20-ft. drive. Thirty-five miles of paths, from 4 to 12 ft. in width, 28 driveway bridges, three viaducts, three railroad crossings, 69 foot bridges, six dams, and other structures such as retaining walls, changes in sewers, drains, etc., will also be constructed. Standard designs for driveway drainage structures have been adopted where possible. In the design of the bridges, competent architects have been consulted in order to provide architectural treatment which will harmonize with the parkway development.

The dams will be low in most cases, and the prin-

cipal feature requiring skill in design will be the automatic crest. Great care has been taken in the design of retaining walls and similar structures, in order to have them harmonize with their surroundings.

As soon as the lands were acquired, buildings and other incumbrances were cleared away, the lands and river channel were immediately cleaned up, and action was taken to abate the pollution of the river. To extend public use, certain development and construction work was necessary. A construction program was laid out early in the season of 1916, and such funds as were available for carrying it out have been used for the purpose since that time. Experienced contractors were consulted, and inquiries were made to find, if possible, contractors with suitable plant who were willing to bid on the work. Tentative specifications for river excavation were drawn up, and were made as simple as possible in the hope of obtaining proposals. Informal bids received were considered too high.

This condition was probably due to the peculiar difficulties attendant upon awarding contracts for park work. Stripping and stacking top soil, protecting trees and other landscape features, are matters which do not especially appeal to the contractor engaged in doing work at a fixed price per cubic yard.

The commission appreciated the difficulty in obtaining the best results for river regulation work and grading at a reasonable cost, if done by contract methods. In order to confirm its views, if possible, a series of questions was sent to the park boards or executives in charge of the principal park and parkway systems throughout the United States. The questions were framed to disclose the comparative advantages and disadvantages of the contract system as compared with day labor for parkway grading and landscape improvement work. The majority of the answers showed that on work of this character the contract system has given unsatisfactory results.

Day Labor and Contract Methods Adopted

This investigation confirmed the conclusion that the fundamental work of river regulation, grading, top soiling, planting and general landscape improvements could best be done by day labor under direct supervision of the commission's engineers and landscape experts. To avoid the necessity of purchasing expensive plant and developing an organization of highly skilled workmen, necessary for erecting bridges and the construction of sewers, pavement, buildings and similar structures, the policy adopted provided for doing such work by the contract method.

Upon undertaking the river improvement work, it was found necessary to consider the types of machinery best adapted to existing conditions, which included low-arch bridges, many overhanging trees which must be preserved from injury, and the fact that much of the work is "wet excavation," which cannot be handled satisfactorily, either by hand labor or by some types of excavating machinery. An investigation was therefore made by the commission's engineers, covering the types of machinery in use throughout various parts of the country on work of a similar nature. This investigation included an inspection of steam shovels, draglines, cable ways and various other classes of excavating machinery, as well as investigation of pumping and hoisting apparatus.

These investigations resulted in a special type of ladder dredge being developed by the Bucyrus Co., of South Milwaukee, Wis., for use in the heavily wooded sections along the river, where a machine of swinging-boom type could not be used. This machine requires very low head room, and the floating hull on which it is mounted draws only about 2 ft. of water. The machine consists of continuously operated ladder buckets, dumping into a hopper leading to a belt conveyor, which places the dredged materials on the river bank. This conveyor can be shifted so as to avoid injuring the trees. The dredging machinery is operated by a 20-hp. electric motor, and the conveyor is operated by a 5-hp. electric motor. Electric power is obtained from a local lighting company, and the cost of operating the dredge is about \$25 per day, including depreciation on plant. The capacity of the machine is about 100 cu.yd. per day.

Cost of Operating Excavator

For use along open stretches of the river where a swinging boom can be used, a Monighan 1-T walking dragline excavator was purchased and used during the 1917 construction season. This machine is equipped with a 35-hp. Westman gasoline engine, a 40-ft. boom and a 1-cu.yd. Page scraper bucket. The machine worked two shifts during the greater part of the season, and in 333 working shifts (this includes all working days except Sundays and holidays irrespective of whether the machine was actually operating or not), 71,717 cu.yd. of materials were excavated or rehandled; an average of 215.4 cu.yd. per shift. The cost of operating this machine for the season was \$11,-967.07, including depreciation, so that the cost per cubic yard was about \$0.16⅔. During a portion of the season the machine was used for loading wagons and a hopper was constructed for doing this class of work. A cost of \$0.318 per cubic yard was obtained for loading, hauling and spreading material by this method.

During some portions of 1916 and 1917 a Keystone excavator was also used for excavating and loading teams. This machine was rented by the day, and in general proved very useful in this class of work, where the digging was clear earth without an admixture of roots or stones of any considerable size.

During the seasons of 1916 and 1917 the commission had on its payroll a labor and maintenance force of about 200 men, and an average of from 15 to 20 teams, and general grading work, grading of paths and driveway and miscellaneous construction work was in progress at many points by team, scraper and hand-labor methods, in addition to the excavation by machinery. The war reduced the labor force materially.

Besides the work done by its own forces, work on six construction contracts, covering pavement of driveway; construction of two reinforced-concrete highway bridges; construction of a reinforced-concrete viaduct across the reservation; diversion of the Bronx River and sewer connections in the City of White Plains, and telford pavement for a subsidiary drive, have been in progress. At the end of 1917 the commission's development work was well under way, and satisfactory results of the careful planning outlined above had

begun to show in many sections of the reservation. On account of the need for laborers in war work the construction was greatly cut down during 1918.

The engineering and constructing work of the commission is being done under the supervision of Jay Downer, engineer, who is also the secretary of the commission, and acts as its general executive officer. Chester A. Garfield is field assistant engineer and Hermann W. Merkel is consulting landscape architect and forester.

Many Tests Made in Study of the Concrete Ship

Emergency Fleet Corporation Investigates Shear in Concrete, Effect of Repeated Loading, and Oil-Tightness

CONCRETE-SHIP design and behavior are dependent on a number of physical properties of reinforced concrete which heretofore have not been as clearly understood as they ought to be. In the study of the designs of the new Government concrete ships, the concrete ship department of the Emergency Fleet Corporation has been making a number of physical tests, mainly on approximately ship-size specimens, which will tend to clear up some of the obscure points in issue. Several of these tests were described by R. J. Wig, head of the department, in a paper presented before the Society of Naval Architects and Marine Engineers at Philadelphia Nov. 14.

The investigations were made to establish safe working stresses and standards of design. Tests already made demonstrate the safety of the designs first made, and indicate how weights may be further reduced without sacrificing strength. The structural investigations are made under the direction of W. A. Slater at the Bureau of Standards' laboratories in Washington and Pittsburgh, the laboratory of Lehigh University at Bethlehem, Penn., and the Office of Public Roads, Arlington, Va.

One of the first serious difficulties in the designing of concrete ships was that of getting sufficient strength to prevent cracks forming diagonally in the vertical sides of a ship of practicable weight. Using the methods ordinarily employed in reinforced-concrete design, a shell thickness of at least 15 in. would have been required instead of the 4 in. used in the 3500-ton cargo ship. Tests of large reinforced-concrete beams were started to make certain that no mistake was being made in using a 4-in. shell. These first tests were made on (a) beams 4 ft. 4 in. deep and 18 ft. 6 in. long; (b) one beam 10 ft. deep and 28 ft. long; and (c) specimen ship frames of full-size cross-section and 20-ft. span. The frames were cut off at a point corresponding to the point of inflection, or 4 ft. 6 in. above the top of the keel. The tests were made in the 10,000,000-lb. testing machine at the Bureau of Standards, Pittsburgh.

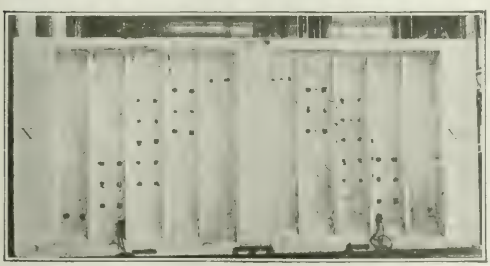


FIG. 1. BEAM 10 FEET DEEP AND 28 FEET LONG TESTED WITH LOAD ABOVE

For the beams the load was applied at the center of the span upon the upper flange. The beams were supported at each end on a steel plate girder. The beam, 10 ft. deep, was first loaded forty times with 640,000 lb., which was four times as much as the maximum which the standards of the Joint Committee on Concrete and Reinforced Concrete would have allowed as its working load. The widest crack at the first application of this load was 0.013 in., and, with forty repetitions of the load, there was no appreciable increase in the widths of the cracks. The beam was then inverted, and load was applied in the opposite direction, causing failure at 1,363,000 lb., or nine times as much as the Joint Committee standards for reinforced-concrete design would have allowed as a working load.

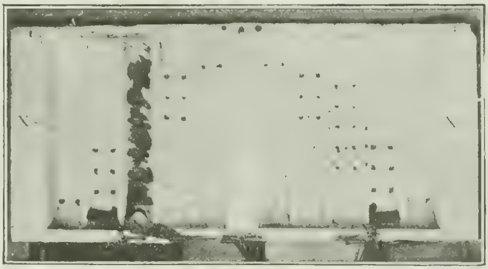


FIG. 2. BEAM SHOWN IN FIG. 1 WITH CRACKS FROM LOAD ON BOTH UPPER AND LOWER FLANGES

Fig. 1 shows this beam after it had been loaded from one direction. The cracks were painted to make them visible. The holes and channels cut in the concrete exposed the reinforcement to allow measurements of change of length of the bars to be made. Fig. 2 shows the beam after completion of the test in an inverted position. The cracks formed in this test were approximately at right angles to those due to the first test. This view also shows the manner of failure.

The ship frames were tested by applying, first, only a vertical load, and adding later a horizontal load at the sides corresponding to the horizontal water pressure on the sides of the ship. It was found that the strength here was about eight times as great as the Joint Committee recommendations allowed for the working load, also that the shear due to the horizontal forces reduced the stresses set up by the shear due to the vertical forces; in other words, that the horizontal water pressure would reduce the stresses caused by the vertical shearing forces on the frame. Fig. 3 shows the frame in the testing machine.

These tests have made it possible to design with confidence, using working shearing stresses much higher than those which are recognized by the last report of the Joint Committee for structural members of ordi-

nary design and proportions. However, it has not been necessary as yet to use working stresses as high as appear from the tests to be justified. The working stresses in shear, for instance, used by the department are:

Maximum unit shearing stress *V/bid* in T-beams and in shell or other slabs, 500 lb. per square inch; in isolated beams, 300 lb. per square inch.

When the maximum unit shearing stress is less than 50 lb. per square inch, the concrete may be considered to carry all the shear.

When the unit shearing stress is greater than 50 lb. per square inch, reinforcement should be provided as follows: (a) In the design of thin slabs, used as the webs of beams, with the shearing action perpendicular to any local shearing stress such as the shell, provide shear reinforcement according to a formula for combining shear and local stresses; (b) in all other cases provide shear reinforcement to carry the full amount of the shear.

Tests are under way to determine the effect of rapidly repeated loads on a reinforced-concrete beam. A beam supported in a frame has a motor operating a lever in such a way as to apply a known load to the beam alternately upward and downward at the rate of about 36

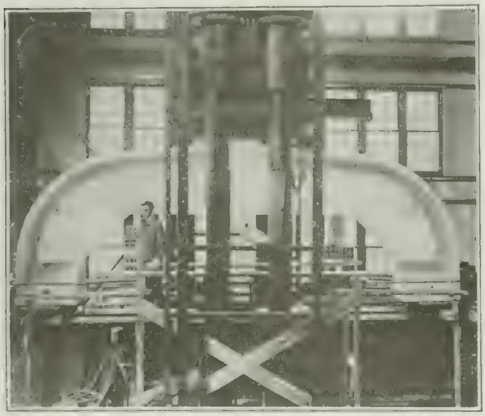


FIG. 3 SPECIMEN SHIP FRAME IN TESTING MACHINE

load applications (18 complete cycles) per minute. The tensile stress developed in the steel is about 23,000 lb. per square inch and 746 000 applications of the load had been made up to Aug. 18. There had been no perceptible increase in the strain in the steel or the concrete after 1000 applications of load, and very little increase between the first and the thousandth application. Cracks appear in the lower portion of the beam under downward load, and in the upper portion under upward load. The largest cracks, on Aug. 18, were about 1/100 in. wide. With continual opening and closing of cracks, if any should occur in the alternate hogging and sagging of a ship, the possibility of a grinding action on the fractured surface has been considered as a possible destructive agency, but thus far in the test no such grinding has been observed.

During the making of all large test specimens, small specimens of concrete have been made using the same material as that going into the large specimen. The compression tests of the small specimens show strengths as great as the assumed strength on which the working stresses used in design were based.

In order to determine whether in the complicated network of reinforcement present in the ship structure the quality of the concrete could be made satisfactory, special tests were made. Slabs 4 in. thick, with a very large amount of reinforcement made up into a complicated network, were poured on edge to a depth of 3 ft. All parts of the structure were well filled out with concrete, covering all the reinforcement satisfactorily, and in the load test which was applied failure occurred by tension in the steel before the ultimate strength of the concrete was reached, although a stress of about 4400 lb. per square inch in compression in the concrete had been developed.

All the evidence thus far accumulated indicates that a concrete strong enough to warrant the use of a high working stress in compression (1500 lb. per square inch) can be obtained in all cases where sufficient attention is given to the placing of the concrete.

Tests are under way to determine the conditions under which leakage through construction joints and through cracks may be expected and how it may be prevented. Thus far hollow beams, having wall thicknesses of 4 in. and construction joints in which as much as seven hours elapsed between the pouring of successive layers of concrete, have been tested under a 30-ft. head of water. No leakage occurred through any of the construction joints, and apparently none through the side wall, except where the wall was penetrated by a steel tie-bar. However, leakage did occur through the thicker upper flange of the beam where imperfections in the construction occurred.

While under a pressure due to a 30-ft. head of water, the beams were loaded so as to give a shearing stress of 300 lb. per square inch. It was found that where a diagonal tension crack was as much as 0.002 in. wide, a small amount of leakage occurred, and where it was 0.004 in. wide the leakage was appreciable.

An inspection made by the United States Bureau of Standards in 1917 of reinforced-concrete oil tanks then in service indicated that mineral oils had no deleterious effects on concrete which was cured before contact with the oil. The series of tests now under way confirms this conclusion and shows that certain organic oils do have a destructive effect on the concrete used. The penetration tests are being made with oil under a maximum head of 16 ft. The penetration into 1:2:4 concrete for the lightest oil used (73.7 B.) was about 1.6 in. in 40 days, and for the heaviest oil (95.5 B.) it was about 0.27 in. Preparations are being made for tests under a head of about 25 feet.

Tests are under preparation to determine the relative advantages, for taking stress, of placing slab reinforcement parallel to and at an angle with the direction of the span.

In a beam having large variation in the area of the cross-section there is uncertainty as to how much of this area is fully effective in resisting the tensile and compressive stresses. Analysis indicates that if the entire area is available the use of properly designed haunches in ship frames may permit a reduction in the weight of ship frames of from 20 to 30 per cent. of the weight required on the basis of existing standards. A series of tests to obtain information on this question is now under way.

Variety of Equipment Used to Move Supplies for Drainage Ditch Construction

Motor Trucks Supply Main Camp from Railroad 25 Miles Away—Teams and Boats Take Supplies from Main Camp to Dredge Crew Camps—Heavy Hauling Done in Winter When Swamps are Frozen

FIFTY-YEAR-OLD lumber-camp methods of getting in supplies, and up-to-the-minute methods of earth handling by machinery, are contrasts furnished by drainage ditch construction practice in northern Minnesota. Camp supplies and fuel for dredges, hauled in winter over snow roads, are accumulated in storehouses and cachéd along the ditch lines. Camps are built of forest trees. Roads are cleared and graded along the ridges and corduroyed across swamp land. Bridges are built of timbers cut near the structure and hewn to dimensions. By the side of these pioneer structures work large floating and walking dredges operating on oil fuel and capable of digging 50,000 cu.yd. of ditch every 30 days. The contrast does not indicate an anomalous condition. The country is a wilderness of forest and tamarack swamp and can be penetrated and opened up for modern machine construction methods only by the methods of the pioneer.

FIG. 1. DITCH SPOIL BANKS LEVELED AND GRADED FOR HIGHWAYS

One of Minnesota's largest drainage projects, known as Judicial Ditch No. 25, lies in that part of Beltrami County between Lake of the Woods and Red Lake and bordering on the Rapid River. In the *patois* of the drainage man a "ditch" in Minnesota is any group or system of ditches which, in law, constitutes a single project. Ditch No. 25, therefore, is not a single ditch but a system of 250 miles of ditches and of as many miles of roads, for Minnesota grades the spoil banks of its ditches and makes highways of them. The total volume of excavation is more than 3,400,000 cu.yd. To prepare the way for moving this earth 1700 acres have to be cleared of trees, and 1000 acres have also to be grubbed. Construction will cost between $400,000 and $500,000.

Railways do not penetrate the wet lands of northern Beltrami County. Ditch No. 25 is nowhere nearer to a railway than five miles, and the main construction camp for the system is 25 miles by camp road from the receiving point by rail for supplies. Woods are everywhere, hardwood in heavy growth, with scattered balsam and pine, along the natural streams, and beyond this edging are the tamarack swamps, which are impenetrable except to a traveler on foot, and in summer are too wet and soft over wide areas for any travel. Work making ready for dredge ditching under such conditions becomes a heavy task. The forest and swamp have to be opened up by clearing and by building roads and camps.

Camp headquarters for construction operations on Ditch No. 25 are situated on Rapid River, about 25 miles from the railway. Log buildings house kitchen, dining room, bunk house, feed and warehouse, blacksmith shop, stables, offices, engineers' headquarters and superintendent's residence. Except for the window sash and roofing paper these buildings are constructed with axe and saw from the trees of the forest. The camp is headquarters and from it radiate all the activities which keep the scattered dredge and road-building outfits supplied with the things they need. It is linked up with the railway and the outside world by the main camp road.

Camp road construction was accomplished by primitive methods and tools. Except for a pile driver, and this was built on the job from timbers hewn from the forest trees, no appliances but the tools of the woodsman and pioneer were used. Where the ground was high a right-of-way was cleared and grubbed and roughly graded. Across the swamp areas corduroy was laid. About four miles of the 25 miles were corduroy construction. Tamarack poles cut from the right-of-way and the bordering woods furnished the material. Stringers of the larger poles were laid down and covered close with

FIG. 2. DREDGES TOW FUEL OIL TANKS

cross poles, some of the larger ones being split. Nine bridges were required, the largest being 80 ft. long. Native timber, cut from the woods nearby and hewed with broad-axes to shape, was used. These hewn timbers were assembled into trusses by the use of old

wire cable for the rods. Floors were built of cross poles hewn flat on top.

Supplies are hauled to the main camp and from there distributed to the gang camps and dredges. With the main camp road completed, a motor truck makes daily trips between camp and railway. Teams supplement the trucks, taking empty oil barrels to the railway and bringing back feed for the horses. For the first season's work a considerable portion of the supplies was hauled to the main camp and distributed from there by snow roads in winter. An important detail of this winter hauling consisted of carrying in and distributing fuel oil for the land dredges.

Fuel oil was hauled from railway to camps in 12-bbl. tanks and at camp was emptied into 50-gal. steel barrels. Each barrel was tested with an air pump before being filled, to insure against leakage. The filled tanks were then distributed along the ditch right-of-way, three barrels in a place, with plugs up. To prevent possible overturning when the ground thawed, the barrels were wired together. Leakage, by these precautions, was reduced to a very small quantity. Yardage of excavation determined the spacing of the barrels. During the first month's work, while frost yet prevailed, a barrel of oil was allotted to each 800 cu.yd. of ditch; for warm-weather work the allotment was a barrel to each 1000 cu.yd. Stored as described, there were placed 1200 bbl. of kerosene for 100 miles of ditch right-of-way, in addition to sufficient gasoline for starting the engines, with cylinder and lubricating oils and cup grease, for three land dredges.

Supplies, other than oil, for the land dredges, are hauled by team as they are needed. As the dredges cast up the spoil banks, their tops are leveled and graded to form roads. This road building follows the dredges as closely as is practicable. First the peak is plowed down. A grader is then used to level off the bank and make it possible for teams to bring supplies to the dredge. Later the road is finished by two large graders hooked to a 60-ton caterpillar tractor. From camp, woods roads reach the nearest available point and then the teams follow the spoil-bank roads.

Water carriage is found the most convenient method of getting fuel oil and supplies to the floating dredges. A steel oil tank holding 5000 gal. is mounted on a barge which is towed behind each dredge. In one instance the barge is eliminated and two oil tanks fastened together are floated behind the dredge. The tanks are each 7 x 20 ft. Similar tanks set along the right-of-way replenish the barge tank. Other floating-dredge supplies are transported by boats. Since the dredge ditch has to be dammed at intervals of about a mile to form the necessary flotation pools for dredge operation, all supplies have to be handled over several dams.

Motor trucks, flat boats and horse and ox teams exemplify the range of transportation methods on these isolated swamp drainage works. No roads exist. Ditch work proceeds at separated points scattered over a wide area and constantly changing. Until the ditches are dug far enough to afford waterways or to permit spoil bank roads to be completed, no ways are open for transportation except temporary woods trails. Over these trails only horse or ox teams can operate with success. Therefore, the first task of the drainage contractor is to work out a rather complicated transportation system for his supplies.

Ditch construction proper involves two principal operations; first, clearing and grubbing right-of-way, and, second, ditch excavation. Clearing and grubbing for Ditch No. 25 were carried out largely during the winter. The men lived in portable camps kept close to the work. Nearly all the timber and stumps removed from the right-of-way were burned; only the best logs and poles were saved. These were piled up along the right-

FIG. 3—CONSTRUCTION CAMPS RESEMBLE LOG SETTLEMENTS OF THE PIONEERS
(1) Superintendent Anderson Has the Only Residence with a Porch; (2) Engineer [illegible] Park's Headquarters and Helpers; (3) General View of Headquarters Camp; (4) Assistant Engineer V. E. Crabtree and Inspector Dick Williams in Full Equipment

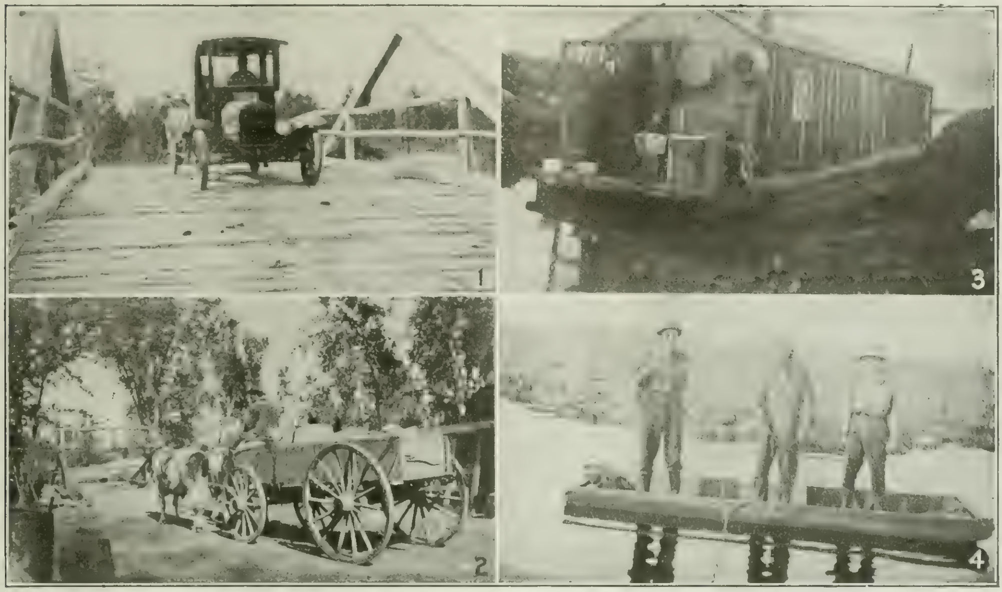


FIG. 4. FLAT BOATS, OX TEAMS AND MOTOR TRUCKS TAKE SUPPLIES TO DREDGE CREW CAMPS
(1) Bridges Built of Hewn Timbers and Old Wire Rope; (2) Ox Teams Only Means of Reaching Certain Camps with Supplies: (3) Dredge Crews Live in House Boats; (4) Flat Boats Take Supplies to Floating Dredges

of-way to be used later for temporary bridges and other construction purposes. Generally, in clearing, the stumps were removed by dynamite.

Six dredges are doing the ditching. Three of these are dry-land walking dredges and three are floating dredges.

Two of the dry-land machines are dragline dredges each equipped with a walking device and operated by a 60-hp. oil engine. The machines each weigh 50 tons. They each "walk" on three feet, two at the rear corners and one in front. Each foot is 10 ft. wide and 12 ft. long, so that the bearing areas of the three feet aggregate 51,840 sq.in. The load on the soil is, therefore, less than 2 lb. per square inch, which is so little that the dredges can ride all but the softest of swamp soils. These machines have excavated 1700 cu.yd. of ditch in a ten-hour shift. They are equipped with 1½-cu.yd. buckets.

The third dry-land machine is a walking dredge with a walking-beam shovel. This dredge straddles the ditch and is operated by a 40-hp. oil engine. The moving device is similar to those of the dragline machines. This dredge, traveling across country on its own feet, accomplished a journey of 13 miles in 4½ days. Its record is 329,000 cu.yd. of ditch in 6½ months.

One of the floating dredges has a 1-cu.yd. walking-beam shovel, but is otherwise of standard type. The other two machines are ¾-in.yd. dipper dredges of standard type.

Dry-land dredge crews are housed in tents, since frequent changes of camp are necessary to keep the men close to the work. The crews of the floating dredges live in a sleeping and cook cabin towed behind the dredge. When operating with full crews and with trained operators the six dredges have an output of 300,000 cu.yd. per month, but war conditions make it difficult to keep the dredges fully manned. It is planned to have the 250 miles of ditch completed in 1919, and to finish the road work the following season.

Judicial Ditch No. 25 is being built by the E. A. Dahl Co., Duluth, Minn., as contractor. V. G. Anderson is superintendent of construction and J. C. Burk is engineer in charge.

Grading by Stationmen on Alaska Railroad

For construction work on the Alaska Railroad the method of having the clearing and grading done by stationmen was adopted, the work being let directly by the Alaskan Engineering Commission, and no general contracts being awarded. Very little capital is required, as the commission furnishes the necessary equipment at a moderate rental, and the men can purchase supplies at the commissary, although this is not obligatory. A recent paper by Col. Frederick Mears, formerly a member of the commission, says it is particularly fortunate that this plan was adopted. Colonel Mears says: "Had the Government railroad, or any part of it been given out to a general contracting firm in 1915, when labor conditions were normal and prices for materials and supplies were low, it would have been impracticable for the contractor to have continued the contract in the subsequent years under the abnormal war conditions of high labor and material costs, without a very generous increase in the contract price. This would have resulted in delay for the consideration of claims, with a consequent loss of time and effort."

Saturation of Concrete Reduces Strength and Elasticity

Tests Show that Moisture Content of Specimens Serves to Counteract the Benefits of Moist Curing

By M. B. Lagaard
Concrete Engineer, Emergency Fleet Corporation, Philadelphia

THERE are three stages in the manufacture of concrete in which water enters as a vital element in the strength of the material. First, at the time of casting, when the materials are mixed; second, during the period of curing, when the concrete is in place; and third, after the concrete has attained sufficient strength to sustain the designed load. The danger of loss of strength from too much water in the first stage and not enough water in the second has been frequently brought to the attention of the engineering profession.

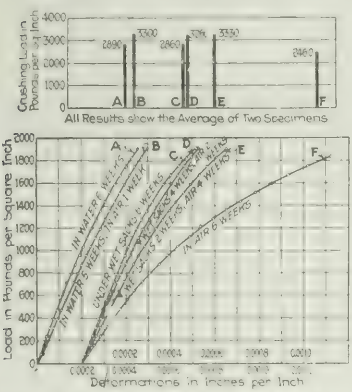


FIG. 1. COMPRESSION TESTS OF 8 x 16-IN. CYLINDERS OF 1:2:4 TRAP-ROCK CONCRETE AT AGE OF SIX WEEKS

However, the effect of the presence of water as a distinctly foreign element in concrete is a question upon which there are still very little published data, but of which clear knowledge must be had, in order to permit of the proper analysis of a concrete structure. Tests made in the experimental engineering laboratory of the University of Minnesota show that this continued moisture tends to reduce both strength and elasticity.

The tests were confined mostly to compression tests in which standard cylinders 8 in. in diameter and 16 in. high were used. Deformations were taken with a four-dial compressometer estimating readings to 0.0001 in. over a gage line of 10 in. The loads were applied in increments of 4000 lb. total, at regular intervals of time, the latter element having been recognized as a vital factor in the test of concrete specimens.

The curves shown in Fig. 1 represent the results of a series of compression tests of 1:2:4 trap-rock concrete specimens, made to show the variation in elasticity and strength of wet and dry concrete in the early stages of curing. All of the tests were made at the age of six weeks. It will be noticed that in all cases the specimens which had been wet the longest show the highest values for the initial modulus of elasticity, while the strength is a maximum with one of the specimens which has been wet for a short period at the beginning and has then been allowed to dry out before testing. Thus specimen E, which has been cured two weeks under wet sacks and four weeks in air, shows the highest strength value, although both A and B, cured in water, and C and D, cured under wet sacks for longer periods of time, show higher values for the initial modulus of elasticity.

Fig. 2 gives the results of another series of tests made about a year earlier, by an entirely different group of observers, where gravel was used as coarse aggregate instead of trap rock, but the results of which show the same peculiarities. The wet cylinder has the highest initial modulus, and one of the intermediate cylinders shows the greatest value for the ultimate compressive strength. Without considering the degree of saturation of cylinders at the time of test, the strengths should increase with the increased time of curing in water, and the values for the modulus should also increase accordingly. However, the fact that this does not take place shows that there is some other element to be considered which affects these two properties.

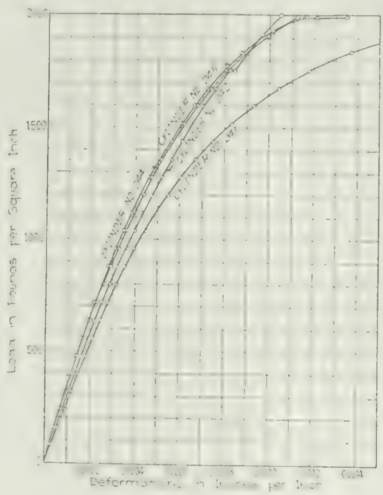


FIG. 2. EFFECT OF MOISTURE ON MODULUS OF ELASTICITY OF GRAVEL CONCRETE. MIX 1:2:4. AGE EIGHT WEEKS

TABLE OF DATA

Cylinder No.	Time in Weeks Under Sacks	In Air	Secant Modulus at 700 lb. per sq. in.	Ultimate Strength lb. per sq. in.
241	1	7	2,530,000	1989
242	3	5	2,790,000	2434
244	7	1	3,000,000	2250
245	8	0	3,170,000	2069

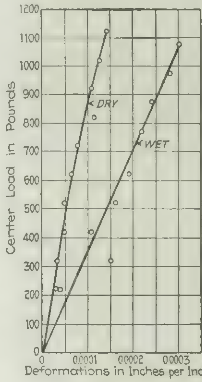


FIG. 3. TRANSVERSE TEST OF 4 x 4 IN. SOLID SANDSTONE BEAM. SPAN 22 FT.

The effect of this other element may also be noticed in the curves of Fig. 3, which show the results of a transverse test of a beam of solid sandstone. The readings in this case were taken with a 2-in. Berry strain gage directly over the load which was applied at the center. The tests were made under two conditions: First, when the beam was thoroughly dried, having been kept in a dry place for several years after quarrying; and second, after it had been immersed in water for a period of seven days. Here the question of age is of no

importance. The effect of water in the specimen at the time of test is at once noticed in the reduction of strength of the specimen. This appears to be exactly what has taken place in the concrete specimens of Figs. 1 and 2. The specimens which had been kept in water up to the time of test were thoroughly saturated and hence showed a much lower strength than would be expected with this curing, while those which had been cured under water for a period of time and then exposed to the air for various periods before testing were more or less dried out and hence did not show such a marked reduction. The specimens which were cured entirely in air were dry at the time of test and showed the normal strength expected. This variation in the percentage of moisture content is shown by the weights of the specimens given in the table. Thus the reduction in strength in any particular case appears to vary with the amount of saturation at the time of testing.

The same thing has occurred, in all probability, in the case of the initial modulus of elasticity, except that the reduction in modulus due to the presence of water was not sufficient to overcome the increase in modulus due to better curing.

The effect at advanced ages is shown in the curves of Figs. 4 and 5. Fig. 4 represents approximately the two extremes of the treatment shown in Figs. 1 and 2, extended over a much longer period of time, the wet cylinder in this case having been 189 days under wet sacks and the dry cylinder having been exposed to the air for the same length of time with the exception of the first two weeks, when it was kept under wet sacks. The results, however, are the same as in the case of concrete six weeks old, and point to the same conclusions.

Fig. 5 shows results from two specimens which were kept under wet sacks for seven days and then left open to the air for more than a year, after which one was placed in water for three weeks and then tested wet, while the other was tested at the same age dry. Both strength and modulus show a decided drop in the wet cylinder, the reduction in strength exceeding 35 per cent.

Results from another group of cylinders are shown in Fig. 6. In this group specimen No. 1129a was kept wet from the time it was cast, No. 1129c was kept dry after first being under wet sacks for a week, and No. 1129 was cured in the same manner as No. 1129c, except that it was placed in water the last 12 days and tested wet. The difference between 1129a and 1129 is in the curing, the effect of which shows up in the lower values of both the strength and the modulus of the latter. Cylinders 1129c and 1129, being cured alike except for the last few days, show clearly the difference due to the presence of water, the wet one having both a lower strength and a lower modulus.

TABLE SHOWING COMPARATIVE WEIGHTS OF 1 : 2 : 4 TRAP-ROCK CONCRETE, AGE SIX WEEKS

Mark	In Water	Under Wet Sacks	In Air	Weight Lb. per Cubic Foot
A	6	..	..	160 7
B	5	..	1	159 2
C	..	6		160 5
D	..	4	2	158 0
E	.	2	4	156.9
F			6	154 5

The outstanding features which the writer has observed in regard to these tests are enumerated below:

First, moisture in concrete reduces its strength and modulus of elasticity. This is in accord with the results found by Prof. J. L. Van Ornum in regard to strength, as reported in the *Transactions* of the American Society of Civil Engineers, Vol. 77, December, 1914.

Second, the effect upon the modulus is not as pronounced as the effect upon the strength.

Third, the reduction in strength due to saturation by water which has been present in concrete from the time of casting may be more than sufficient to overcome the increase in strength due to better curing.

Thus we find it possible to have two concrete specimens having the same modulus of elasticity and yet differing widely in ultimate compressive strength, and vice versa. The effect of this will be seen by referring to specimens No. 125a and 124a of Fig. 4 and applying

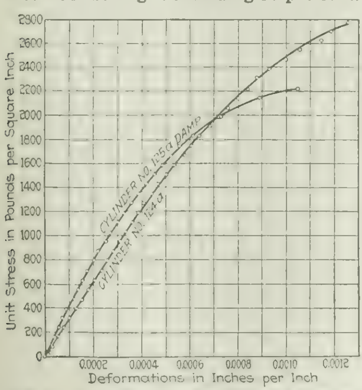


FIG. 4. COMPRESSION TESTS OF 8 x 16 IN. 1 : 2 : 4 LIMESTONE CONCRETE. AGE = 189 DAYS

Data: Cylinder No. 124a cured two weeks under wet sacks, then open to air of laboratory until tested. E = 3,078,000. Ultimate Strength = 3310 lb. per square inch.
Cylinder No. 125a cured under wet sacks until tested. E = 4,150,000. Ultimate Strength = 2480 lb. per square inch.

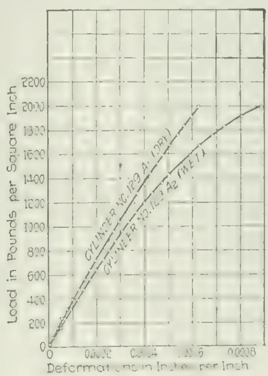


FIG. 5. EFFECT ON ELASTICITY OF MOISTURE SHOWN BY TESTS ON 8 x 16 IN. 1 : 2 : 4 LIMESTONE CONCRETE

Data: Cylinder No. 129A. Age = 469 days. Cured 7 days under wet sacks and 462 days in air. E at 600 lb. per square inch = 3,700,000. Ult. Comp. Strength = 3630 lb. per square inch.
Cylinder No. 129 A_2. Age = 462 days. Cured 7 days under wet sacks, 434 days in air and 21 days in water. E at 600 lb. per square inch = 3,150,000. Ult. Comp. Str. = 2310 lb. per square inch.

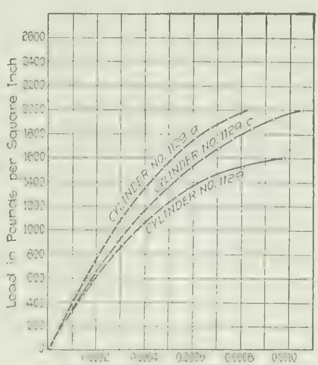


FIG. 6. COMPRESSION TESTS OF 8 x 16 IN. CYLINDERS, 1 : 2 : 4 LIMESTONE CONCRETE

Cyl. No	Under Wet Sacks	In Air	Under Wet Sacks	Age	Strength, lb per sq in
1129-a	102			102	2150
1129-c	7	95		102	2350
1129	7	90	12	109	1670

(TIME IN DAYS heads the Under Wet Sacks, In Air and Under Wet Sacks columns.)

to each the method for determining the modulus of elasticity outlined by the Joint Committee on Concrete and Reinforced Concrete in 1917. According to this method Cylinder No. 124a would fall in class D with a modulus of 3,000,000, which is very nearly the true value found by actual measurements, while Cylinder No. 125a would fall in Class C with a computed modulus of 2,500,000, whereas the measured modulus is about 66 per cent in excess of this amount. Subsequent drying would no doubt have put the latter specimen high into Class D, while saturation would in all probability have dropped Cylinder 124a into Class C, thus reversing the original condition.

From these results it is seen that the effect of saturation clearly must be recognized in an analysis of test data, and if reductions in strength as high as that shown in Fig. 6 can be expected in practice, the possibility of such a weakening must be taken into account in the design.

The writer wishes to express his appreciation to Prof. F. R. McMillan of the University of Minnesota, now in charge of extensometer tests of concrete ships for the United States Emergency Fleet Corporation, for the loan of data and for suggestions and assistance in the making of these tests.

Milwaukee Sewer Tunnel Contract Defaulted

CIRCUMSTANCES leading to the abrogation of a contract, resulting in the present suit and countersuit over the Harbor Entrance sewer tunnels at Milwaukee, Wis., are outlined as follows in the recently issued fourth annual report of the Sewerage Commission:

Contract No. 19, covering the construction of two conjoined inverted siphons under the rivers near the Harbor Entrance, was awarded Sept. 14. 1916. The time for the completion of the work was later extended from May 11 to Sept. 1, 1917. On June 14, 1917, the chief engineer reported to the commission that upon lowering the air pressure, cracks and leaks had appeared in both tunnels, and that on June 3, when all pressure had been removed, several cracks $\frac{1}{16}$ in. wide entirely around the tunnels had developed. Immediately work was begun repairing these cracks and was continued until June 8, when all work was stopped. Notification was given the contractor to resume repairs, which the contractor did, continuing work until Sept. 4, when the concrete floor in the construction shaft at the foot of Erie St. blew up, flooding the shafts and the tunnels under the Harbor Entrance and the Milwaukee River, with mud and water. Immediately after the flooding, the ground around the Erie St. shaft settled between 6 and 7 in. throwing the weigh-house of the adjacent incinerating plant out of commission. Upon occurrence of this failure it was decided to postpone granting an extension of the contract time to Nov. 15, which the contractor had requested on Aug. 24, awaiting the action of the contractor regarding the recovery and repair of shafts and tunnels.

Reporting to the commission Sept. 12, the chief engineer announced the failure as outlined above and stated that beyond one day's unsuccessful work trying to put the weigh-house scales in repair the contractor had done no work, and to all appearance had abandoned operations. At this meeting agreement was made with representatives of the contractor for a special meeting Sept. 18 to confer on ways and means.

At the meeting Sept. 18, the contractor, through attorney, presented a written statement. This statement, in brief, asserted that the conditions existing were in no respect directly or indirectly chargeable to the contractor or his work, and were due entirely to faulty and inadequate plans and specifications. It also maintained that certain work must be done before a resumption of the work under the contract could begin: that this work was expensive and in a measure dangerous, and that it was beyond the scope of contract No. 19. The contractor, it was asserted, was ready and willing to undertake the work intended to make it possible to resume work under contract No. 19, upon these conditions: (1) The city pay any and all sums due for work done under the contract; (2) the city pay for the work done in mending the cracks, and (3) the work necessary to be done before resumption of operations under the contract be regarded and agreed to be beyond and outside the scope of contract No. 19 and be paid for under that understanding. Specific definition of the preparatory work was not made.

Following the conference the Sewerage Commission formally notified the contractor to resume work in 10 days. To this notice the contractor replied, offering to eliminate conditions 1 and 2 named in the statement of Sept. 18, but did not define the work involved under condition three. Ten days having elapsed without resumption of work, the commission, Oct. 1, declared the contractor in default, and instructed the chief engineer to take possession of the work. Possession was taken and an appraisal was made of the construction plant and materials belonging to the contractor. A contract was then made with a new contractor to recover the tunnel and complete the work on a basis of actual cost plus 15 per cent.

Official information is not available concerning subsequent happenings. Construction, however, has proceeded and is now in progress under the new agreement. Meanwhile, the original contractor has brought suit against the city for $111,274.98 claimed to be due for work done, and the city has answered by a counterclaim of $500,000 for damages sustained due to discontinuation of the work by the contractor.

Has Free Garbage Collection and Disposal

Both garbage and dead animals are collected and disposed of by contractors at Springfield, Mo., without cost to the city. There are two separate contracts. Under one the garbage is fed to hogs. Under the other contract, which runs for a term of five years and is held by E. W. Biggs & Co., of Springfield, dead animals are treated in a reduction plant located about three miles from the city. This company has three trucks in service for the collection of dead animals in Springfield and vicinity. The collection service extends a distance of 40 miles. Dr. Edwin F. James is commissioner of health and sanitation. The contractor for the disposal and collection of garbage is J. C. Dysart.

Porous Canal Banks Blanketed by Hydraulic Sluicing

Temporary Power Line Supplied Current to Portable Plants—Material Spread From Flume on Raft to Leaking Area

THE Pishkun Canal, carrying 1000 sec.-ft. of clear water from the North Fork of the Sun River to irrigate 65,000 acres north of Fort Shaw, Mont., has been given a lining of silt supplied by hydraulic sluicing to check loss of water through the porous gravel in which the canal is excavated. This work was done by the engineers of the United States Reclamation Service.

Motor-driven pumps furnished the supply to hydraulic giants which washed fine material from the rocky slopes above the canal, as there was no adequate supply of silt fine enough to be carried in suspension for any long distance.

Furthermore, according to R. B. Stevens, superintendent of irrigation, in an article printed in the *Reclamation Record*, the limited waterway capacity at the lower end of the canal would have made it necessary to check the flow at various regulating structures in order to secure the desired depth of water.

In silting the first and most obstinate leak of 10 sec.-ft. in a depth of water of only 18 in. two centrifugal pumps were set up immediately above the leaking section, one a 2-in. pump direct connected to a 5-hp. motor, and the other a 4-in. pump belted to a 10-hp. motor. A 4-in. pipe line with nozzle was attached to the discharge of these pumps. The fine material among the rocks was washed out with the stream and run directly down the slope into the canal. This open-sluicing method proved unsuitable to the class of material handled, as all of it settled to the canal bottom before it had traveled more than 300 ft. A pit of finer material was then tried about 300 ft. from the canal. The same installation was used, but the material was carried to the canal through 16-in galvanized sheet-iron pipe. This pipe was used because available. It was laid on the ground and the material distributed across the canal by a flume supported on a raft, and having side openings at regular intervals. This method, although productive of somewhat better results than the first, was far from satisfactory, as the coarseness of the material caused it to sink within a short distance. Long-distance sluicing was then abandoned in favor of local work. The flume on the raft was extended to and along the canal bank with gate-controlled side openings toward the bank. With this arrangement it was possible to place a blanket of fairly impervious material on the sides or bottom to any desired depth, and by adjusting the height of the flume above canal grade and the depth of water in the canal, the blanket could be spread over nearly the entire inside slope of the bank and part of the bottom. This plan was quite satisfactory and was carried out until the loss in this 1600-ft. reach was reduced from 10 to 3.3 sec.-ft., while the depth of water in the canal was increased from 1.5 to 8 ft. When the depth of water was reduced to 3 ft., or double that when work first commenced, the loss was only 0.1 sec.-ft.

One of the worst leaks occurred in a 2000-ft. section below mile 1.3 in a stretch of coarse gravel overlying seamy shale. Part of the canal water seeped out through the gravel, but the greatest loss was through the shale in the canal bottom, the water appearing in springs along the river bank from 800 to 2000 ft. from the canal. At its maximum the loss was estimated at 35 sec.-ft. with a flow in the canal of 175 sec.-ft. Early in the season some material was hauled about 600 ft. in wheel scrapers from a pit to a sluicing plant placed near the upper slope of the canal, dumped through a trap into a chute, and sluiced directly into the canal. This method proved impracticable. Ground sluicing was used as before and the sluiced material from both pumps discharged into a common flume on a raft, with side openings distributing the material across the canal. Although the lower end of the leaking section was 3600 ft. down the canal from the plant, and the material was hard to get at owing to its location among rocks where it was necessary to use dynamite, when it was discharged into the canal the operation proved to be quite satisfactory. After 10 days' sluicing the surface leaks were reduced from 4.5 to 0.6 sec.-ft. with a marked reduction also in the underground losses. The plant was then closed down for the winter.

Alternating current for pumping was available at 16,500 volts on a transmission line built along the lower side of the canal. Current was obtained from the Great Falls Power Co. at a substation near the headworks at 1 to 2½c. per kw. hr. The ordinary force employed for each plant was a pumpman at $4 to $4.40 per day and two assistants at $3.30 to $3.60, dropping to one assistant when in good material which would not clog the flumes.

When the plant was moved the services of a man and team were required. For future operations it is planned to mount the plant on a raft and thus reduce the moving cost considerably.

The costs of this work were high owing to difficulty of securing the material in any large quantities, the cost of installing the electrical equipment for each move, and the high wages paid for labor. The cost of the sluiced material in place, exclusive of superintendence and general expense, was about 71c. per cu.yd., measured in excavation, of which 29c. was for power, plant, etc., and 42c. for labor and teams. About 2500 cu.ft. were excavated.

Leakage Is 5.85 Per Cent. of Pumpage

Water leakage measured on 108 miles of mains in Chicago in 1917 averaged 14,050 gal. per mile, which the report of the Department of Public Works states may be assumed as an average for the entire system of mains. On this basis the total leakage would be about 40,000,000 gal. per day, or 5.85% of the average daily pumpage. These figures are said to show that the leakage from mains is not as large an item of the total waste as is commonly supposed to be the case. The measurements were made on streets that were to be paved and were part of the investigations conducted by the engineer force of the water-pipe extension division, under the direction of John Ericson, city engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Field Warehouse Record Card Carries Perpetual Stock Inventory

THE field warehouses which are maintained on each of the divisions of the Miami Valley flood protection work employ a card system for a stock ledger. Besides recording the warehouse transactions, these cards serve as a price list, a perpetual inventory of stock on hand, and a means of tracing material. The warehouse cards are printed on stiff paper and both sides are alike. A separate card is made for each size of each kind of supply or material passing the local warehouse. As indicated by the reproduction, space is provided for orders, receipts, issues and stock on hand. All the materials and supplies received on the division are handled through the local warehouse, and are obtained by orders on the general warehouse in Dayton. A record of these orders on the general warehouse is entered in the "orders" space. Goods are received on the division from the general warehouse, from direct shipments, or in a few cases from local purchases. Each shipment is accompanied by a way-bill carrying the unit costs and the values of the articles supplied. Entry is made of everything received, in the "receipts" space on the ledger card.

Duly authorized foremen carry books of "orders on local warehouse." When they desire material or supplies from the local warehouse they make out one of these orders, which shows also the item of work against which each article is to be charged. This charge is indicated by a number, in accordance with the standard account number system of the district, described in *Engineering News-Record* of Nov. 7, 1918, p. 865.

When the "order on local warehouse" is filled, the orders are posted in the space for "issues" on the record. By carrying out the quantities and values in the "on hand" space, a perpetual inventory is had of the material on hand. No general inventory, with its attending confusion, is contemplated under this system. The man in charge of the local warehouse is expected, however, to check from time to time his material on hand with the balance on hand shown on the ledger card.

The accounting division audits the local warehouses from time to time, the local warehouse men never knowing when to expect such an audit. The accounting division has a record, obtained from the purchase records and the accounts of the general warehouse, of all of the material going into the local warehouse. This record is balanced against the total of the receipts at the local warehouse, and is also balanced, by both money and material, with the issues and the stock on hand. Test checks are made by the actual counting of some of the material that is on hand.

At intervals the local warehouse orders are sent to the accounting division at headquarters, where they become the original entry for the cost-distribution system, using the account number, as has been mentioned in a previous paragraph, to obtain the detail for the distribution.

The ledger cards remain in the field warehouses as a permanent part of their records.

This warehouse system was adapted from the one used by the United States Reclamation Service in keeping its records.

To All Contractors

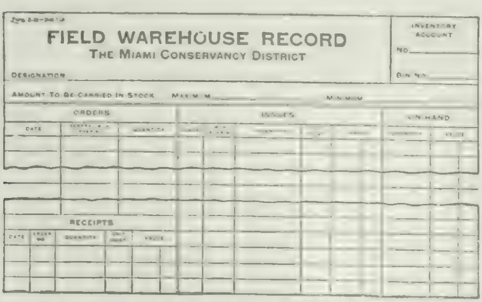
Read the Purposes of the Organizing Convention to be held in Chicago next week, on

Page 915

Then—

Read why it is needed and why you should attend, on

Page 879



WAREHOUSE CARD SHOWS STOCK ON HAND

Wheelbarrows Reduce Labor Force

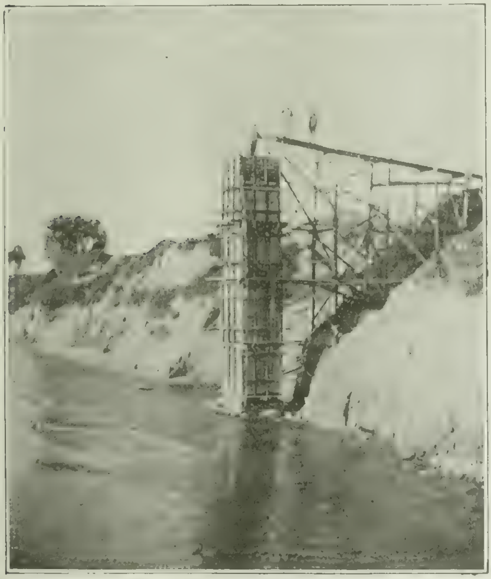
USE of wheelbarrows and inclined runways instead of hods and ladders, for delivering brick, mortar and concrete in building construction has materially reduced the labor force required for the construction of a new roundhouse at Galion, Ohio, for the Cleveland

Cincinnati, Chicago & St. Louis R.R. As the work is in open country, there is ample room for the approach incline, and the roof level is reached in two lifts or stages of inclines supported by the scaffolding. These runways are three planks wide, with hand rails on the longer incline from the ground level. The walls are of brick, with reinforced-concrete lintels over the wide window openings, in order to avoid the use of steel beams. The Walsh Construction Co., Davenport, Iowa, is the contractor, with John Lundstrum as superintendent.

Concrete Pier Built Vertical and Toppled Into Place

BY G. H. CONNOLLY
City Engineer's Office, Racine, Wis.

BUILT upward like a tower on the water edge, a 6 x 6 x 40-ft. concrete shaft was let topple into the lake to form a pier to protect a sewer outfall, at Racine, Wis. Wave action was gradually undermining the shore end of the submerged concrete outfall structure. Riprap was piled up against it at the shore, but every storm would wash the rocks out. It was decided to build a pier about 100 ft. south of the outfall, in the hope that this pier would protect the outfall and also change the wave action so as to form beach.



CONCRETE TOWER BUILT ON SHORE EDGE AND TIPPED INTO LAKE TO FORM PIER

To build a concrete pier out into the water would necessitate the construction of a tight cofferdam at a considerable expense and a great deal of inconvenience. City Engineer P. H. Connolly, therefore, decided to try the experiment of building a reinforced-concrete pier in an upright position on shore and then toppling it into the water.

The base, 6 ft. square, was built at the water's edge, the sand being excavated so that there was a clay foundation. This base was allowed to cure for about a week. A timber grillage was then built on the base and the sides were formed up. The plan was to burn the timber grillage out on the side toward the lake, allowing the pier to topple into the water. The pier was 6 ft. square and was built up to a height of 40 ft. in 6-ft. sections and reinforced with scrap iron. After a height of 20 ft. was reached the timber grillage began to crush and the pier leaned toward the lake. By the time the top was reached the pier was a foot out of plumb, but leaning in the right direction. After the forms were removed it was the intention to allow the concrete to cure for a couple of weeks before tipping it over, but the elements were against this plan. A heavy north-easter blew up, and during the night the pier toppled over into the lake. It landed in the right position and couldn't have been placed better if the placing had been done by man. In tipping, the pier must have slipped off the base, for a space of 6 ft. was left between the shore end and the base. One crack developed about the middle of the pier, but with such green concrete this was to be expected.

This pier has been a success beyond all expectation. In one month, beach has been formed out beyond the end of the pier, completely protecting the outfall and filling up the space between. The pier now looks like a slab on the sand. The cost of the entire construction was approximately $600. The work was done under the supervision of the Board of Public Works by day labor.

The estimated cost of a pier built in a cofferdam was $3000, so that the saving to the city was about $2400.

Concrete Delivered by Slip Scraper Pulled Along Wooden Trough

OPERATING in a shallow, wooden trough, a slip scraper conveyed concrete more than 100 ft. for making emergency repairs to a small dam under construction last fall. A break occurred in the headrace wall about 125 ft. from the spillway which was under construction at the time. Approximately 100 cu.yd. of concrete were needed for the repair work. The volume of work did not justify moving the concreting plant (consisting of a guy derrick and a stationary mixer) or the construction of an inclined chute to reach the whole distance. To move the concrete by hand would have been too expensive. As an alternative, old lumber was utilized to build a trough about 3 ft. wide and 1 ft. deep along the level top of the headrace wall, one end at the break and the other at a point within the reach of the derrick. Beyond the break a snatch-block was anchored, and a rope was run from the river bank below through the block and back along the trough to the end by the derrick. A small slip scraper was attached to this end, and a horse was hitched to the end on the river bank. The concrete was dumped into the trough by the derrick, and moved to the break with the slip scraper. In this manner two men and a horse handled about 10 cu.yd. an hour. The work was done under the direction of E. P. Cartwright, civil engineer, Rochester, N. Y.

NEWS OF THE WEEK

New York, November 14, 1918

Sweeping Changes in Priority Regulations Aim to Assist Reconstruction

War Industries Board Adopts Measures for Construction To Resume on Peace Basis Quickly as Possible

Far-reaching changes in priority regulations were announced Nov. 12 by the priority division of the War Industries Board, through the issuance of circular No. 57. The regulations are drawn with a view to insuring the most expeditious return of industry to a peace-time footing.

Section 1 of the circular revises section 5 of the last priority circular, dealing with non-war construction, by making 12 reclassifications of construction work so that projects falling within the reclassification will be automatically approved by the new circular, and it will not be necessary to obtain permits or licenses for them from the non-war construction section of the Priorities Committee. The reclassification is as follows:

1. Construction projects approved in writing by the facilities division of the War Industries Board.

2. All farm and ranch buildings, structures or improvements.

3. All buildings, structures, roadways, plant facilities, or other construction projects of every nature whatsoever, undertaken by the United States Railroad Administration, or by any rail or water transportation company, organization or utility (whether or not under the direction of such administration) or by the American Railway Express Co., or by the owner or operator of any telegraph or telephone line.

4. The construction, maintenance, improvement or development, by Federal, state or municipal authorities, of highways, roads, boulevards, bridges, streets, parks and playgrounds.

5. The construction, extension, improvement, maintenance or repair of any public utility, including water-supply systems, sewer systems, light and power facilities, and street and interurban railways.

6. The construction, extension or repairs of all irrigation and drainage projects.

7. Construction projects connected with the extension, expansion or development of mines of every character whatsoever, or connected with the production and refining of mineral oils and of natural gas.

8. The construction, alterations or extensions of, or repairs or additions to, plants engaged principally in producing, milling, refining, preserving, refrigerating or storing foods and feeds.

9. The construction of new, or the alterations or extensions of existing, schoolhouses, churches, hospitals, and Federal, state or municipal buildings, involving in the aggregate a cost not exceeding $25,000.

10. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of, existing buildings and structures, in either case involving in the aggregate a cost not exceeding $10,000.

11. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of, existing buildings or structures, in either case involving in the aggregate a cost not exceeding $25,000; when approved in writing by the state Council of Defense or its duly authorized representative.

12. Buildings begun prior to Sept. 3, 1918, where a substantial portion of the building has already been constructed.

The second section of the circular states that all limitations on the production of building materials, including brick, cement, lime, hollow tile and lumber, are hereby removed, and the materials so produced may be sold and delivered for use in connection with any building project for which no permit or license is required under the 12 classifications of section 1.

Section 3 cuts in half the restrictions on the consumption of materials in the production of a wide list of commodities. Where an industry has been curtailed a certain percentage in production or in the consumption of materials for a stated period, this percentage has been reduced one-half; as in the case of an industry that has been curtailed 25% for the last four months of 1918, such curtailment is reduced by the circular to 12½%. The list of commodities mentioned includes road machinery, farm tractors and builders' hardware.

Section 4 relieves dealers in raw materials, semi-finished and finished products from the obligation to give and require any pledges relating to such commodities enumerated in any of the orders or circulars issued by the Priorities Division, or any previous stipu-

(Concluded on page 917)

No More Army Commissions

Secretary of War Baker announced Nov. 12 that there would be no further recruiting for officers in the Army. Except for the regular promotions in the service and for the rare cases where some specialist position is to be filled, no more officers will be commissioned. All campaigns for candidates for commissions in the engineer and other staff corps have been stopped.

Drop Overtime in Shipyards and All Other War Plants

All Sunday work and overtime in Government construction, and in Government-owned or controlled plants and plants producing war supplies, are to be discontinued, according to instructions which it was decided to send out immediately, at a conference between the Secretary of the Navy, the Chairman of the Shipping Board, and the Secretary of War, Monday morning following the announcement of the armistice.

The readjustment of the labor and industry of the country will be undertaken, with a view to bringing it about with the least dislocation of labor and the greatest facility possible to be afforded for the reëstablishment of industry, according to plans of the War Industry Board and the Department of Labor.

Illinois Voters Approve Bond Issue for Highways

Approval was recorded by a large majority of the voters of Illinois for the $60,000,000 bond issue for highways, at the recent election. This large system of highways can now go forward as soon as the bonds are sold.

The election was held on the basis that the roads would not be built until after the war. However, surveys are to begin at once, so that the Highway Department can be ready for construction when the funds are available. The system consists of 4800 miles of connecting highways. A description and map showing the location of the various highways were published in *Engineering News-Record* of Oct. 24, p. 777.

Aside from the $60,000,000 bond issue for state roads, the City of Chicago voted $3,000,000 to complete the Michigan Boulevard link improvement. This much-needed connection can now be made.

Chicago Road Meeting Postponed One Week

The joint convention of the American Association of State Highway Officials and the Highway Industries Association has been postponed from Dec. 2-6 to Dec. 9-13. The meeting will take place in Chicago.

Tacoma Votes for Port District

At the election Nov. 5 the County of Pierce, in which Tacoma, Wash., is situated, voted by a large majority in favor of the establishment of a port district which, under the state law, will have authority to study the local problems and devise a general scheme for the development of the port of Tacoma. The large favorable vote was due to recognition of the fact that trans-Pacific trade will become a great factor on the Pacific coast after the conclusion of peace. The district includes the entire county and will be under the management of three elected commissioners who will serve without salary. The state law permits such a district to raise funds by an annual tax not exceeding two mills on the dollar of taxable property in the county. Until a definite plan has been prepared by the commissioners and adopted by public vote, no money can be expended beyond that necessary for the presentation of the plans. Thereafter only the amount raised by the tax can be expended until the people by a 60 per cent vote have authorized the issue of bonds. These bonds are limited to 3% and may be for a term of 50 years.

Highway Bond Issue Approved by 180,000 in Pennsylvania

Pennsylvania has reversed its 1913 attitude on highway construction, by approving a constitutional amendment providing for the issuance of $50,000,000 worth of road bonds. The majority for the amendment was approximately 180,000, a turnover in good roads sentiment since 1913, when the issue lost by 40,000, of 220,000 votes. Only three counties voted adversely.

Like the program in Illinois, mentioned elsewhere in this issue, the Pennsylvania program called for delay in issuing the bonds until after the war. Since the war is now over, work can go forward without delay, providing the state legislature immediately enacts the laws to make it effective.

Contract Signed for Laguna Dam Connection

The contract for the Laguna dam connection, a part of the project for an all-American canal to serve the Imperial Irrigation District, California, has been signed by Secretary Lane on behalf of the United States Government. It had been previously signed by the officials of the district, as stated in *Engineering News-Record* of Oct. 17, p. 734, but will not become effective until approved by the voters of the district, at an election tentatively set for Dec. 21.

Stabilizing of Entire Contracting Field Is Purpose of Chicago Meeting

Contractors Will Organize in Convention Next Week To Establish Standards of Practice

To stabilize the general contracting business, and to create better relations between the contractor, the engineer and the owner, is the aim of the meeting to be held in Chicago Nov. 20-21. The contractors will convene at that time to perfect the organization of the National Association of General Contractors, 4000 invitations to join which have been sent to reputable firms and individuals throughout the country. It is reported that more than 1000 acceptances have been received, and that the Secretary of War has expressed his willingness to speak if his engagements will possibly permit to do so.

The organization had its inception at the formation of the National Federation of Building Industries in Atlantic City July 15-16. At that time the contractors realized that the field of the federation was so wide and large, and the interests of the general contractor had become so involved, that more specific attention, which could be realized only through a general contractors' association, was absolutely necessary.

Although the perfecting of the organization is the chief business of the convention, one of the main objects of its formation will be to promote efficiency and higher standards of business and ethics. As stated by the committee appointed in July, the object of the association is threefold: First, confidence between the contractor and the owner; second, confidence between the contractor and the material man, and third, confidence between the contractor and labor. It is pointed out that the nature of these objects makes it necessary to confine the membership of the organization to contractors or contracting firms engaged in construction work which undertake and carry out, at least partly with their own forces, construction operations of any description in their entirety.

Those Ineligible for Membership

Some misunderstanding has arisen over the clause in which the matter of friends or associations ineligible for membership is treated. It is not the intention of the association to antagonize or in any manner eliminate the good feeling that exists between general contractors, in the sense under which they are organizing, and contractors who either supply materials or do the work only partially under subcontracts. On the contrary, the association is formed to make possible a coördination of activities such that the dealings between the general contractor and these other activities will be carried on more efficiently and broadly.

The committee points out that confidence between the general contractor and the engineers and the owners is of paramount importance under the existing conditions. The feeling of suspicion that exists in the minds of owners when dealing with contractors is admitted to be the result of the stigma brought upon the contractors through the practices of unreliable men whose desires to increase their profits overpowered their inclinations toward honesty. One of the efforts of the association will be to eliminate this element, and by a systematic campaign of education to reëstablish the confidence necessary for success of any project.

Relations With Material Men

In the relations of the contractors with the material men, it is pointed out, the organization will not exclude any company or association that sells construction material, providing it is also in the general contracting business. For instance, the American Bridge Co. is a steel merchant, but it is also a general contractor in that it will take a contract to construct a building or bridge in its entirety. All the members of the Bridge Builders' and Structural Society have been invited to join, as well as any other material-producing firm that does actual contracting work. The objects of the association make it necessary for the general contractor to have controlling representation, so that his interests will receive paramount attention. This, it was pointed out, was not possible in an organization such as the Federation of Building Industries formed last summer, in which the smaller or subcontractors as well as the host of material men outnumbered the general contractors to such an extent that it would have been impossible for them to give the general contractors' problems the attention they require.

The committee also calls attention to the situation as to the problem of labor, and shows that it is assuming such proportions that will require most careful consideration. It is the intention of the association to handle this subject on a broad and equitable basis, on the ground that labor is also entitled to all the money it can make and it is the committee's opinion that unless the problem is handled in this light only delay, trouble and possible disaster will result. The committee asserts that the time is past when any large association can, by the weight of its members or influence, control labor in a manner inimical to the workers' interest.

The number of replies and acceptances to the invitations sent out has exceeded all expectations. From these replies the committee predicts the convention will be one of the most important meetings of its kind ever held.

Brigadier General Marshall of the construction division of the Army has

been invited, and has commended the aims as set forth in the invitation, stating that he will attend if possible. Charles M. Schwab of the Emergency Fleet Corporation has also expressed his endorsement of the purposes of the convention. Col. W. A. Starrett has stated that an association of this kind, with representatives at Washington, is so important, in his estimation, that should a Washington representative be appointed he will see to it personally that it is immediately supplied with offices and equipment.

Nominations for New England Water-Works Association

The nominating committee of the New England Water-Works Association has made nominations for officers of the association for the year 1919, including the following: President, Samuel E. Killam, superintendent of pipe lines and reservoirs, Metropolitan water-works, Boston; secretary, Willard Kent, civil engineer, Narragansett Pier, R. I.; editor, Henry A. Symonds, consulting engineer, Boston; and treasurer, Lewis M. Bancroft, superintendent of water-works, Reading, Mass.

Pooling of Government Motor-Vehicle Equipment Successful

The pooling, recently ordered, of the motor-vehicle equipment of the Army under the control of the Motor Transport Corps, has proved so successful in the District of Columbia, where it was first tried, that the system will speedily be extended to the entire United States. All passenger and cargo-carrying vehicles are included in the order, the effect of which will be to give a more efficient motor-transportation service for the Army with a greatly reduced equipment. Heretofore, motor vehicles have been assigned to the various departments for their exclusive use. Under the new plan, they will be operated under one control and for the benefit of all departments.

In Washington, where the need for passenger cars for official business is great, an elaborate taxi system has been established, consisting of 13 stations connected with an adequate system of telephones. Officers above the rank of captain are provided with cards entitling them to call Government cars, when needed, for official business only. Junior officers and civil-service employees must have trip tickets to gain the use of the special motor-car service. A bus service, operated on schedule between the principal buildings occupied by Army organizations, provides transport over regular routes for officers and employees on official business.

These arrangements have made it possible to reduce to 23 the large number of motor cars formerly assigned to officers for their individual use. Only the heads of departments, corps and bureaus are entitled to have cars assigned to them individually. The new system will reduce the motor equipment necessary for the Army's use.

Discuss Snow Removal and Highway Transport

Highway Traffic Association of State of New York Considers Plans for the Coming Winter

Snow removal in its various aspects and difficulties, and in its relation to highway transportation projects such as mail and industrial deliveries, was discussed at the meeting of the Highway Traffic Association of New York State, held Nov. 11 in New York City. Many prominent speakers who are experienced in snow removal were present and gave information as to cost, methods and necessary equipment. Throughout the meeting a patriotic sentiment prevailed, and many of the speakers prefaced their remarks by calling attention to the importance of highway improvements in giving employment to the returning soldiers. The president of the association, Prof. Arthur H. Blanchard, presided, and presented a resolution adopted by the executive committee favoring snow removal from the motor-truck routes by the various states.

Success of Motor Parcel Post

In announcing the success of the motor parcel-post service and the importance of good roads every day in the year, James I. Blakeslee, fourth assistant postmaster general, called attention to the use that might be made of the thousands of motor trucks being employed by the present military establishment. He stated that there are about 100,000 of these either in service or in course of construction, and suggested that they might be used in Government transportation of mail and merchandise.

The financing of a great system of national highways to take care of this service could be handled with much less friction than by the taxing method on account of the fact that the revenues of the service would soon pay the entire cost, it was asserted. As evidence of this fact, Mr. Blakeslee said that with a present investment of $300,000 the earnings of the service are $2,000,000 per year.

Snow-removal methods and equipment were next taken up, the principal speakers being Charles J. Bennett, state highway commissioner of Connecticut, and George H. Biles, second deputy highway commissioner of Pennsylvania. Attention was called to the various methods which must be used in various localities, depending upon the amount and character of the traffic. An important thing, according to Mr. Bennett, is to start early in the storm and to have the equipment so located, so manned and so instructed that upon the occurrence of a 3-in. fall of snow the organization will get to work without orders by telephone or otherwise.

Motor trucks with plows and road machines are used in snow removal, and rollers are used where it is desired to preserve the sleighing. Both speakers mentioned the value of the Weather Bureau reports in reporting the approach of storms.

Mr. Biles outlined the experience of Pennsylvania in snow removal during the past winter and called particular attention to the economic side of the matter. He asserted that, while at first the officials had considered the expenditure as practically a waste of money, they are now convinced that it is of great value in preserving the roads, the state roads having come through last winter in much better condition than ever before. On improved roads it is important to clear the snow to a maximum depth of 3 in., so that it will quickly melt and not rut; the rutting causes the motor trucks to follow the same track and thereby injures the surfacing. Open drainage is also an important factor. For a fall of 12 in. of snow, road machines work the best. From 12-in. to 36-in. trucks, with plows, are preferred. For a depth of more than 3 ft. a large A-shaped plow, with a spread of 16 ft. at the back, has proved successful. Snow removal costs from $50 to $200 per mile, according to conditions. Snow fences built for about 50c. per running foot have proved useful as a preventive.

Conditions in New York State were discussed by H. E. Breed, first deputy commissioner of highways, who read a letter from Commissioner Duffey, and by the Hon. Peter J. Ten Eyck, regional chairman, second district, Highways Transport Committee. While New York got a bad start last year in snow removal by waiting until the roads had a covering of from 1 to 2 ft., full preparations are being made to keep the main truck routes open in the coming winter. The importance of selecting the roads to be cleaned, so that the present transportation facilities are utilized to the utmost, and of coöperation with the local authorities to this end, was brought out by Mr. Duffey. Mr. Ten Eyck bore particularly on the danger of cleaning roads to such an extent that sleighs could not be used for transportation.

Work of Transport Committee Described

A short description of the work of the Highways Transport Committee was given by Raymond Beck, field engineer for the committee. He emphasized the fact that this committee would have as much work in the reconstruction period as it had during the war, if not more, and stated that the personnel of the committee now consists of 30,000 men. Col. W. D. Sohier, chairman of the Massachusetts Highway Commission, spoke briefly upon snow removal and the economics of highway transportation. He does not believe that motor-truck transportation will expand to any great extent, because railroad equipment can carry freight for one-tenth the cost and much faster. If highway transport is to be developed, roads that are tremendously stronger than those we now have must be built, according to Colonel Sohier, and others.

Sweeping Changes in Priority Regulations

(Concluded from page 914)

lations that required pledges from those why buy them for resale; except for such work as is not included in the 12 classifications.

In conclusion, the circular states that the Priorities Division will, as far as practicable, assist industries in procuring materials, fuel, transportation and labor to enable them to increase their operations to normal limits as rapidly as conditions may warrant. Precedence must, however, be given to stimulate and increase the production of cargo ships and supply the requirements of the Army and Navy of the United States, as well as to provide for this nation's share of the enormous volume of materials, equipment and supplies required for the reconstruction of the devastated territories of Europe. Precedence will also be given to such activities as will tend to stimulate the production of coal, natural gas, oil and its products, and of minerals; and to provide for maintenance, additions, betterments and extensions of railroads, telegraph and telephone lines, and other public utilities, and to permit and stimulate the intensive development of inland waterways.

Akron Adopts Commission-Manager Form of Government

Akron, Ohio, adopted a commission-manager form of government by the vote Nov. 5 on a proposed new charter for the city, for which 11,584 votes were cast in favor, and 6233 against. In the main, the new charter calls for a form of government formally known as the commission-manager form, although in Akron the commission will be called the council and the manager will be known as the chief administrator.

The council will consist of nine members, including the mayor, who will be elected by the people and will act as presiding officer of the council. The other members of the council are elected at large for four-year terms, four members being elected every two years. The mayor is to be elected for a two-year term. The council is subject to recall.

Under the terms of the charter adopted the chief administrator will be chosen by the council and can be removed by that body. He will select the department heads, with the exception of the director of the department of public health, who will be appointed by the health commission, the members of which will be selected by the chief administrator. The other departments created by the charter are those of law, public service, public safety, social service, and finance. The chief administrator also appoints members of the civil commission.

The charter gives broad powers to the city planning commission, appointed by the mayor.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

The National Federation of Building Industries will hold a meeting at Atlantic City Dec. 7, immediately following the meeting of the war service committees under the auspices of the Chamber of Commerce of the United States.

The New England Water-Works Association held its November meeting in Boston yesterday. After a meeting of the executive committee in the morning, a general meeting was held in the afternoon, the chief topic of discussion being "Experience on Labor Troubles." Papers were delivered on "Rates of Flow in Service Pipes and Meters," by Caleb M. Saville, Board of Water Commissioners, Hartford, Conn., and "Painting Standpipes," by Charles W. Sherman, consulting engineer, Boston.

The Brooklyn Engineers' Club will hold its regular meeting for November tonight, and will be addressed by George A. Orrok, New York, on "The Hydro-Electric Installation on the West Canada Creek at Trenton Falls, Near Utica, N. Y." A description of the plant that is the subject of Mr. Orrok's lecture was published in *Engineering News-Record* of May 30, 1918, p. 1028.

The Washington State Good Roads Association will hold its annual meeting at Pasco, Nov. 21-22. It is said that a large part of the discussion will be devoted to a state-wide system of highways. R. K. T. Hany, U. S. engineer, Yakima, Wash., will speak on "Preparation for Peace."

The Engineers' Club of Philadelphia will be addressed by George S. Webster, director of the Department of Wharves, Docks and Ferries of Philadelphia, on "The Port of Philadelphia," at the weekly luncheon to be held Tuesday, Nov. 19.

The Louisiana Engineering Society will be addressed at its meeting Nov. 18 by Leo. S. Weil, who will speak on "Fuel Conservation in Louisiana." It was necessary to postpone the regular meeting of the society from Nov. 11 to Nov. 18 on account of the influenza epidemic.

Personal Notes

LEWIS C. DUNCAN, Westville, N. J., has been appointed a member of the New Jersey State Highway Commission, succeeding the late George W. F. Gaunt.

WALTER MCNICHOL, Scranton, Penn., has been appointed chief of the Bureau of Factory Inspection and ex-officio acting Commissioner of Labor and Industry, succeeding Col. John Price Jackson, now absent on military duty.

R. E. KREMERS, chief of the bureau of construction, Board of Public Works, Portland Ore., has been commissioned with the rank of captain and assigned to duty with the 403d Engineers, stationed at Fort Douglas, Utah.

LIEUT. COL. PHILIP SCHUYLER DOANE, head of the health and sanitation division, industrial relations groups, United States Shipping Board, Emergency Fleet Corporation, will go to France during the next month to engage in hospital work.

CHARLES DAVIS, Spokane, Wash., has been appointed acting city engineer of that city during the absence of A. D. Butler, who has entered the construction division of the Army, as mentioned in *Engineering News-Record* of Oct. 17, p. 736.

JOHN F. LABOON, who was previously with the Pittsburgh Filter Manufacturing Co., Pittsburgh, Penn., has become a member of the firm of Chester & Fleming, engineers, Pittsburgh, by which he had formerly been employed.

D. G. THOMAS, chief engineer of the Denver Union Water Co. for the past 15 years, has resigned to enter private practice as a consulting engineer. During the first half of his 30 years' service with the company and its predecessor, he was general superintendent, his earlier experience in public utilities having been gained in England in gas works. The plant of the Denver Union Water Co. was turned over to the water commissioners of the city for operation, but the company still retains its corporate identity, the change in administration being brought about by the recent popular vote mentioned in these pages.

H. M. NABSTEDT, assistant engineer for the new water supply of Oklahoma City, has been appointed chief engineer, succeeding Guy V. McClure, whose death is noted elsewhere in this issue.

E. K. TROIL, C. L. Wartelle and R. W. McCrory, of the city engineering department of Seattle, have been com-

missioned in the Corps of Engineers, each with the rank of first lieutenant.

A. H. KINDRICK, city engineer of McAlester, Okla., has resigned to become supervising engineer on the construction of the sewage-disposal plant at Okmulgee, Okla., for Burns & McDonnell, consulting engineers, Kansas City, Mo.

HENRY R. STEVENS and Robert L. Rockwell have announced the dissolution of the firm of Stevens & Rockwell, consulting engineers, Seattle. Mr. Stevens has become electrical engineer for Stone & Webster's Seattle division, and Mr. Rockwell will continue in private practice, taking over the organization and equipment of the firm.

EDWARD EVERTT HALL, inspector, city engineering department, Seattle, has been commissioned in the Corps of Engineers with the rank of captain.

WALTER C. PATON, city engineer of Excelsior Springs, Mo., has been commissioned as a captain and assigned to the 412th Engineers, Camp Sherman, Ohio.

F. J. BISAILLON, K. C., Montreal, has been appointed as a member of the International Waterways Commission, succeeding P. B. Mignault, who has been appointed judge of the supreme court.

LIEUT. HARVEY C. C. WALKEM, Canada, who was severely wounded in France, winning the Military Cross, has been appointed resident engineer, Petewawa Camp, Ontario. Lieutenant Walkem is a graduate of the Royal Military College, Kingston.

CALVIN E. COCK, Spur, Tex., has been appointed engineer for the $3,000,000 road bond issue in Baylor County, Texas.

H. H. BIGHOUSE, second vice-president and chief engineer, C. O. Bartlett & Snow Co., Cleveland, who has been in charge of the eastern district of the company, will hereafter have his headquarters in the main office of the company at Cleveland, after the closing of the eastern branch in New York City on Nov. 12.

W. A. WYNN, Harrisburg, Penn., has resigned as engineer of the bureau of township highways, Pennsylvania State Highway Department, to become engineer for an organization of oil companies engaged in the development of Texas oil fields.

MAJ. GEORGE A. JOHNSON, officer in charge of the water and sewer section of the maintenance and repair division of the Construction Division of the Army, previously a consulting engineer of New York City, has been promoted to the rank of lieutenant-colonel, becoming ranking officer under Col. C. D. Hartman, officer in charge of the Maintenance and Repair Division. Some months ago Major Johnson closed his office in New York City and since then has been devoting his entire time to Government service.

F. L. SANFORD, lumberman and lumber mill owner of Zona, La., who recently has been largely engaged in advising Government departments on lumber purchases, has been commissioned with the rank of captain in the 20th Engineers, one of the forestry regiments.

H. L. TREEMAN, industrial engineer, J. G. White Management Corporation, New York City, has been promoted to the position of manager of the electric department of the Eastern Pennsylvania Railways Co. and the Eastern Pennsylvania Light, Heat & Power Co. of Pottsville, Penn., both of which are operated by the White corporation.

ROBERT C. BARNETT, until recently of the Missouri State Highway Department, has become economic engineer for the highways transport committee of the Missouri Council of Defense at Jefferson City, Mo.

BURTON LOWTHER, acting chief engineer of the Denver Union Water Co., has been made chief engineer of the water-works, which were turned over by the company to the water commissioners Nov. 1. Mr. Lowther went to Denver three months ago from Kansas City, where he had been chief engineer of the water department. He succeeds D. J. Thomas, mentioned elsewhere in these columns.

OBITUARY

EARL MILLER, Berkeley Springs, W. Va., for several years county engineer of Morgan County and district engineer of Berkeley, Morgan and Jefferson Counties, died recently, at the age of 28.

M. A. BENBENNICK, Bremerton, Wash., vice-president of the Northwest Master Builders' Association, died Oct. 18. Mr. Benbennick was also president of the Building Industries Board of Kitsap County, and had been active in the formation of the association.

I. M. BROWN, engineer maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at Indianapolis, Ind., died Oct. 3. He was born at Waynesboro, Penn., Feb. 3, 1882. His service with the railway began in 1907, as an instrumentman. He was successively inspector, supervisor of track, assistant engineer maintenance of way on the Chicago and Cincinnati divisions, and then engineer maintenance of way of the Indianapolis Terminal division.

GUY VINCENT MCCLURE, chief engineer for the new water supply of Oklahoma City, died Oct. 23 at the age of 43. After two years in general surveying work, Mr. McClure entered the service of the Sapulpa & Oklahoma Western Ry. in 1895, and remained in railway work until 1906, when he resigned as chief engineer of the Oklahoma City, Lexington & Sulphur Springs Electric Ry. to engage in private practice in the firm of Moore & McClure, consulting engineers of Oklahoma City. He was city engineer of Oklahoma City from 1911 to 1917.

MAJ. HAROLD W. ESTEY, who went to France in September, 1917, with the 101st United States Engineers, died of pneumonia Oct. 28. He was detailed from his regiment to a French staff war college, and after completing the course was assigned to duty as liaison officer connected with the General Staff. In April of this year he was decorated by the French Government for bravery. His military service began in 1897, as a private in the former First Corps of Cadets of Boston, in which organization he was a captain when war was declared. Soon after he became a major in the 101st United States Engineers. He was 46 years old.

CHARLES JOHN AUGUSTUS MORRIS of the firm of Morris, Shepard & Dougherty, railroad contractors in St. Paul, died in that city Oct. 27 at the age of 68. Mr. Morris was the chief engineer of the old St. Paul & Duluth Ry., now part of the Northern Pacific, from May, 1898, to 1900, when it was taken over by the Northern Pacific. After a short time in the service of Frankman Bros., bridge contractors, he formed the firm of McMullen & Morris in 1892. Mr. Morris' first engineering work was on the location and construction of the St. P. & P. R.R., from Barnesville to St. Vincent in 1871, and the construction of the railroad bridge over the Mississippi River at St. Cloud in the same year. In 1876 he became assistant engineer with the United States Engineering Department on surveys of the smaller lakes in Minnesota.

HOWARD RAYMOND MOORE, Company 3, Engineer Officers' Training School, Camp A. A. Humphreys, Virginia, died of pneumonia Oct. 3. He was graduated from the College of Civil Engineering at Cornell University in 1913 and was afterward on subway construction work in New York City and on power-house construction work at Omaha, Neb. He withdrew from the latter in 1917 to enter the Signal Corps of the Army on the construction of aviation fields at Fort Worth, Tex., and later at Lonoke, Arkansas.

FIRST LIEUT. HUNTER MCCLURE, Co. N, 21st Engineers, died of disease in France Sept. 26. Lieutenant McClure was a graduate of Cornell University, and at the time of his enlistment in December, 1917, was in charge of a field party on the valuation work of the Interstate Commerce Commission in California.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Scientific Precision for Industries Advocated

Present and Future Conditions Indicate Necessity for Study of Reduced Waste

War-taught lessons of scientific precision applied to all industrial operations is the substance of an article in a recent issue of *Commerce Reports* by Burwell S. Cutler, chief of the Bureau of Foreign and Domestic Commerce. He contends that the elimination of waste in distribution as well as in production, and the close study of the laws of supply and demand, are basic necessities. He says:

"If there is any one thing that the present war has taught our producers and merchants it is the basic necessity of scientific precision. Time and again military failure has been threatened by inability to utilize to the *n*th degree the scanty materials available for production of munitions. This is no less true in the manufacture and distribution of uniforms than of guns and shells. The elimination of waste, whether it be in men or time or material, has been forced upon all belligerent peoples as a measure of national defence.

DIFFICULT CONDITIONS MET

"It was impossible for any one of the belligerent nations to increase its production proportionately to the needs of its armies and its civilian population and at the same time withdraw from factory and shop millions of men—unless the utmost skill in the use of remaining facilities was employed. Factory after factory had to reduce the waste formerly resulting from rejection of faulty workmanship; even the original amounts of material allowed for standard units of production were reduced to the point where greater output and less material ran concurrently. For instance, a far greater volume of steel products is now being made with less steel than was anywhere near the case four years ago. Less wool is found in clothing; less first-grade sole leather in shoes, etc. Yet this change has come about in many cases without deterioration in quality, measured by the usefulness of the article. It is quite conceivable that a 6-in. shell can be given as high a destructive force with a $\frac{1}{16}$-in. casing as a $\frac{1}{2}$-in. casing, and that is true of the other commodities mentioned, the test being always the exact purpose to be served.

"Under the supervision of the best scientific managers to be found in industrial and mercantile life, every process of production and distribution has been carefully measured, until a nearly ideal attainment is established as a standard for all to follow. The need was desperate and the regeneration has been thorough.

"It may be said that the ground of procedure has been exact data, ascertained by thorough study and experimentation. Putting it another way, no goods are manufactured for which there is not a specific need thoroughly apparent and demandatory; neither is there delivery of articles to any region or people where want of them is not acute. This surety of procedure requires, of course, a prior study of the facts, and these facts are the data to which I refer. The inquiry has extended into many phases of human activity.

"This habit of basing all operations on sound and accurate information may be expected to survive after the war in the factories and storehouses of Europe. We in the United States must adopt the same attitude of scientific precision and should, as business men, avoid the excess cost of business conducted on inspiration as compared with business based on industrial and trade data. The Department of Commerce and other institutions of Federal, state and private authority can supply our business interests with the facts of the case relative to almost any economic problem or uncertainty, if the business men will acquire the habit of applying to those agencies for advice and information."

Wider Use of Metric System in This Country After War

That there will be a wider use of the metric system in this country after the war is indicated in the adoption of a resolution regarding the matter by the American Section of the International High Commission. The resolution recommends more extensive use of the metric system in the trade and commerce of this country. The commission regards this subject as of particular importance to the United States, pointing out that one of the main obstacles to documentary uniformity between the United States and Latin America is to be found in the fact that the United States does not make the use of the metric system obligatory.

Now that the United States is being drawn into closer and more vital commercial relations with the rest of the world, and particularly with Latin America, it is pointed out that our manufacturers and exporters will be obliged to meet the demands of their prospective customers, and the use of the metric system, it is pointed out will be an important step in that direction.

Program of Industrial Conference Announced

War Emergency and Reconstruction Meeting Will Concentrate on Post-War Conditions

Announcement has been made of the program of the Nation's Industries War Emergency and Reconstruction Conference, to be held in Atlantic City, Dec. 4-6. The meeting will be held as stated but, since the war is ended, the original plans for a war emergency conference will be diverted, so the whole conference will be concentrated on reconstruction.

One of the main purposes of the convention, as indicated in previous announcements, will be the forming of a federation of all the war service committees under the direction of the Chamber of Commerce of the United States. The 354 war service committees which until now have been acting separately will have means for concerted action through the federation.

The program announces that on Dec. 4 the opening session will be held on the "million-dollar pier," at 10 a. m. It will be followed by the general session at 2:30 p. m., in the same place. The separate meetings of the 350 or more war service committees will be held in the evening, and anyone who will attend is directed to consult the chairman of his committee to learn the place of meeting.

On Dec. 5, at 10 a. m., another general session will be held on the same pier; to be followed at 2:30 p. m. by the conferences of the ten major groups of committees. This will probably consume the remaining time of that day.

Another general session will take place on the same pier at 10 a. m. Dec. 6, and the final session at 2:30 p. m. in the same place will close the conference.

First Woman To Take Up Electric Welding Now at Hog Island

Miss Sarah A. Erwin, electric welder, is the first woman in the United States to be engaged in actual ship construction work, according to information received from the United States Shipping Board. Miss Erwin says that she likes the work and enjoys the distinction of being the first woman actually to have a hand in building the ships which will carry supplies to France.

She is the only woman in the correction and angle-plate shop of the Hog Island shipyard.

Miss Erwin is a product of the electric welding class of the yard training school, established under the direction

of H. A. Horner, head of the welding branch, industrial relations group, United States Shipping Board, Emergency Fleet Corporation. Miss Erwin spent two weeks in the school. Miss Anna Kanvisto took the same course and is also doing construction work.

Board Established to Adjust Government Contracts

Appointed by the Secretary of War to Hear and Determine Claims, Doubts or Disputes

A Board of Contract Adjustments has been constituted by order of the Secretary of War, to hear and determine all claims, doubts, or disputes which may arise under any contract made with the War Department.

Through the operation of the board, the contractors supplying the Army will be able to submit to it any differences that may arise between them and the contracting officers of the various supply bureaus. It will act without any of the technicalities of court procedure and insure a speedy and equitable adjustment, according to the bulletin sent out by the War Department. The board says that the service of lawyers will not be necessary, as the contractor or his representative may appear before the board and state his case clearly and fully, with the assurance that he will receive an impartial hearing and a prompt decision.

The members who have been appointed are Lieut. Col. Christopher B. Garnett, chairman, who was formerly chairman of the Corporation Commission of Virginia; Lieut. Col. H. H. Lehman, chief of the methods section, purchase branch, purchase, storage, and traffic division; and Lieut. Col. Edward S. Malone, formerly assistant corporation counsel of New York City for the Borough of Queens. The legal advisor of the board will be a judge advocate appointed by the judge advocate general. The board will also have a recorder and several examiners, who will be commissioned officers of the United States Army appointed by proper authority. The office of the Board of Contract Adjustment will be in Washington, but it is stated, hearings may be held in such other places as may be found convenient or necessary for the proper performance of its duties.

County Purchasing Motor-Propelled Road Equipment

The Mercer County (N. J.) Board of Freeholders has adopted a plan to obtain a number of motor-propelled snowplows to keep the highways open during the winter. They will confer with the committee on transportation of the Council of National Defense, and coöperate with the committee in working on the problems of keeping the roads throughout the East in the best possible condition, made necessary by the heavy war traffic.

Adjustment of Industries to Peace Basis

At Present War Contracts Will Largely Continue, but Cancellation Is Provided For

The cessation of hostilities has brought to the front the question of the adjustment of industries from war to a peace-time basis. For some time, for a period to be determined by the war-making agencies of the Government, Government contracts must continue on a wide scale, says a statement issued by Mr. Baruch of the War Industries Board. A memorandum issued by General Goethals, chief of purchase, storage and traffic, in the form of a circular provides for the cancellation and termination of contracts on which the work has not been finished.

The circular states that the contract provisions have been worked out with considerable care to meet the situations presented by both the cost-plus and fixed-price contracts. Should it become necessary to end a contract in which there are no provisions for termination, it will be possible for those who hold the contracts to adjust their rights by the provisions covering contracts in Supply Circular No. 88 issued by the Director of Purchase, Storage and Traffic, dated Sept. 17, 1918.

Other provisions for adjustment of contracts are possible through the appointment of a special war department board mentioned elsewhere on this page, but Mr. Baruch in his statement expresses the opinion that existing conditions will require the continuation of a large amount of war contracts.

Statement by Chairman Baruch

"As the demand for raw materials is lessened," the statement continues, "by the reduction of war requirements, the raw materials so made available will be released and allocated by the War Industries Board, for use in supplying civilian and export demands, which have been held in check during the war. In addition to the ordinary commercial requirements, there will be a heavy flow of materials thus released to supply the demand for the great reconstructional work required by the European countries.

"At the same time there is to be a gradual lifting of the restrictions and curtailments that have been imposed upon industry by the exigency of the war, so as to allow as promptly as possible free flow of all supplies into peace channels.

"The War Industries Board will continue to exercise its functions until the peace treaty is signed, to the end that the readjustment of the matters on which it has been acting may be made in as orderly a manner as possible.

"A committee named by the President has been and is now at work to devise the best mechanism of bringing about the adjustments from a war to a peace basis. Its report may take the form of suggested legislation."

W. S. Gifford Resigns From National Defense Council

Walter S. Gifford, until recently director of the Council of National Defense, has been appointed controller of the American Telephone and Telegraph Co., and has entered upon his new duties. Mr. Gifford was formerly chief statistician of the American Telephone and Telegraph Co., and his services were lent by that company, at the request of the Secretary of War, to assist in the organization of the Council of National Defense.

In accepting Mr. Gifford's resignation, the Secretary of War expressed appreciation of the services rendered by Mr. Gifford and the helpful and considerable pride he took in the organization and development of the Council of National Defense. Mr. Baker also expressed his regrets at Mr. Gifford's departure.

Business Notes

The Chicago Pneumatic Tool Co. announces the appointment of A. M. Brown as district manager of sales, 1740 Market St., Philadelphia, succeeding G. A. Barden, who remains in Philadelphia as sales representative for the company. For some time past Mr. Brown has been in the New York offices of the company as assistant manager of the compressor sales division.

E. P. Ballou & Co., export freight contractors of New York City, will open offices in Seattle, with J. H. Simmons in charge

The J. W. McMurry Contracting Co., railroad and bridge contractors, Kansas City, reports its removal to new offices at 511 Railway Exchange Building, Kansas City, Mo.

Trade Publications

The Brown Hoisting Machinery Co., Cleveland, Ohio, has issued catalogue D-1919, with half-tone illustrations of tram rails, trolleys, electric hoists, overhead traveling cranes, crabs, winches and portable floor cranes.

The labor turnover problem is treated in a 23-p. pamphlet entitled "Reducing Your Labor Turnover," published by the Industrial Housing Co., 405 Lexington Ave., New York City.

The Portable Power Saw Co., 247 Railway Exchange Building, Chicago, has issued an illustrated pamphlet describing the "New Portable Power Saw."

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

November 21, 1918

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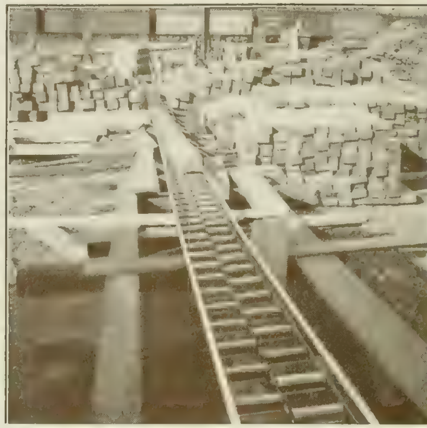

Portable sections can be moved about at will.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

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Let Public Works Take Up the Slack

EACH day that labor is unemployed there is an economic loss to the community. Every man not employed is either a public charge or an idle producing unit, and since it is certain that return to a peace basis will take some time, public works should absorb labor as fast as possible, even under conditions which might seem uneconomical on account of high wage scales and high prices of materials. Even if the public pays a greater price for public improvements, it prevents the economic loss due to idle man-power. If, to prevent unemployment, the army is demobilized slowly, the public pays for the maintenance of the soldiers. It would be better to demobilize as promptly as the military situation permits, increasing the amount of public work to such an extent as to prevent unemployment. Such a course would mean permanent and substantial returns for the money spent, whereas the maintenance of men in camp after the military necessity ceases is a dead loss.

A Slogan for Reconstruction

WITHOUT guiding principles of high character no movement or agency can come to great success. The war, for example, took on a new character after President Wilson had crystallized its purpose—"to make the world safe for democracy." In this period, similarly, the results will be great or small, lasting or ephemeral, according to the spirit by which reconstruction is animated. Some may want to restore the pre-war status in its fullness, regardless of cost, others may contend for all the structure and gains of war times without recognizing the disappearance of the conditions which brought them about. Between these contenders will be all manner of compromise positions, based, in many cases, upon the personal advantage of the scheme to the proponent. It will be difficult, of course, to eliminate selfishness, but after what the world has endured in these four terrible years it should be possible to get men in the mass to accept in so great an enterprise high ideals and guiding principles. So only can we bring out of the welter of war a better social order and one that will be lasting. We waged the war for "justice and humanity." So let us carry on our reconstruction. War-made institutions should be judged by those standards, and fall if they fail to conform to them. The time for idealism and sacrifice did not end on Nov. 11. It will not end until the last adjustment between war times and peace has been made.

Restrictions Removed From Road Building

IT IS good news to the highway engineers and builders of this country that all restrictions (save those relating to the obtaining of steel and the floating of bond issues) have been removed from highway building. Simultaneously with their removal the function of the United States Highways Council ceases. For the last there will be no regrets. The council, charged with a selective task, interpreted its work as being almost wholly restrictive, and its record accordingly is not such that its late demise will cause any sorrow. Highway work can now go forward wherever money is available from taxes, while, in addition, it is reasonably certain that the Capital Issues Committee will look with favor upon bond issues for road work. In fact, we expect the committee to welcome such issues, for a large amount of work must be undertaken shortly if we are to pass from a war to a peace basis without widespread unemployment. It is not too much to say, therefore, that the restrictions on highway building are off and that the road needs of the country can again be fully met. There is big work to be done, and in the doing of it the highway builders of the country will be sure of full support from the public.

Reconstruction Before the War-Service Committees

IN THE first week in December there will be a general meeting in Atlantic City of the war service committees created at the suggestion of the Government in some 367 industries or crafts. "What of reconstruction?"—that is the big question which the committees have been asked to face. In a sense, it will be the introduction of the industries of the country to their new rôle, that of demobilizing industry, of foreseeing the difficulties that are ahead and of arranging for an orderly and peaceful transfer of the country's factories and enterprises from a war to a peace basis. The meetings will be of tremendous importance. On the decisions reached will depend the attitude of the nation's industries during reconstruction. That the decisions will be wise, that they will be vigorous, that they will be so appealing as to win universal support, will be the prayer of every American. The penalty for vacillation, for selfishness, for a weak attack is serious for industry and for the country; under those conditions the thinking business men of the nation would have little influence on the progress of reconstruction, and the whole great problem would be cast into the hands of the politicians. Already the latter

are quarreling over its handling. If they are allowed, unchecked by the thinking elements of the community, to settle the grave questions at issue on the basis of bargaining and political advantage, the country is destined to suffer from the mischief that will ensue.

Engineer Heads Citizenship Efforts

AS A reconstruction measure, the Dallas Chamber of Commerce has appointed an engineer to develop a department to increase community spirit and character of citizenship. Successful business development, just like successful community life, is more dependent upon character of citizenship than on increase in population or in number of factories. Charles Saville, the new director, is a sanitary engineer, has been connected with the Dallas Board of Health for several years and has traveled much abroad. He is well fitted by experience for this important task. Mr. Saville recognizes that two of the most important industrial problems are labor shortage and the lack of sympathy and coöperation between capital and labor. He proposes to meet the former difficulty through increased labor efficiency, by making the worker's home and his community surroundings more desirable. A bureau of industrial relationships will study local labor problems and be prepared to ease the relations between employers and employees. It will anticipate and relieve certain kinds of working conditions before they become so intense as to cause serious and difficult situations. That Dallas has chosen an engineer for this work is gratifying. Accustomed to studying causes and effects and trained in the search for facts, he is better qualified than any other specialist for such a task. The profession will be glad of Mr. Saville's opportunity and will be interested in the results.

Engineer Personals

NEWS of the movements of engineers—their appointments, promotions, changes and resignations—is of such interest in professional and commercial circles that the notes published in the "Personal" columns of *Engineering News-Record* weekly are very widely read. Very soon they will receive added importance, because we shall try to record therein the return to civil life of the thousands of engineers and contractors who have been in the service of their country. As our readers well know, we tried to record their entry into military or public service. That was important, because it showed the extent to which engineers and contractors were backing the Government in its great enterprise. Yet the new "personals"—those of demobilization—will be all the more important because they will enable friends to get in touch again with each other and will tell to all interested in engineering work the positions which the returned soldiers and civilians in Government service have taken up. For the supply of news of this sort reliance must be placed largely on those directly concerned or on their friends and business associates. We strongly urge upon all of our readers the prompt sending to us of news of the reëntry into civil life of men from the civil engineering ranks, both engineers and contractors. We shall avail ourselves of the ordinary military and public sources of information, but these will not tell the positions to which the men are going. Of course, we want news of all changes pertinent to the civil engineering field, but at this time in particular we appeal to readers for news regarding those who are leaving the service of their country, whether they have been in uniform or not.

Primitive Construction Methods Necessary in an Age of Tools

CONSTRUCTION methods of the pioneer, despite a quarter of a million miles of railway and our multitude of machines, have an important place in the work of the engineer even today. The mechanical helps of the lumberman are many and most efficient, but the constructor must still go ahead and with axe and saw and the other simple tools of the pioneer prepare the way for their use. So also, as was described in last week's issue, the constructor of drainage works in the tamarack and cypress swamps of Minnesota and Arkansas must build extensively by pioneer methods in preparation for the work of his giant land and floating dredges. Talent of a special kind is demanded of these pioneer builders, and experience and practice count more heavily in reaching success than they do where the paths have been marked by textbook and pocket manual. It is a real test of the engineer's talent as a builder, to go into the woods with no more materials and tools than a team can haul in a woods wagon and cut and hew and assemble and erect the timbers for an 80-ft. span truss bridge. Let us not forget to salute this man among construction engineers.

Abandoning the Electric-Railway Ship

"ABANDONING an electric-railway ship" may be a horribly mixed way of stating the situation, but abandonment is just what some electric-railway operators are now advocating. Early this month there was introduced at a meeting of the American Electric Railway Association a resolution urging upon the member companies that they facilitate in every reasonable way the acquisition by the public of the present electric-railway properties and assist in the promotion of the necessary enabling legislation. The introduction of such a resolution in an association of this sort is cause for surprise, especially as it came from the president of the Milwaukee Electric Railway & Light Co. and had the support of the president of the United Railways Co. of St. Louis. The resolution has been submitted to the member companies for letter ballot.

It is not conceivable that the association will indorse it. While the electric-railway properties of the country are in bad shape financially, it is unlikely that their owners will "throw up the sponge." In fact, we feel that local conditions in Milwaukee and St. Louis biased the judgment of those who fathered the resolution. It has the outward appearance of corporate weariness and a desire to be rid of difficulties.

We may sympathize with the individuals in their trouble, but instead of just quitting we expect from them a solution which will be for the best interests of the public. Why, otherwise, have they been managing *public-service* enterprises? A paper read just before the introduction of the resolution very surprisingly stated that all problems of service, rates of wages, rates of

fare, etc., could be better solved under public than under private ownership. If that is true, then electric-railway operators—and also the operators of other public utilities privately owned—have been dishonest with themselves and with the public for these many years. They have contended that private operation was better for the public than public operation. In this view *Engineering News-Record* still persists. We believe that there are certain advantages in private operation that cannot be obtained, in the present state of civic development, under public operation. But private operation, if it is to be governed by the type of brains or lack of brains which has characterized much of the electric-railway operation of this country, can never expect to succeed. The electric railways are in their present position largely because they deserve it.

What we should expect from an association such as that of the electric railways is a broad consideration of all of the factors affecting electric-railway operation, all questions being constantly referred back to the primary purpose—the best service to the public. Such an inquiry, we believe, would result in an indorsement by the association of the partnership type of operation, such as obtains in a number of cities of the Middle West. Here there is close community control, with an assurance that the company cannot profiteer. On the other hand, the benefits of private operation are retained.

Will the electric railways abandon the ship, or will they fight for a solution best for the public and fair to themselves?

Caution Necessary in Revising the Shipbuilding Program

CHANGES in ship demand came upon the world suddenly with the end of active warfare. A month ago the call was for ships, ships of any kind so long as they were ships—wood, steel, concrete; small or large; economical or wasteful in coal and crew expense—no matter, provided they would float and carry cargo across the seas. Today the demand is for ships that can meet commercial needs and compete on even terms with the rest of the world's fleet.

It is inevitable that shipbuilding should be adjusted to the new demands. The nation's enterprise of building a merchant marine sufficient for all its transportation needs will fail if its ships are not efficient as carriers on the ocean trade routes. We must build the best and most serviceable vessels which the naval architect's skill can produce.

But above all, we must build ships. The momentum of our new shipbuilding industry may not be checked. The need of the day is to stimulate rather than diminish the zeal of shipbuilders. They are now burdened with the double responsibility of maintaining production though radically altered working conditions are in prospect, and preparing for changes in their product and methods to enable them to enter competitive commercial work as soon as the Government may direct.

Encouraging words were spoken last week by the Shipping Board authorities and by the Secretary of the Navy. Their message was that full activity in shipbuilding is to be maintained. And the people of the country are heartily with them in this resolution. The country demands undeviating pursuit of the merchant-marine ideal. It demands also that the hundreds of millions of investment in the shipyards shall remain at work, for it knows that present safety depends upon wise conservation and upbuilding.

Abrupt revision of the shipbuilding program will accomplish the very opposite result, however. New forces of great magnitude have been brought into action in speeding the construction of ships. If these forces are paralyzed—except on the clearest justification of compelling necessity—the stability of the industry will be gravely menaced.

Wooden, concrete and fabricated-steel vessels were created. Each drew into its service vast resources of men and materials. Are these to remain at work or be eliminated? Are they to be released to individual initiative? The yards of the Lakes were set to work building seagoing ships, small, it is true, but vital in our emergency. Shall they continue in the work?

These questions demand early answer. Yet it is of the utmost importance that they be answered in the right way. The danger of disruptive and disorganizing changes in the shipbuilding program is close at hand.

There is another new condition that has been created by the return of peace to the seas. Coöperation of the entire country in the high-pressure work of shipbuilding will henceforth be contingent on the country's participation in shaping the policies; and this participation must be based on knowledge of the underlying facts. Information on ship service and shipyard operations had to be withheld from public knowledge while the war was in progress, and policies had to be shaped by decree—a condition which the country willingly accepted during the war. An opposite procedure now becomes necessary—clearest and fullest publicity.

Are concrete and fabricated-steel ships justifying themselves in service and cost? Have wooden ships made a success? Is the service of the Great Lakes vessels satisfactory? No light has been thrown on questions of this kind in the months past. Yet further action in respect to the shipbuilding program is bound to depend on them. Let it be recognized that such action will secure public support only in the degree that the underlying facts are made known. To engineers in particular these facts are important; and if, for example, radical changes are to be made in the program for building concrete ships or fabricated-steel ships, they are not likely to accept the decision unless it is preceded by adequate justification by facts.

In the revolution through which shipbuilding has gone, there are involved potential changes in ocean shipping conditions also. No one man, and no small group of men, possesses the foresight needed for safely making far-reaching decisions on future shipping. There are many signs to indicate that, just as life-long shipbuilders have in recent times acquired new views of their art and its possibilities, so the men who carry on the world's shipping are remodeling their traditions and are arriving at a new knowledge of ships. In the light of this contingency, it is even more emphatically necessary for our Shipping Board, when it undertakes revision of the shipbuilding program, to proceed with utmost caution and in partnership with the country.

New Impact Formulas Needed in Designing Bridges of Various Types

Scarcity of Experimental Knowledge of Impact Shown By Review of Tests and Studies—Group of Formulas Proposed—Lower Impact Allowances for Solid-Floor Bridges and Concrete Arches

BY J. A. L. WADDELL
Consulting Engineer, Kansas City, Mo.

RECOGNITION of the fact that impact effects are less in solid-floor bridges than in bridges with light wooden floors, and less in solid-filled masonry arches than in steel bridges, has been quite general among bridge engineers for years past, but no formulas expressing this fact quantitatively have become established. Such formulas are needed for safe and economical designing. The writer therefore proposes a group of formulas, covering all the principal types of bridges, based in part on a discussion of impact tests and in part on long experience in bridge design.

It is necessary first to establish clearly what impact in bridges really is. Many engineers believe that impact allowances either cover or should cover the prejudicial effects of shock, vibration, alleged fatigue of metal, eccentricities, secondary stresses, and minor imperfections in manufacture—in fact, that they usurp the function of what the late C. Shaler Smith used to term "the factor of ignorance." Such is not the case. As the bridge designer applies it, *impact is the measure of the difference in the effects of any load applied dynamically and applied statically.*

In amount, impact varies greatly with the governing features of the structure, the character of the loading, the velocity of the moving load, the conditions of track and rolling stock, etc. The bridge engineer naturally is concerned only with its maximum values; hence, in determining formulas and diagrams for impact, the worst probable conditions are always assumed.

It is difficult to divorce the idea of impact from that of secondary stress; and in one sense it is impracticable to do so, because impact applies to secondary as it does to primary stresses. If the impact allowance increases the computed static primary stress in any bridge member 25%, it will increase also by 25% any secondary stress that may exist simultaneously therewith in that member. Secondary stresses are due mainly to eccentricities of connections and to distortions of rigidly-connected members under load; and it is evident that these, as well as the direct or primary stresses, are augmented by shock or vibration.

First Impact Tests Made Seventy Years Ago

The existence of impact on bridges was recognized as far back as the middle of the past century, for in 1849 some crude experiments were made by an English engineer named Willis by running a carriage variously loaded, and at different velocities, over a pair of iron bars 9 ft. long. The deductions drawn from the experiments were that the deflections increased with the velocity, at least up to a certain point, and that they reached to two or three times the static ones; but the bars were made so light that their deflections were proportionately too great to be compared with those of a bridge.

In 1875 the late J. T. Fanning obtained diagrams of the motion of a bridge under live load at or near midspan, by means of a platform supported by the ground and entirely disconnected from the structure.

In 1881 H. Sabine and the late Prof. S. W. Robinson made some records of deflections at both center and quarter points of a 60-ft. Howe-truss span, which was one of a pair of continuous spans. They found an impact varying from 6 to 12% with velocities not exceeding 30 miles per hour.

In 1881 Dr. W. Fränkel of Germany invented his extensometer and made a few tests with it for secondary stresses, but did not then apply it to the determination of impact. In 1884, however, he used it for this purpose, in connection with his deflectometer, on different members of railroad bridges; and in 1887 similar experiments were made by him on an iron rocker-pier viaduct at Weida.

Between 1881 and 1887 Prof. S. W. Robinson, during tours of inspection of certain Ohio railroads, made a number of deflection tests on bridges; and in the latter year he read before the American Society of Civil Engineers an important paper entitled "Vibration of Bridges." In it he showed impact records running as high as 50%, with an average for a dozen cases of 26½ per cent.

Impact tests were started in France in 1891 by M. Cüenot. He experimented upon a 35-m. span, and found with a train-velocity of 22 miles per hour an impact of 22%. These tests were followed there in 1892 by those of M. Deslandres, who experimented upon a 30-m. highway span. He discovered that the vibration due to the passage of a single horse and cart at a trot caused a deflection as great as one-half of that from the maximum load when statically applied. Three horses and carts, weighing altogether less than 10,000 lb., when passing at a trot gave approximately the same deflection as that of the said statically applied maximum loading.

Rabut's Formula Developed From Tests

The most important impact experimenting done in France was the work of the writer's friend, Col. Charles Rabut. He started his investigations in 1892 and completed them in five years. He obtained impacts ranging from 10% to 50%, and established for short spans the formula,

$$I = \frac{1}{1 + \left(\frac{L}{4}\right)^2}$$

where L is the span in meters.

J. Melan of Austria in 1893 made a mathematical analysis of impact for various span lengths, finding values varying from 77% for 5-m. spans to 15% for 120-m. spans.

In 1899 Prof. F. E. Turneaure of Wisconsin began

his famous research on the effect of impact, which he has continued up to the present time. Of late years his work has been done in connection with the American Railway Engineering Association, in which he acts as chairman of a special committee. His first tests were made on plate-girder spans varying in length from 25 to 80 ft., and on truss bridges with spans from 100 to 200 ft., mainly under regular railroad traffic. The largest value for impact which he then found was 50%. About the same time E. Herbert Stone conducted an extensive series of experiments upon impact on railroad bridges in India, finding a maximum value of 50% for short spans.

Schneider Formula Used For Many Years

As early as 1887 the late C. C. Schneider, afterwards president of the American Society of Civil Engineers, had proposed the formula,

$$I = \frac{300}{L + 300}$$

in which I is the coefficient for impact and L is the length in feet of that portion of the span which is covered by the moving load when the member under consideration receives its greatest live-load stress.

This formula was used for many years thereafter, indeed until five or six years ago.

Theodore Cooper may be said to have covered the effect of impact in some of his earlier specifications for bridge designing, when he provided that the working intensities applied to dead-load stresses should be twice as great as those applied to live-load stresses. For instance, D being the dead-load stress and L the live-load stress, and the intensity for tension being 10,000 lb. for live load, the intensity for dead load would be 20,000 lb., and the sectional area required would be given by the equation,

$$A = \frac{L}{10{,}000} + \frac{D}{20{,}000} = \frac{2L + D}{20{,}000}$$

This means that the impact allowance for the live-load stress in any part of any kind of bridge of any span length should invariably be 100%; or, in other words, that the live load is always twice as effective (or destructive) as the dead load, no matter whether the piece under consideration be the beam hanger of a suspended cross-girder or the chord of a 500-ft. span. A number of American railway engineers, when writing bridge specifications for their systems, copied this feature and continued to employ it for many years, notwithstanding its *prima facie* lack of soundness.

Confusion Caused By the Fatigue Fallacy

For more than a decade many American bridge specifications were cursed with a provision against an imaginary fatigue of metal, based upon the results of the investigations of some German scientists, who, in their testing, stressed metal *beyond the elastic limit* many times in quick succession—often until rupture was accomplished. Sometimes the experiments were in either tension or compression only, but in some cases they were alternately in each. Certain American engineers, who apparently desired to be progressive, incorporated this fatigue-of-metal idea into bridge building by employing for intensities of working stresses factors involving maximum stress and minimum stress, thus greatly augmenting the work of bridge computers. A few American bridge specialists, however, among them the writer, from time to time protested against both the uselessness and the incorrectness of the alleged refinement; and gradually the objectionable feature disappeared from our standard bridge specifications. The logical reason for abandoning the burdensome practice was that fatigue of metal does not occur until after the elastic limit is passed, and in bridge designing it is customary to limit the intensities of working stresses to one-half of this for combined live, impact, and dead loads, and to seven-tenths thereof for the most improbable combination of maximum stresses due to all the kinds of loadings that are ever considered in bridge designing as acting simultaneously.

A very satisfactory proof of the incorrectness of the fatigue-of-metal theory in bridges was given in *Engineering News-Record* of Apr. 4, 1918, by George H. Pegram, past president of the American Society of Civil Engineers, who made a number of tests on metal specimens cut from one of a lot of stringers that were removed from a New York City elevated railroad. Mr. Pegram could find no evidence whatsoever of any fatigue, notwithstanding the fact that the stringer thus tested had withstood the passage of fully one hundred million wheel loads.

Recent Experiments and Conclusions

In 1891 the writer, in a paper presented to the American Society of Civil Engineers, entitled "Some Disputed Points in Railway Bridge Designing," made an earnest appeal to the engineering profession for a systematic study of the question of impact on bridges; and in 1896, when preparing the manuscript of his "De Pontibus," he outlined a series of tests which he contemplated making. The project fell through, but early in 1902, when examining bridges on the International & Great Northern Ry. in Texas, the writer was able to make numerous experiments on deflections, using for the purpose a somewhat crude but quite efficient deflectometer constructed in his own office. He found impacts varying from 50% on an 88-ft. deck open-webbed riveted span to 20% on truss spans not exceeding 160-ft. in length. He learned then a very curious fact, viz., that for identical superstructures the amount of impact is dependent upon the character of the supporting substructure; because in the case of several spans of 159 ft. resting on masonry piers the percentage was 20, while it was 40 for two similar spans on small cylinder piers.

No other step of any importance was taken in America to study systematically the question of impact on railroad bridges until 1907, when the American Railway Engineering Association appointed a committee to make a thorough investigation of it. That committee in 1911 issued a report indicating that it had experimented upon 21 plate-girder spans up to 100 ft. in length, and upon 24 truss spans from 100 to 250 ft. in length, using generally enough loaded cars to cover the span tested, and employing speeds from 10 to 60 miles or more per hour. From that report are taken the following statements and conclusions:

For speeds under 10 or even 15 miles per hour the recorded impact was practically zero.

The chief factors in causing impact are unbalanced locomotive drivers, rough and uneven track, flat or irregular wheels, eccentric wheels, rapidity of application of load, and deflection of beams and stringers. (The term "impact" was considered by the committee to include any effect of the moving load which results in primary stresses exceeding the static stresses).

With the track and the rolling stock in good shape, the chief cause of impact is the unbalanced condition of the drivers of the ordinary locomotive. This condition does not exist in balanced four-cylinder locomotives or in well designed electric locomotives.

Recommendations of A.R.E.A. Committee

The committee corroborated the fact, discovered long ago by Prof. S. W. Robinson, that the maximum impact on a bridge is dependent upon how nearly its normal rate of vibration coincides with the times of the series of impulses from the unbalanced-driver loads. The critical speeds observed varied from 65 miles per hour for 60-ft. spans to 25 miles per hour for 300-ft. spans and to 20 miles per hour for a 440-ft. span. This corroborated the results of the writer's experiments, previously mentioned, in which he found for spans of 150 or 160 ft. critical speeds of 35 or 40 miles per hour. The committee also noted, as the writer had anticipated many years previously, that the impact on the separate main members of a span is greater than that upon the structure as a whole, or, in other words, that extensometer measurements give somewhat larger results than deflectometer measurements.

The committee suggested two formulas for impact based on these experiments: viz.,

$$I = \frac{1}{1 + \frac{L^2}{20,000}} \text{ and } I = \frac{60}{L}$$

where I and L have the same significance as in the Schneider formula previously quoted.

New Formula Proposed Two Years Ago

The summary of the committee's report given on p. 41 of Part 3 of the American Railway Engineering Association's *Proceedings* for 1911 (and reproduced on pp. 125 and 126 of the writer's "Bridge Engineering") makes very interesting reading.

Its subsequent report, published on p. 115 of the 1916 *Proceedings*, recommends a new formula,

$$I = \frac{1}{1 + \frac{L^2}{30,000}}$$

This is an improvement on the two others previously recommended; nevertheless, the curve which it represents passes beneath some of the plotted points for comparatively long spans.

In Volume CC of the *Proceedings* of the Institution of Civil Engineers, p. 178, there is a valuable paper by Charles William Anderson, entitled "On Impact Coefficients for Railway Girders," in which, among other matters, he deals with some experiments conducted in India by the government bridge engineer, H. S. Sales, deducing the following impact formula:

$$I = \frac{50}{50 + L}$$

The author of the paper states that "the formula has no direct scientific basis." It does not cover all the maximum results of the experiments, and he expresses some doubt about its being "sufficiently liberal for new girders." When the corresponding curve is plotted on a diagram upon which are marked the results of the A. R. E. A. experiments, the insufficiency of the proposed formula becomes very apparent. (See the accompanying diagram, Fig. 1.)

Experiments made in the summer of 1917 by Prof. F. E. Turneaure on spans varying from 60 to 240 ft. under trains hauled by electric locomotives form the latest contribution to the test record. His general de-

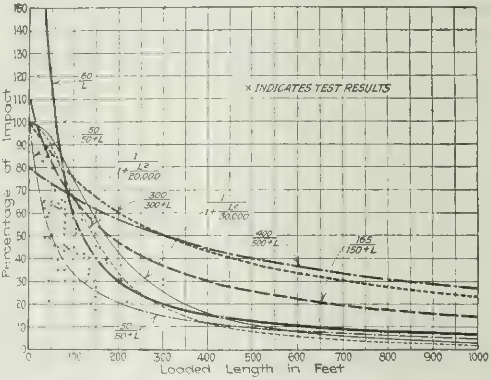


FIG. 1. SOME IMPACT FORMULAS INADEQUATE TO COVER MAXIMUM TEST RESULTS

duction is that "it appears to be fairly well established that the impact effect from electric locomotives is very much less than that from steam locomotives of the usual type"—in fact, not to exceed one-third thereof.

This information, which is about all of any value that the profession possesses concerning impact from electric locomotives, is of great importance. In view, however, of the paucity of such experiments, the writer suggested in a letter to Professor Turneaure that, for the present at least, it might be well, as a matter of precaution, to assume that impact on bridges from electric locomotives is about one-half of that from steam locomotives; and to this Professor Turneaure agreed. He says—quoting from his letter in reply—"Of course, in adopting a formula for actual use on the basis of the limited amount of experimental work we have done, it would be wise to be on the safe side; and an allowance of one-half would be very reasonable from this standpoint. As I now think the matter over, I do not see that there would be any great difference in relative effect on different members of the bridge, as our experience throughout has shown an overpowering effect of the unbalanced parts of the steam locomotives."

Various Formulas Compared

The preceding condensed history contains references to practically all the investigations of any importance yet made. Some others there were, it is true, but as the results thereof were not conclusive they have not been mentioned.

While there have been numerous impact formulas advocated during the past three decades, only two of them

have been employed at all generally—that of Schneider and the writer's modification of it; viz.,

$$I = \frac{400}{L + 500}$$

Concerning the latter formula, the writer two decades ago in the first edition of "De Pontibus" stated as follows:

"This formula was established to suit the average practice of half a dozen of the leading bridge engineers of the United States, as indicated in their standard specifications, and not because the author considers that it will give truly correct allowances for impact. In spite of all that has been said to the contrary in the past or that may be said in the future, the impact method of proportioning bridges is the only rational and scientifically practical method of designing, even if the amounts of impact assumed be not absolutely correct; for the said method carries the effect of impact into every detail and group of rivets, instead of merely affecting the sections of the main members, as do the other methods in common use."

In the twenty years since, the writer has found in his practice no reason for doubting the correctness of this opinion. It is true that the elaborate series of experiments conducted by the American Railway Engineering Association has shown that the old formulas give results which are too low for very short spans and are unnecessarily high for very long ones; but the variations on the side of danger have not been at all serious, nor have those on the side of safety been excessively extravagant.

In "Bridge Enginering," on pp. 125 and 127, are recorded various recognized impact curves and numerous points indicating the results of the A. R. E. A. experiments. From these has been prepared the diagram marked Fig. 1, which shows the old Schneider and Waddell curves, the three curves corresponding to the proposed formulas of the A. R. E. A. committee, the new British curve derived from the Indian railways experiments, and a curve lately suggested by the writer in "Bridge Engineering;" and also records, by crosses, the before-mentioned results of the A. R. E. A. experiments.

From this diagram it will be seen that the Schneider formula gave more correct results than the writer's modification thereof, both being on the safe side for spans of 100 ft. and over but on the danger side for the shorter spans. The new English formula is seen to be entirely inadequate, being generally on the side of danger. The three proposed formulas of the American Railway Engineering Association pass beneath a number of the plotted points, and the two complex ones fail to give any values greater than unity, just as did the old Schneider and Waddell formulas.

Single-Track and Multiple-Track Impact Formulas

Basing on this graphical comparison, the writer contends that his single-track impact formula,

$$I = \frac{165}{L + 150}$$

provides better results than any of the others, being somewhat on the side of safety for spans longer than those which have thus far been tested for impact.

Unfortunately, the experimenting done thus far has been mainly upon single-track structures. Consequently, the formulas for double-track and multiple-track structures have had to be established by *a priori* reasoning. The writer's formula for steam-railway bridges is

$$I = \frac{165}{nL + 150}$$

where n is the number of tracks carried by the structure.

If we compare the values given by this formula for double-track and for single-track bridges, we find that the ratios vary from 0.71 for short spans to 0.55 for long ones, with an average of about 0.59. If we assume, which is more than probable, that a load on one track only will produce quite as large an impact effect on the nearer truss as that which would exist with both tracks loaded (because the vibrations from the two trains tend to check each other), the ratios of impact value for double-track and single-track structures will be the same as those of the live loads per truss for one track only loaded and both tracks loaded. These ratios vary from 0.73 for short spans to 0.7 for long ones. As it is likely that a live load on a double-track bridge will give percentages of impact a trifle lower than the same live load would on a single-track bridge (because of the greater shock-absorbing capacity of the former), it is probable that the writer's formula when applied to double-track bridges is sufficiently accurate.

Concerning its correctness for a still greater number of tracks, it is almost entirely useless to make any surmise, because there are no data whatever to go by. The fact that for very long spans the formula when applied to multiple-track bridges gives values of less than 5% is a fair indication of its probable reliability within reasonable limits.

Impact on Electric-Railway and Highway Bridges

In establishing his impact formula for electric-railway bridges,

$$I = \frac{120}{nL + 175}$$

the writer depended solely upon his judgment. The results of this formula for both single-track and double-track bridges are about 70% of those found by the formula for steam-railway structures. Judging by the correspondence with Professor Turneaure, previously referred to, it would have been more nearly correct to write it with 84 in the numerator. In that form it gives results so close to those of the writer's formula for impact in highway bridges, viz.,

$$I = \frac{100}{nL + 200}$$

that the latter may properly be assumed to cover both highway and electric-railway structures. When tested against the impact formulas for single-track and double-track steam-railway bridges, it indicates ratios varying from 0.5 for short spans up to 0.6 for long ones; hence, it should certainly be safe and suitable for both electric-railway and highway structures. In the latter the value of n is the total width in feet of the entire deck divided by 20, while in the former, of course, it is simply the number of tracks on the structure.

When one considers that rapidly passing motor trucks on the rough pavements of highway bridges are

just as likely to produce high values of impact as are easy-riding trains on the comparatively smooth track-rails of electric-railway bridges, it is evident that there is no incongruity in employing the same impact formula for these two classes of structure.

In Fig. 2 are plotted the impact curves for single-

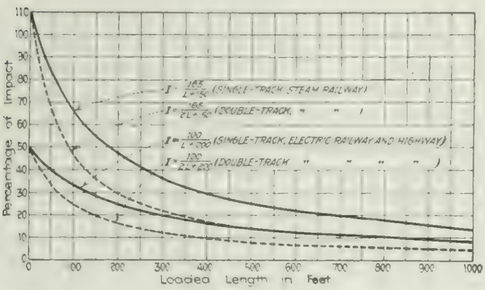


FIG. 2. EFFECT OF DECK WIDTH AND BRIDGE SERVICE ALLOWED FOR BY RECOMMENDED FORMULAS

track and double-track steam-railway loads and for single-track and double-track electric-railway loads. The last two curves, as before noted, apply also to highway loadings.

Impact Allowances for Special Cases

In figuring loads on foundations the impact is generally taken as zero. This is all right for heavy bridges, especially if the piers are massive; but for light structures resting on slender piers a certain amount of impact should be included, ranging from about one-half that of the trusses or girders for trestles down to about one-quarter of the same for long spans. This is a matter in which judgment based upon wide experience should govern. It must not be forgotten that the impact for a pier must be computed for a length of structure equal to the sum of the lengths of the two spans which it helps to support.

All the formulas for impact on railway bridges hereinbefore discussed are predicated upon the employment of open floors of the ordinary type of railway track; and those for highway bridges upon using plank flooring supported on timber joists. If, instead, a reinforced-concrete base to support the track or the pavement be adopted, its massiveness will certainly aid materially in checking vibration and, therefore, in reducing impact; but to what extent no one can say until an elaborate series of experiments is made. In the writer's opinion, the solid floor will probably reduce the impact about 25 per cent.

Modifications for Concrete Open-Spandrel and Filled Arches

Again, the impact on reinforced-concrete arch rings is very much less than that on trusses of steel railway bridges with open decks or on those of steel highway bridges with wooden floors; because, in addition to the rigidity obtained from the reinforced-concrete base, there is that due to the massiveness of the cross-girders and columns or the cross-walls, as the case may be. On these accounts, the writer believes that the impact on arch rings for open-spandrel arch bridges may safely be taken as one-half of that adopted for the trusses of the corresponding steel structures with flooring of light type.

Finally, for the arch rings of earth-filled arch bridges, shock and vibration are so absorbed by both the massiveness of the concrete construction and the inertia of the superimposed earth filling that it will be proper to assume the value of the impact to be only one-fourth of that for the before-mentioned trusses of the corresponding steel structure with light flooring.

Recommended Formulas Summarized for Ready Reference

Recapitulating, we have the following impact formulas to cover all kinds of bridges:

Steam Railway Structures:

For steel bridges,

$$I = \frac{165}{nL + 150}$$

in case of open floor;

$$I = \frac{124}{nL + 150}$$

in case of ballasted floor on concrete base.

For reinforced-concrete structures, excepting spandrel-filled arch bridges,

$$I = \frac{83}{nL + 150}$$

For spandrel-filled arch bridges,

$$I = \frac{41}{nL + 150}$$

Highway and Electric-Railway Structures.

For steel bridges,

$$I = \frac{100}{nL + 200}$$

in case of light floor;

$$I = \frac{75}{nL + 200}$$

in case of heavy, solid floor.

For reinforced-concrete structures, excepting spandrel-filled arch bridges,

$$I = \frac{50}{nL + 200}$$

For spandrel-filled arch bridges,

$$I = \frac{25}{nL + 200}$$

These eight formulas may be condensed into two, thus:

Steam Railway Structures,

$$I = \frac{165A}{nL + 150}$$

Highway and Electric-Railway Structures,

$$I = \frac{100A}{nL + 200}$$

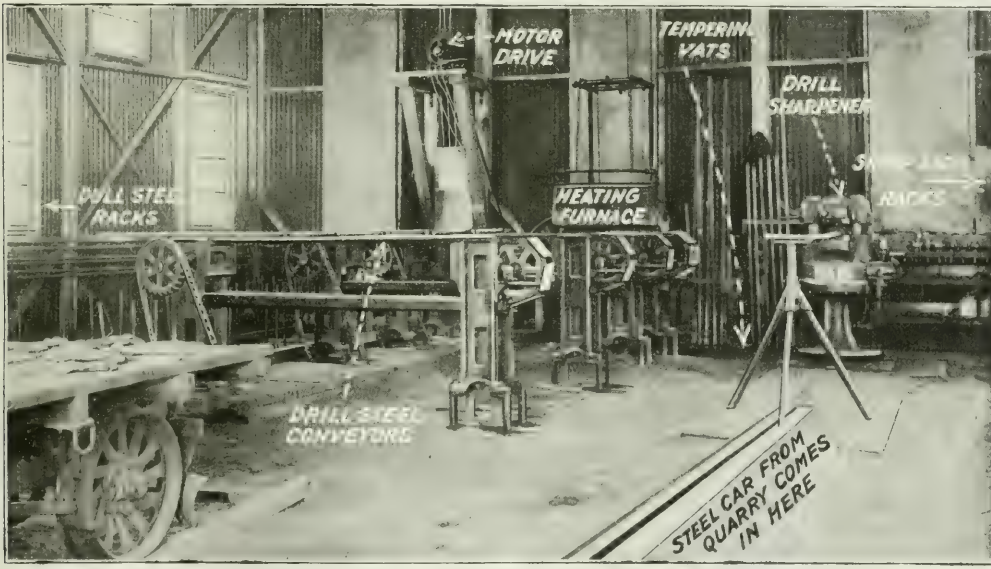
where A has the following values: For steel bridges with open or light floors, 1.00; for steel bridges with heavy, solid floors, 0.75; for reinforced-concrete structures, excepting spandrel-filled arch bridges, 0.50; and for spandrel-filled arch bridges, 0.25.

Central Plant for Sharpening Drill Steels Saves Money in Quarrying

Sharpening Shop with Two Men Replaces Five Smithies—Steel Conveyor, Oil-Fired Furnace and Concrete Quenching Vats

SUBSTITUTION of a central drill-sharpening plant for scattered blacksmith shops has reduced the cost and increased the efficiency of drilling operations at the 10 quarries of the Boutwell, Milne & Varnum Co., Graniteville, Vt. An hour a day derrick time hoisting drills has been saved at each quarry, and the labor of five blacksmiths and their five helpers has been eliminated. Drills are kept running a larger part of the time, and, due to machine sharpening, the cutting speed is greater.

Housed in a metal-covered wood-frame building 39 x 27 ft., the sharpening outfit comprises a heating furnace and drill conveyors, a drill sharpener, a tempering vat, roof cranes and drill racks. About 300 drills, reamers and broachers can be sharpened in an 8-hour day. The furnace and the conveyors which serve the furnace are of the type made by the Pirie Sharpening Machine Co., Barre, Vt. Any length of drill steel, from 1 ft. to 25 ft., is handled by the conveyors, which have chain speeds of $4\frac{1}{2}$, 6 and 9 in. per minute. This range of speeds gives ample variation of heating time for all sizes of bits, both for sharpening and tempering. The furnace is kerosene-fired by a Gilbert-Barker No. 5 high-pressure burner consuming about 12 gal. per eight-hour day. A 300-gal. underground tank supplies the oil. Improvement has been made in the furnace as ordinarily installed. A counterweighted brick drop curtain was added. By means of this curtain, which can be raised or lowered according to the size of bit being heated, the heat is concentrated on the bits to a greater extent than ordinarily.



DRILL STEEL MOVES ACROSS PLANT FROM DULL-STEEL RACKS TO SHARP-STEEL RACKS

Five different types of drills, most of them tripod drills, are employed in the quarries; the total is 47 drills. Rock conditions call for four types of bits, cross-bits, bull-bits, reamers and broachers, and two shapes of steel, quarter-octagon and hollow-hexagon, in four sizes of 1, $1\frac{1}{2}$, $1\frac{1}{4}$ and $1\frac{3}{8}$ in. All drills using the $1\frac{1}{4}$-in. hollow-hexagon steel are equipped with an improved type of chuck using steel without shanking. This type of chuck was designed and made by the company for private use in its quarries.

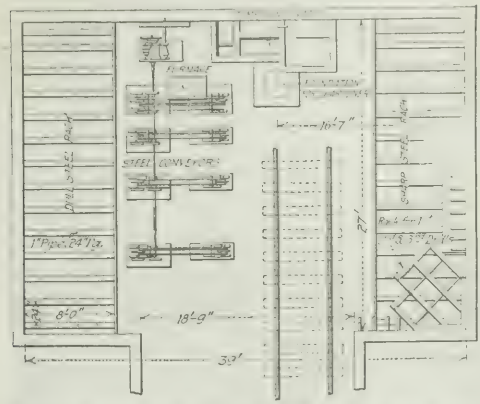
Bits are formed and sharpened in an Ingersoll-Leyner No. 5 sharpener, with certain changes made by the quarry company from its own designs. The mode of sharpening the cross-bits has been improved by using dies with round openings instead of octagon, by which it becomes possible to make the wings of the bit on the corners of the steel instead of on the flat. All cross-bits are made this way; there is less steel to upset, and the bits mud more freely because of the greater clearance.

When the plant was put into operation, trouble was experienced from the drills rifling. By changing the gaging blocks to decrease the taper of the wings of the bit from 14 deg. to 2 deg., the trouble was eliminated and the cutting speed increased. Bit gages have been standardized, so that only two separate sets of gaging blocks are used, one set for the large steel and the other for the small, each set with 12 gages differing 2/32 in. These blocks are used for the quarter-octagon steel only; the $1\frac{1}{4}$-in. hollow-hexagon steel is gaged by standard gaging blocks.

The tempering vat is made of reinforced concrete with a waterproof asphalt lining. It is partitioned off into four compartments. Gratings are used in these compartments to obtain the proper depth of immersion, $\frac{3}{4}$ in. The first two compartments are used for tempering steels up to 10 ft. in length, while a third compartment is for longer steels. The solution, a brine of 100 lb.

of salt to 50 gal. of water, is pumped from the fourth compartment to the first and second, overflows to the third (a trough to the bottom of the compartment prevents spattering) and thence back to the fourth, as indicated by the drawing of the vats.

When a car loaded with dull steels enters the shop the crane unloads it and places the steels in the dull-steel rack, then reloads from the sharp-steel rack with

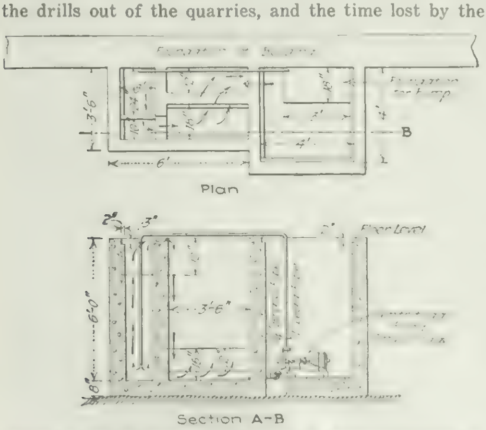


FLOOR PLAN OF DRILL-SHARPENING PLANT SERVING TEN QUARRIES

duplicates of the steels brought in. The racks are so arranged that there is place for every type of bit and length of steel. A surplus of sharp steel is always kept on hand, so that cars can be reloaded without delay.

Two men operate the plant, one overseeing the heating of the steel and the other handling the sharpener. After the steel is sharpened it is laid aside until nearly cold. Then it is returned to the conveyors, reheated to a dark cherry red, quenched, and allowed to remain in the vat until cold; after it goes to the sharp steel rack.

Before this central plant was installed each quarry had a blacksmith shop where the drills were sharpened by hand. Each drill runner also had his own kit of drills. Time was wasted by the derricks in hoisting the drills out of the quarries, and the time lost by the



BRINE FLOW IN TEMPERING VATS IS KEPT CONTINUOUS BY PUMPING

drill helpers waiting in the shops for the drills to be sharpened was excessive. These losses have been eliminated by the central plant.

The plant was designed and constructed under the supervision of Guy R. Varnum, superintendent (now captain, ordnance department, U. S. A.). The changes made in the equipment of the plant for its successful operation under the conditions encountered were planned and carried out by E. D. Palmer, acting superintendent, W. H. Paine, master mechanic, and H. B. Wallis, mechanical engineer.

Sewage Mixes Progressively in Its Passage Through Tanks

Lawrence Experiments With Activated-Sludge and Settling Tanks Show That Common Assumptions Are Not Founded on Fact

By H. W. Clark

Director and Chemist, Division of Water and Sewage Laboratories and Lawrence Experiment Station, Massachusetts State Department of Health

ALTHOUGH it is recognized that many factors enter into the manner and time of the passage of water or sewage through sedimentation or activated-sludge tanks, yet it is generally assumed that the time of passage is equal to the number of hours that it would take to fill the tank at a given rate of flow. How far off this assumption may be was shown by studies made during 1917 at the Lawrence Experiment Station of the Massachusetts State Department of Health. In these studies an investigation was made of the actual rate and manner of flow of liquids through activated-sludge tanks Nos. 485 and 486, and through a plain sedimentation tank of different size and shape. Starting with full tanks, the liquid entering the tanks was always so treated with either common salt or ammonium chloride that the time of its appearance at the outlets of the tanks could be easily determined. It was also possible to determine at any time the proportion which the effluent of the tanks contained of the treated sewage passing into the tank and of the sewage held in the tank when each experiment was started.

In the work here described the activated-sludge tanks were so operated that theoretically the sewage in the different tests was 6, 9½ and 10½ hours in passing through. Diagrams illustrating the results of this study are here reproduced. At the time of two of the experiments illustrated, Tank No. 485 consisted of three main sections, each 8 ft. in depth above conical bottoms, while at the time of a third experiment two of these sections each contained a baffle across its center reaching 3 ft. below the surface of the sewage in the tanks. When the experiments were made air was being applied to the sewage at the rate of 150,000 cu.ft. per hour per 1,000,000 gal. of sewage passing through the tanks, and of course the entire depth of liquid in all sections of the tank was in a state of quite violent agitation.

Turning to Fig. 1, it will be noticed that in one experiment with Tank No. 485 while the theoretical time of the passage of sewage through this tank when it was applied at the rate followed was 10½ hours, yet certain volumes of the applied sewage appeared at the outlet of the tank in practically one hour; 50% appeared in

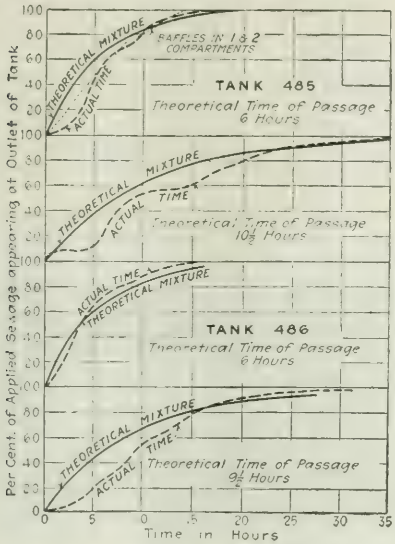


FIG. 1. THEORETICAL AND REAL SEWAGE MOVEMENTS IN ACTIVATED-SLUDGE TANKS DO NOT AGREE

7½ hours; while the remaining 50% lagged to such an extent that only after the expiration of 35 hours had all this sewage, which theoretically should have passed through in 10½ hours, finally passed from the tank. That is, the effluent was always a mixture of applied and held sewage, some of the applied sewage having been treated in the tank less than an hour while some was treated for periods which varied from 1 to 35 hours.

On the diagram (Fig. 1) a second curve is given with each experiment illustrated, this curve being intended to show the *theoretical mixture* of applied and held sewage in such a tank when this sewage is passed into the tank at the rate followed during the experiments just described, and the liquid in the tank, considering it all as one compartment, is in a state of thorough agitation.

It will be noticed that this second curve and the curve showing the actual manner of passage of the sewage are very similar; that is, in a tank of this description, even with three compartments and at times with baffles in two of these, the sewage does not pass through as a compact body of liquid but as a *progressive mixture*. Theoretically, when such a tank is being operated on a 10-hour storage basis and a mathematically correct progressive mixture is taking place, 10% of the sewage would appear at the outlet of the tank in the first hour, 9% additional the second hour and 8.1% additional the third hour, etc.; or, expressing it in another way, a total of 10, 19 and 27.1%, etc., of this entering sewage should appear at the outlet of the tank at the end of the first, second and third hours, respectively. These figures are perhaps not absolutely correct, but only higher mathematics could express them exactly.

Fig. 2 shows also experiments and observations of this nature when the sewage was passing through a second baffled activated-sludge tank (No. 486) theoretically in 6 hours. The results of these experiments and many others carried on by us prove clearly the fact here illustrated; namely, the progressive mixture of applied and held sewage in tanks which are operated in this way.

Further experiments have been made, one or two of which can be mentioned here, using a small tank 31 ft. long, 31 in. wide and 30 in. deep (Tank K). In the experiments mentioned here, this tank was so baffled that the entering sewage passed below the first baffle near the inlet of the tank, and at the outlet of the tank rose above a second baffle before reaching the outlet. Sewage was passed into this tank in a series of experiments so that theoretically it should, in the different experiments, have been 4, 6 and 8 hours in passing through if passing as a solid body. The results obtained, however (Fig. 2) were practically the same as with the activated-sludge tank just described. Curves on these diagrams show that when operated on the 4-hour time-of-passage basis, 50% of the entering sewage reached the outlet in 4 hours, while the remaining sewage lagged to such an extent that it was 15 hours before all had reached the outlet. The 6-hour and 8-hour experiments show similar results.

In this wooden tank, in which the sewage was not agitated by air, the temperature of the water in different parts and depths of the tank varied to a slight extent, and these differences in temperature of course caused this water or sewage to pass in more or less stratified layers. In all activated-sludge tanks and sedimentation tanks greater efficiency is probably obtained when all the sewage passes through as a fairly compact

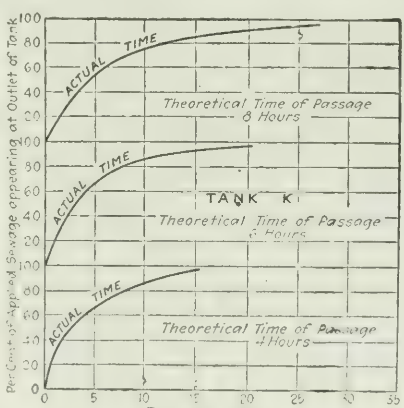


FIG. 2. ACTUAL TIME OF SEWAGE FLOW THROUGH SETTLING TANK IS FAR BEHIND THEORETICAL

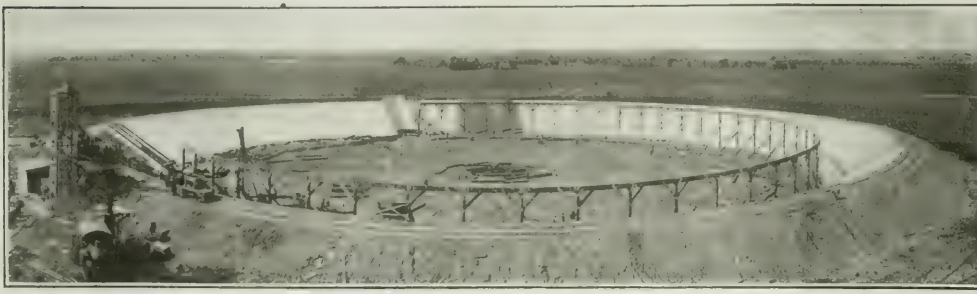
mass and is a definite number of hours in passing, instead of passing in the manner here illustrated—that is, as a progressive mixture.

Further studies, to show the effect of baffles and different arrangements of baffles in both the quiescent tanks and the tanks agitated with air, are being made in order to determine if possible a method of baffling which will cause the entering sewage to pass through with as little mixture with the held liquid as possible.

Circular Earth Embankment Lined with Concrete Forms Oil Reservoir

Type Originated in California—Introduced in Texas Oil Fields on Account of Lack of Steel — Concrete Roof Carried On Wood Frame Also Because of Scarcity of Structural Steel for Supports

By E. D. Cole
Resident Engineer, Empire Gas & Fuel Co., Bartlesville, Okla.



RESERVOIR UNDER CONSTRUCTION WITH SLOPES PAVED AND ROOF STARTED

OIL-storage reservoirs in the Texas oil fields have usually been of the steel-tank type, but the current shortage of steel led the Empire Pipe Co. to adopt for its new 350,000-bbl. reservoir at Gainesville, Tex., a concrete-lined earth embankment of the general type used to some extent in the southern California fields.

The reservoir consists of an earth embankment 12 ft. wide at the top and with 1½ on 1 side slopes forming an annular ring of 326 ft. bottom diameter and 392 ft. top diameter. Its inside depth is 22 ft. and the outside height of the embankment about 17 ft., as the fill was made from a 5-ft. excavation in the reservoir to a limestone stratum. The inside slope and the floor are covered with a 3½-in. lining of concrete, and the roof consists of a 2½-in. concrete slab on timber posts and girders.

Stability and tightness of the ground on which the reservoir was built were the first considerations in construction. A good limestone was struck at about 5-ft. depth, and overlying the rock was a layer of yellow clay carrying a small percentage of limestone gravel. This material when packed or tamped would not absorb water to any perceptible extent. The surface soil, approximately 1½ ft. in thickness, was black adobe. The site was cleared of grass and roots, and the fill was started on the compact yellow clay underlying the adobe.

The embankment was built up by fresno and wheel scrapers in horizontal 3-in. layers from material excavated in the pit. Water was used freely both in the pit and on the fill, and further compacting was carried on by means of a petrolithic road roller, disk harrow and road grader that were operated continuously around the top of the fill. Mules were used in preference to horses, being better adapted to this class of work, and the continuous tramping of their small feet very materially assisted in building up a solid and compact fill. Upon the completion of the main portion of the embankment the inside slope was lined with a 2-ft. layer of selected clay bonded to the main bank and compacted in a similar manner.

The floor of the reservoir was excavated to a depth of 1 ft. below grade and back-filled with selected clay. In places, limestone was struck within a few inches of floor grade, and this was also excavated to the same depth. The clay blanket on the floor and inside slope was placed to furnish a uniform backing for the concrete lining and to protect the concrete from cracking due to any slight settlement that might take place.

The floor and the slope were covered with a 3-in. lining of concrete reinforced with one layer of wire mesh. In the floor slab a 6-in. square mesh was used, made up of No. 6 wire each way, while in the slope slab 4-in. square mesh, made up of No. 8 wire each way, was used.

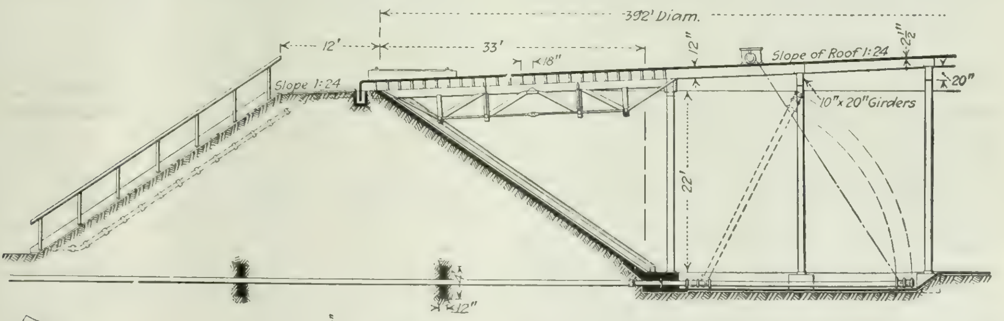
The concrete lining received a finish coat of rich cement mortar ½ in. in thickness. A 2-in. cushion of sand was provided as a backing for the concrete lining, both on the floor and the slope, the object of the sand being to provide good drainage back of the slab and to protect the concrete from a slight settlement or swelling of the embankment. This sand cushion is a very necessary feature of the construction, for the clay that makes up the bulk of the embankment is of such a nature that it cracks badly when the moisture leaves it, and consequently swells when wet. The placing of a thin slab of concrete directly on such soil is therefore poor practice, and should always be avoided. A 2-in. drainage line was laid across the floor of the reservoir and about 10 in. below the level of the sand cushion, to carry away any water that might collect, and thus do away with the danger of pressure against the concrete lining from below due to water uplift. This line connects with three gravel wells or sumps 24 in. square by 18 in. deep and filled with screened gravel. A 2-in. open nipple 6 in. long extending down into each gravel

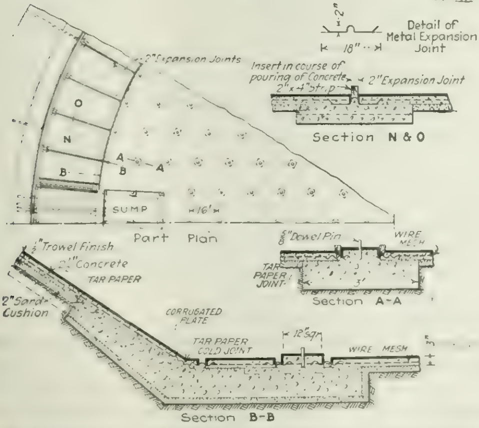
well and covered with fine sand screen serves as a connection to the drainage line.

The concrete was mixed in a 1-cu.yd. batch mixer stationed at the foot of the slope on the outside of the embankment, and the mixed concrete was delivered into a hopper, at the toe of the inside slope, by means of a hoisting tower and chute. From the hopper the concrete was distributed over the floor with concrete buggies. The finish coat was mixed in a 4-cu.ft. batch mixer and applied immediately after the main slab was poured. No expansion joints were provided in the floor except where the slab joined the concrete column supports. At this point a 1-in. shrinkage space is provided around each support, and a 10-in. strip of corrugated iron is embedded in the support and the center of the floor slab to cut off oil seepage. The entire floor received a carefully troweled sidewalk finish.

The concrete for the slope was poured without the use of forms, as the mixture was delivered dry enough to hang together on the slope but still plastic enough to be struck off by vigorous use of a straight-edge. Expansion joints in the slope were provided every 30 ft., and each slab between joints was made at one pouring. In this way all cold joints were eliminated. The joints were made up of a piece of galvanized iron 18 in. wide embedded into the edges of the main slab and supported by an underlying slab of concrete 30 x 6 running radially up and down the slope. The expansion groove, 2 in. wide, above the galvanized iron was filled with a plastic compound insoluble in oil. The function of this filler is to protect the galvanized iron from being attacked by the oil and also to safeguard doubly against any seepage of oil around the edges of the iron. The slope lining received the same carefully troweled finish coat as the floor.

The roof as originally planned was to be of reinforced concrete throughout and designed to carry a load of 100 lb. per square foot. This plan was abandoned, however, due to the excessive cost. Structural steel was then considered as a substitute, but was abandoned in favor of wood, on account of the uncertainty of steel deliveries. As built the roof consists of a 2$\frac{1}{2}$-in. slab of concrete reinforced with a layer of metal lath supported on 2 x 12-in. wooden rafters spaced 20 in. c. to c. The rafters were placed radially out and were supported by 10 x 18-in. girders and 10 x 10-in. posts. The posts were spaced 16 ft. c. to c. and in concentric circles around the floor of the reservoir. The pier supports for the posts were of concrete 14 in. square and 8 in. in thickness. A $\frac{5}{8}$-in. dowel pin placed in the top of each small pier centered and stayed the bottom of the posts. A 6 x 10-in. corbel block 24 in. long was spiked to the top of the posts to furnish proper bearing for the girders. The ends of the girders were beveled to conform to the degree of curve or circle in which they were placed. The ends were butted together and tied to the posts by two $\frac{5}{8}$-in. dowel or drift pins 30 in. long. Holes were bored through the ends of the girders to receive the drift pins, which were driven home, through the corbel block and into the top of the posts, with a heavy sledge.





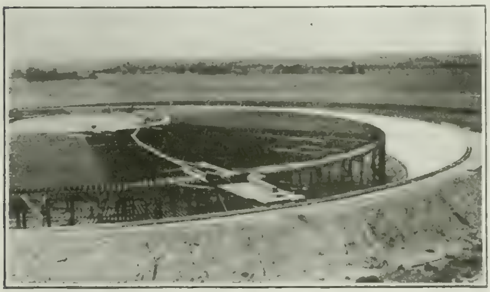
OKLAHOMA OIL RESERVOIR FORMED BY LINING CIRCULAR EMBANKMENT WITH CONCRETE

The roof from the edge of the reservoir to the first row of supports at the toe of the slope is supported by combination wood and steel trusses spaced about 20 ft. c. to c. The inner ends of the trusses are supported by the 10 x 10-in. posts, while the outer end rests on a concrete bearing block designed for that purpose. A piece of flat galvanized iron placed flush with the surface of the concrete support permits of free movement for radial contraction and expansion of the roof. No other provision for contraction or expansion of the roof was provided for except the placing of temperature reinforcing bars in the roof slab.

The roof slab was made up of 2 in. of concrete poured directly on the metal lath and further reinforced by $\frac{3}{8}$-in. rods spaced 30 in. c. to c. at right angles to the ribs in the metal. To insure the roof slab being watertight, a $\frac{1}{2}$-in. layer of cement mortar was poured on

the top of the slab and an asphalt and gravel roofing applied. A layer of gunite was placed on the under side of the roof, primarily to protect the metal lath from attack by moisture or gas escaping from the oil. It also serves to make the roof gas-tight.

The concrete slab at the edge of the roof was carried over the ends of the rafters and down within 3 in. of the bottom of a concrete ditch placed just outside of the mudsill and extending all the way around the top of the embankment. This ditch is 18 in. deep and 12 in. wide, with walls and bottom 4 in. thick and reinforced with a layer of wire mesh. Expansion joints were provided every 25 ft. Water 9 in. deep is maintained in the ditch, which provides a 6-in. head of water against the gas pressure within the reservoir.



PART OF TIMBER ROOF HAS BEEN PUT ON RESERVOIR

This water seal was devised by J. J. Allinson, chief engineer of the company. Six-inch sewer-tile drains laid just beneath the surface of the embankment lead from the ditch and serve to carry storm water from the roof of the reservoir and also to maintain the 6-in. head of water in the water seal. The drains are spaced approximately 50 ft. apart around the circumference of the reservoir and extend to the foot of the outside toe of the slope. Three 8-in. outlet or draw-off pipes were placed in position at the beginning of the earthwork 2 ft. below floor grade and extending the full width of the embankment at this level. Swing pipes equipped with special swing-pipe joints serve to drain oil from any level desired. These pipes are operated from gas-tight winch boxes placed on the roof of the reservoir. An 8-in. filling line is carried into the reservoir over and through the top of the embankment, as shown.

Two gaging wells were provided. They consist of two 8-in. pipes placed on opposite sides of the reservoir and near the toe of the inside slope. They extend vertically from the roof to the floor of the reservoir, with the lower ends of the pipes resting on a $\frac{1}{2}$ x 18-in. square steel plate set to the floor elevation of the reservoir. The lower ends of these pipes contain four slots 2 in. wide and 36 in. long, to permit the oil to flow into the wells.

A 3-in. dry gas line is carried in to the center of the reservoir under the roof, and is to be used to maintain at all times a slight gas pressure in the tank, so as to prevent the entrance of air which might form an explosive mixture. A 4-in. wet gas gathering line is supported on the second rows of posts toward the center from the toe of the slope and 18 in. above the oil level when the reservoir is full. This line follows this row of posts all the way around and is connected at a common header with a 6-in. line leading out from the reservoir through the top of the embankment. An open 4-in. T looking down was placed every 100 ft. throughout the length of the 4-in. line to allow free entrance of the gas and also to prevent the formation of pockets of condensed gas. Each of these gas lines leads away from the reservoir on a uniform grade underground to a small gas-regulating house above 200 ft. outside the fire wall. Both lines are provided with water drips to draw off any water or condensed gas that may collect in the line.

To protect the reservoir from being set on fire by lightning the following precautions were taken:

The reinforcing metal in the roof slab was made everywhere continuous by overlapping and wiring together at frequent intervals, and at points about 20 ft. apart around the outer rim of the tank the reinforcing metal of the roof and slope slab were tied together with No. 9 galvanized wire, using soldered connections. All pipe lines leading into and from the reservoir beneath the roof were connected to the roof reinforcement in a similar manner. The object of the wiring was to furnish an easy path for the discharge of the earth electrical field during a storm, and in this way prevent a short circuit or spark that would ignite the gas underneath the roof. With the above installations there is a double safeguard against lightning attack. The gas-regulating lines will maintain a slight gas pressure inside the reservoir and prevent the entrance of air which would form an explosive mixture. The wiring together of the reinforcing metal will provide a continuous path for the grounding of the accumulated earth electrical field passing through the tank.

The popular theory to explain why oil tanks are set on fire by lightning seems to be that the lightning flash ignites escaping gases above the roof, which in turn ignite the oil in the tanks. Another theory advanced is that the ordinary steel tank with a wooden roof is so constructed that the roof is practically insulated from the steel sides, and when the tank is struck by lightning a spark takes place on the under side of the roof, setting fire to the gas and the oil in the tank. Whether or not either of the above theories is correct the writer does not know. It is his belief, however, that a concrete-lined reservoir constructed as described above, with a gas-tight roof, should not be set on fire by lightning, for the reason that the reinforcing metal in the roof as well as in the reservoir lining is all tied together, thus forming an easy path for the electricity to escape into the ground. The insurance companies also entertain some such belief, as their insurance rate against fire in the case of the concrete tank is only 25% of that charged for insuring a steel tank.

The total cost of this type of storage is from 32 to 35c. per barrel of capacity. The cost of similar work would vary slightly, depending on ground conditions and weather.

The construction work was carried on by company labor, under the immediate direction of the writer. J. D. Hackstaff is manager of the Empire Pipe Line Co., and J. J. Allinson is chief engineer, with headquarters

at Bartlesville, Okla. Acknowledgment of valuable assistance is made to the firm of Dodd & Struthers, Des Moines, Iowa, under whose direction the wiring to safeguard the reservoir against lightning attack was carried out.

Principles on Which the French Highways Are Built

Roman System of Direct Lines Between Strategic Points Followed—Great Attention Is Given to Drainage

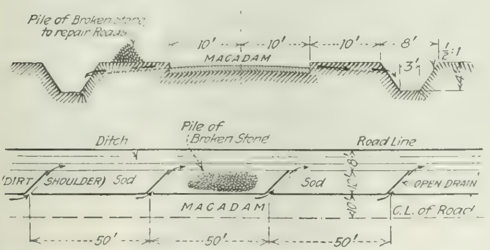
By Frank W. Harris

Captain of Engineers, United States Army, American Expeditionary Forces

FRENCH practice in the location and construction of roads follows in general four principles—that all roads between trade centers and fortresses shall be straight; that all construction shall follow the general contour of the ground, the limiting grade being probably 8%; that an adequate drainage system shall be worked out at the time of building the road, and that a macadam surface shall be applied. These roads are located for purposes of war as well as peace, and the old Roman military idea that roads between strategic points in the empire should be straight is still followed.

In all parts of France the roads are very solid, and after years of war use are in good shape in all sections back of the lines. The main reason for this is the good drainage provided. The plan and cross-section views show the construction of a typical French road. The side slopes vary with the soils, and the years have worn them in all manner of shapes. There is therefore no fixed ditch section. The dimensions vary along the same road, but the general principles shown are pursued.

Wide dirt shoulders and a low crown are the rule, and the side drains running across the shoulders show ingenuity and are very important. The sodded spaces



FRENCH HIGHWAYS HAVE SPECIAL DRAINAGE SYSTEM

between them are used for piling broken stone ready for making repairs. The roads are maintained and repaired on the old idea that a stitch in time saves nine.

French engineers build their main roads, as stated above, in a straight line between trade centers, the roads following the natural surface of the ground, so that it is unusual to see very heavy cuts or fills on the highways. While this frequently results in short stretches of grade up to 8%, it shortens the distances between trade centers, the surface of the road is hard and good, and the grades have not proved serious obstacles to the heavily loaded army trucks.

In the United States we have been dominated by the railroad idea of low grades in highways. This idea, while good, has often been carried to extremes, with the result that it has cost us too much for grading. Under conditions of modern motor-truck transportation, where any grade up to 6% or even 8% in special cases is permissible, we shall get better road-building results if we increase the rate of grade and spend less money making heavy cuts and fills. The money saved in grading can be invested in larger and better side drainage is discussed, but there the matter often ends.

In all road textbooks and at good-roads conventions, drainage is discussed, but there the matter often ends. Our modern roads are a modification of a railway roadbed, and our ditches are the old track ditches. We have not yet adopted a real highway section, largely due to the fact that railroad engineers designed the sections in use on our new roads. It can be seen easily that the adoption of such a section as is shown in the illustration would add at least 25% to the cost of construction, unless we modified some of our highway location and construction theories.

World Port for Shanghai Planned By Conservancy Board

Authorities Make Study of Scheme Whereby Whole River Is Converted Into Tidal Dock to Float Largest Vessels

POST-WAR trade development which would make China an important factor in the world's commerce is anticipated in a recent report on the proposed port works of Shanghai by the Whangpoo Conservancy Board, the body that controls the port. The report frankly looks far into the future, for it plans a port to take care of vessels drawing up to 50 ft. of water, and contemplates a total expenditure of nearly $100,000,000 over two decades. But the commercial conjectures of the engineers are interesting to all shipping men, particularly those on the Pacific Coast, and the engineering design of the new port is bold beyond any previous similar project.

The report is entitled "The Future Development of the Shanghai Harbor" and was prepared by H. von Heidenstam, a Swedish engineer who is engineer-in-chief of the Whangpoo Conservancy Board, acting jointly with the Hydraulic Engineering Bureau of Stockholm, represented by J. G. Richert and P. G. Hornell. It is accompanied by a lucid commentary by W. F. Tyler, coast inspector, Chinese Maritime Customs.

It is the contention of the authors of the report that the time is fast arriving when Asian industry and demands will build up a tremendous commerce. The conclusion is reached not only from a belief in the early industrial growth of the Chinese people, but also by the increased facilities of transportation from Europe and the eastern coast of America to China through the Panama Canal. This canal has not had time to demonstrate its effect on world commerce, because of the restrictions of the great war, but in the

post-war period will undoubtedly have a pronounced influence on trade. Particularly, in the views of the authors, will this affect the Pacific Ocean, which to their minds will be the scene in the next twenty-five years of the greatest maritime growth in the world. Of interest to Americans is their conclusion that a large part of this new Pacific trade will be between both coasts of the United States and China. Whether this will be carried in foreign or American bottoms is not part of their investigation.

Looking Ahead Fifty Years

On the basis of such assumptions as to world trade, the port engineers demonstrate to their own satisfaction that Shanghai is the proper port to which most of this new trade will come, and should, therefore, be developed to take care not only of the ordinary tramp steamer traffic, but also the largest types of ocean vessels which, as has been demonstrated in the past, can be made commercially successful only when traveling on stabilized routes. The authors go so far as to assume that the day is not too far distant when steamers as large as or larger than those now plying the transatlantic route will make regular sailings between Pacific Coast and Chinese ports. This means, in their view, that a port designed for fifty years to come must have at least a 50-ft. draft at deep water.

To bring about such a port at Shanghai requires a radical engineering design. Shanghai is on the Whangpoo River, which is a tidal estuary of the Yangtsze and empties into the latter about 15 miles below the center of the city. The proposed project consists in closing the mouth of the Whangpoo with a dam carrying lock gates, thus transforming the whole Whangpoo River into a continuous dock harbor with a water level corresponding to the mean water level at the mouth of the Whangpoo.

Details of the Project

The width of the river crossing which will have to be dammed is not given in the report, but on a small-scale map accompanying the report it is about one mile. Subsidiary details connected with the project are the building of training walls to increase the depth of the approaches to the river, the rearrangement of the sewage disposal and water-supply of the city, which now are tied up to the tidal estuary, and the construction of quays along both sides of the fixed-level river which would be established by the construction of the tidal locks. Contributing difficulties may be found in the control of the Yangtsze estuary, which is one of the largest river mouths in the world and is not entirely stable.

The report, while most elaborate, is presented merely as a preliminary to suggested investigations which are necessary for a more detailed study of the plan. The authors state that in the Yangtsze valley contributory to Shanghai there are living 170,000,000 persons, or about one-tenth of the inhabitants of the earth. It is their claim that these people are about to enter into a great industrial development, and that an attempt must now be made to plan for the next fifty years, to take care of the expected increased commerce which this development will entail.

Water-Works and Sentiment

NOT often is there much sentiment connected with the water-works business. Not often does the citizenry look upon its water-works structures with reverence. However, the real old Chicagoans are up in arms over the proposed removal of the Chicago Ave. water-works tower, which is as much identified with old Chicago as Faneuil Hall is with Boston or the Tower of London is with London. The tower is in the line of the roadway of the greatly widened Michigan Ave. Boulevard link improvement. The Board of Local Improvements proposes to move it back 50 ft., and "if in doing so it happens to fall it will not be built up again," says the president of the board.

The protests aroused by the plan have called forth the following comment in the Chicago *Tribune*, addressed to the president:

"Mr. Faherty, you're a good citizen, with excellent impulses, but you only arrived in Chicago in 1888. What does Chicago's past mean to you? What visions are there in your mind of the young, ardent, ambitious city which directly after the Civil War undertook civic improvements far more important to its time than any you are now fostering? Do you realize the satisfaction with which they contemplated the finished power house in 1866, and the overwhelming pride that filled their bosoms when they gazed upon the completed tower, which soared above the miles of comfortable, prosperous, little homes stretching to west and north?

Recalls the Big Fire

"Were you one of the fleeing multitudes who on Oct. 9, in 1871, saw the tower standing, a solid white shaft, amid whirling flames that devoured every other structure for miles? Was your youth spent in its shade as the new city sprang up out of the ashes in the seventies and eighties?

"The architect of the water-works and the tower, W. W. Boyington, was a great man in his time. He came here from New York in 1853 and designed practically all of the principal buildings of his era. The old Chicago University buildings, including the then famous Dearborn Observatory, were his work, and, like the water-works, were built of solid, rock-faced ashlar stone from Vermont, in what was then called castellated Gothic style.

"In the years immediately following the fire he was the architect of $2,500,000 worth of buildings. So he was a man of importance here.

Tower or Residence?

"The present proposition is to move the tower back so as to allow the new boulevard to end its extreme width at Pearson St., leaving the quondam J. V. Farwell house as the chief object in view. Now, in its day, the Farwell house was considered a fine example of domestic architecture, but, as an alternative to the water-works tower for an effective bit of street-end building, it isn't in it with the tower.

"Knock down, if you will, old homes, old houses, old landmarks, but spare that 154 ft., of white, gleaming shaft, whose turrets and crenelated battlements mean so much to so many people."

Some Heavy Fitting-Out Cranes—II. Cantilever and Jib Travelers at Newark Bay and Bristol

Double Cantilever Bridge Traveling Along Pier Commands Line of Ships on Either Side—Provision for Extension—Friction Draft-Gear Buffers—Tower Jib Crane Fitted with Special Safety Devices

[Passed by Publication Approval Committee, Emergency Fleet Corporation]

CONTRASTING sharply with the fixed derrick and bridge cranes of Kearny and Hog Island, described last week and shown by Figs. 1 and 2 herewith, travelers are used at Newark Bay by the Submarine Boat Corporation, and at Bristol by the Merchant Shipbuilding Corporation, for heavy service at the fitting-out dock. The Newark Bay machine travels along a pier and commands ships on either side. The Bristol crane serves riverside dock frontage only. This latter machine, while specially designed in all respects, is of well established type; the Submarine Boat Corporation's double cantilever bridge, on the other hand, is a machine as original in type and details as it is impressive in its general appearance, shown by Fig. 4.

Travelers were adopted at both yards in order to save the trouble and delay of moving the ship into position under a fixed crane. The requirements of the work are not essentially different from those prevailing at yards using fixed machines, whether of the type described in our previous article or of the shear-leg type popular on the Great Lakes. It was believed, however, that with machines able to move along to the ship it would be possible not only to gain time in placing boilers, engines and the few other parts of great weight comprised in the ship equipment, but also to do some of the lighter installation work, in order to supplement the service of the smaller machines provided for this work; maximum flexibility of the whole fitting-out plant was aimed at.

FIG. 1. HOG ISLAND FITTING-OUT PIERS HAVE A FIXED CRANE BRIDGE OF 100 TONS CAPACITY AND SMALLER TRAVELING GANTRY JIB CRANES

General dimensions and some essential structural features of the Newark Bay cantilever traveler are given by the drawing Fig. 3. The crane, running on two narrow-gage tracks spaced 41 ft. between centers, operates along a pier about 60 ft. wide by 702 ft. long, and straddles a set of railroad tracks extending the full length of the pier and connecting at the land end with the yard track system. All material is brought out by way of these tracks, and the crane trolley must pass

FIG. 2. HEAVILY BRACED TRIANGULAR PLATFORM CARRIES 100-TON PILLAR-CRANE DERRICK IN KEARNY YARD OF FEDERAL SHIPBUILDING COMPANY

together against chance disjointing. The tower leg engages the truck girder by means of a transverse pin through the girder webs, the leg being formed into a strong fork or jaw passing outside of the girder to take the pin. The pin is located at mid-length of the girder, but is near the inner edge of the tower leg, so as to bring the vertical reaction as near as possible to the center-line intersection of the tower leg and the lower member of the fore-and-aft tie, and thus minimize the bending in the tower leg. One of the two trucks of each tower leg is driven. There is a separate motor at each of the four driven trucks, geared to both of the axles of this truck. All motions of the crane are controlled by automatic acceleration switches; this is to eliminate risk of accident from operator's negligence or error. The speeds for which the crane is designed are as follows: Main hoist, 10 ft. per minute; auxiliary hoist, 40 ft. per minute; trolley motion, 40 ft. per minute; crane travel, 150 ft. per minute. At the ends of the crane tracks and of the trolley track, buffers are provided to stop

it out through the space between the gantry legs in transferring it to the ship. For this reason, though the legs are tied by a deep and rigid tie strut near the bottom, the space above this is not encumbered by bracing.

Very heavy construction characterizes the machine, but apart from the interesting manner of framing and the make-up of the tower legs the arrangement is simple enough to require no description. The superstructure is a simple bridge supporting a pair of suspended track beams for the crane trolley. This latter is a 50-ton trolley built by the Morgan Engineering Works. Its winding drums are placed transverse to the track; they had to be made unusually long to take care of the great height of lift required, which accounts for the wide spacing of the tracks.

Special study was given to the design of the trucks which carry the crane. Because the pier structure contains three piles in a closely spaced bent under each track, a two-rail track on either side of the pier was adopted, as distributing the track load better than a single rail. Each leg is carried by two four-wheel trucks. A heavy truck girder of box section rests on the truck frames by cast-steel ball-and-socket bearings; links attached to lugs of the upper and lower halves of these bearings, two on each truck, tie the structure

the machine or the trolley without sudden impact. Friction draft gears were used as shock-absorbing elements in these buffers. Thus, in the construction of the buffer at the end of the crane track, oak striking plates at the front of a timber crosshead receive the impact of the crane wheels; the crosshead is held to the rails by nuts on through bolts of the buffer timbers engaging the under side of the rail head. Directly back of this crosshead are mounted two Westinghouse friction draft gears in series, held in position on a timber base and backed by an anchor block securely fastened to the bent-up ends of the crane track rails.

A shown by the drawing, Fig. 3, the crane is intended to have an ultimate reach sufficient for serving two lines of boats on either side of the pier, which will take care of eight boats at one time. Normal working conditions do not require so large a capacity, however, and for present service the crane has been built only to half reach on either side, as is indicated in Fig. 3, and more definitely shown by the view, Fig. 4. In its present condition the structure, trucks and machinery weigh about 700,000 lb., which, with the trolley weight of 78,000 lb., makes a total of about 780,000. In its completed condition the crane will weigh roughly 1,000,000 lb. Its cost at half length is $134,000.

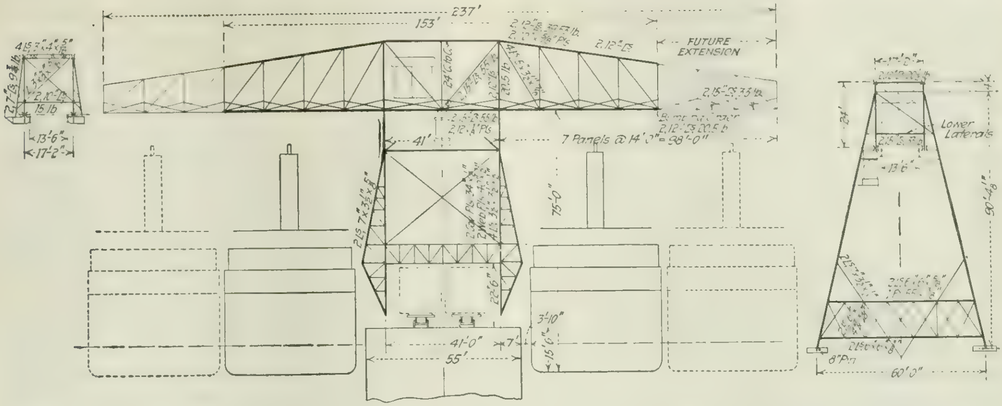


FIG. 3. STRUCTURAL DIAGRAM OF THE NEWARK BAY CANTILEVER TRAVELER—ULTIMATE EXTENSION OF THE BRIDGE AS INDICATED WILL ENABLE IT TO COVER TWO LINES OF SHIPS ON EITHER SIDE OF THE PIER

Light fitting work at Newark Bay is handled in a separate location as well as by separate machines. The pier with the cantilever crane is devoted to heavy work exclusively; this pier projects out from the main yard front into the waters of Newark Bay as an extension of a marginal dock which forms the south boundary of the yard, fronting on a channel or slip extending inland about 2700 ft. along this side. This dock is used for the light fitting work. Its equipment comprises a three-track railroad along the length of the dock, and a trestle for locomotive cranes between the tracks and the face of the dock. Three long-reach locomotive cranes operating on this trestle handle the ship-equipment material from the supply tracks to the ships lying along the wharves.

With the length of slip and dock available, 18 of the Submarine's 5000-ton ships can lie along the dock, in two lines. With the same double-line arrangement the heavy fitting-out pier accommodates eight ships, making a total capacity of 26. It is not expected that this will be normally required. The estimates are for 21 ships undergoing fitting-out simultaneously, four at the heavy pier and 17 along the trestle. This estimate is based on a fitting-out period of 45 days.

The trestle is about 30 ft. high by 14 ft. wide. It carries a track of 16-ft. gage for the main locomotive cranes which do the fitting-out work. A standard-gage track has also been laid on the trestle, to take ordinary locomotive cranes (with outriggers bearing on the two outer rails for stability).

Noteworthy innovations were introduced in the design of the locomotive cranes, based on the experience of the steel-erection men in the engineering department of the Submarine Boat Corporation. The cranes each have four single-drum winches in the cab, handled by separate controllers, and thus avoid the use of clutches so common in all forms of hoisting machinery. Each winch is a simple grouping of motor, gears and drum in a frame, generally with a solenoid brake on the motor shaft and an emergency foot-operated brake on the drum. The winches handle respectively the main hoist, the auxiliary hoist, the topping lift and the swing. The swinging motor has no solenoid brake, as this would be likely to give too abrupt a stop and tend to cause the load on the hook to swing. Two diagonally opposite trucks of the machine are equipped with separate motors for the travel of the machine. The two motors are handled by one controller, making the fifth controller in the cab. These motors have a solenoid brake only.

A five-part main hoist and a single-line auxiliary hoist are used. The winches are designed to give about 180 ft. per minute speed with a 25-hp. motor, under normal load conditions. The travel speed of the crane is about 175 ft. per minute. The hoist hooks are swiveled on ball bearings, which in practice give very easy rotation of the load.

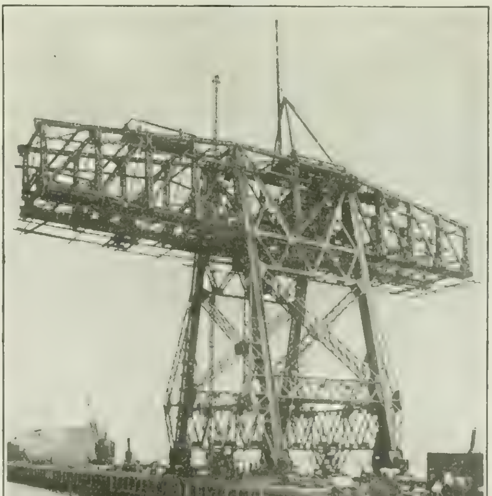


FIG. 4. NEWARK BAY 50-TON CANTILEVER TRAVELER DURING ERECTION

A boom length of 90 ft. was adopted, to enable the crane to reach out over two ships abreast. The lifting capacity is 10 tons at 50-ft. radius and 4 tons at full 90-ft. reach. A high A-frame and a counterweight raised high enough to pass over the rail of the ship at maximum stage of the tide are features of the structural arrangement of the crane. The machines were built by the Industrial Works, Bay City, Mich.

In contrast with the fixed cranes of Hog Island and the Federal yard, the managers of the Merchant Shipbuilding Corporation gave preference to a traveling crane for equipping their yard at Bristol, Penn.. The problem presented there was very closely like that at Kearny, since both yards have 12 shipways and carry on their fitting-out work alongside an ordinary dock wall. Furthermore, the ships built at the two yards are of about equal size (9000 and 9600 tons capacity). In spite of the similarity of general requirements the solution with respect to the crane equipment differs radically.

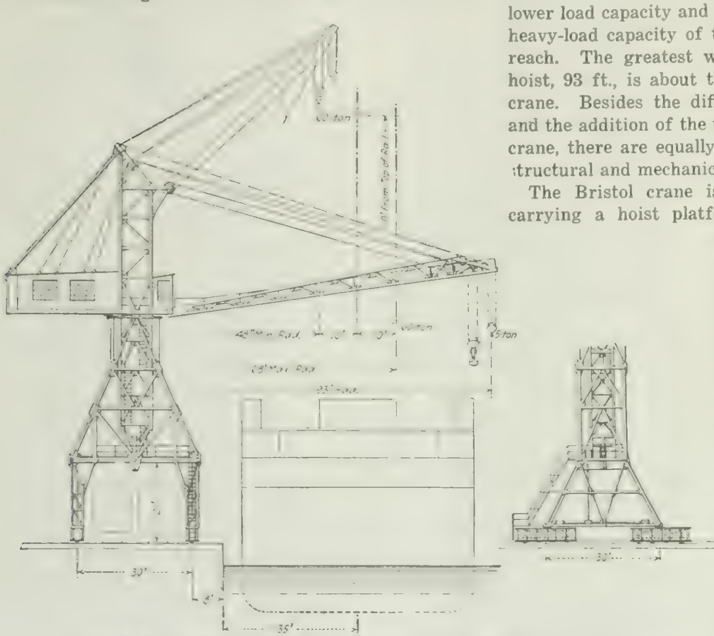


FIG. 5. TOWER TRAVELER ON BRISTOL FITTING-OUT DOCK

Bristol, besides choosing a traveling crane, fixed a lower load capacity and a smaller reach. The maximum heavy-load capacity of the machine is 60 tons at 68-ft. reach. The greatest working radius of the auxiliary hoist, 93 ft., is about the same as that of the Federal crane. Besides the differences in capacity and reach, and the addition of the traveling function in the Bristol crane, there are equally fundamental differences in the structural and mechanical arrangement.

The Bristol crane is of the revolving-tower type, carrying a hoist platform and boom pivot at about mid-height. The weight is transmitted from the tower to the supporting gantry through a pin seat at the base of the tower, while overturning is taken care of by eight horizontal wheels carried by the tower, bearing against the inside of a curb ring of the supporting frame. The structural arrangement of the machine is shown in Fig. 5, which also gives the main dimensions. The design of the structure for the several load conditions and wind was carried out for a working stress of 15,000 lb. per square inch tension and 13,000 (reduced by formula) compression. The stability of the machine is sufficient to provide for a wind pressure of 10 lb. on the loaded crane and about 30 lb. on the empty machine. The counterbalance at the tail of the hoisting-engine platform takes care of about half the maximum load moment, and thus gives about equal margins of stability in loaded and empty conditions.

The swinging-engine has some rather unusual features, designed to permit smoother operation. Instead of the usual solenoid brake on the tail of the motor

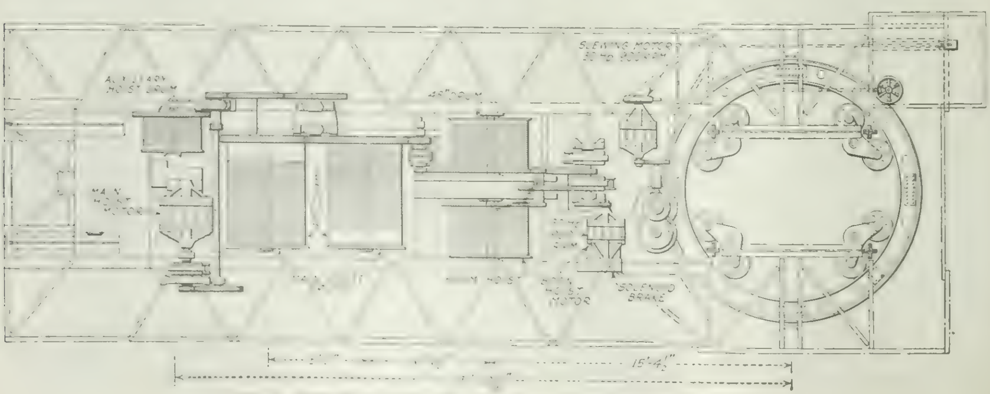


FIG. 6. THREE-[illegible] OF THE MACHINERY OF BRISTOL CRANE

shaft, a hand brake was provided to enable the braking effort to be varied as circumstances may require, or to let the swinging motion coast to a stop when desired. To permit the use of an easily applied brake and yet prevent the operator from jamming it on too hard, as well as to prevent damage in case of suddenly reversing the motor, a friction drive was installed on one of the gears between the motor and the rack circle. This has an adjustable spring pressure, providing the necessary friction to accelerate or retard the crane at the proper rate, but preventing this rate from being greatly exceeded.

Interconnected hoist and boom-hoist rigging also characterizes the machine, the object of the arrangement being to limit the work of the boom hoist to changing the position of the boom, without lifting the load, in accordance with the principle first applied to derricks many years ago. The main hoisting rope is carried through the hoist block and dead-ended on the boom-hoist drum. By this arrangement the load on the hook acts as a counterweight pulling on the boom-hoist tackle, thereby tending to neutralize the effect of the load on the motion of the boom. While the boom is being raised from its extreme outer to its extreme inner position, the hook describes a flat-curved line which through most of its range does not depart far from the horizontal. When the auxiliary hoist is in use and the main hook is idle, this neutralizing action is not called for. On this account the gear-shifting mechanism which connects the hoisting motor to the auxiliary hoist drum (after disconnecting it from the main hoist drum) simultaneously connects the main hoist drum to the boom hoist, so that the operation of the boom hoist in this case carries the hook along in fixed relation to the boom.

On the reverse operation, changing the motor from the auxiliary to the main hoist drum, the gear-shifting mechanism drops a pawl into the gear of the auxiliary drum, to hold the auxiliary hook from dropping.

Safety lowering brakes are used on both the hoist motor and the boom-hoist motor. These brakes consist of alternate steel and bronze disks running in oil, and make it impossible to lower without running the motor backward. Both motions are also equipped with magnetic brakes on the motor shaft, requiring power in the circuit to release the brake and permit operation of the motor. Limit switches control the motion of the hoisting rope so as to prevent overwinding, and also make it impossible to operate the 60-ton hoist when the hook is at a radius exceeding 68 ft. The boom hoist has limit switches to prevent the boom moving upward or downward beyond definite limits of motion, and other switches to stop both hoisting and boom motions when either of the two hooks comes within a predetermined distance of the boom structure.

The operating speeds of the machine are the following: Hoist, 15 ft. per minute; maximum lifting range, 110 ft.; boom hoist, full range of motion under maximum load of 60 tons, 2½ min.; auxiliary hoist, 100 ft. per minute; swinging motion, ½ r.p.m.; traveling motion, 75 ft. per minute. Four motors operate the machine, all of them running on three-phase alternating current at 440 volts. The hoisting motor is of 75 hp. It drives either the main hoist drum or the auxiliary hoist drum, according to the position of a shifting pinion. The same motor brake and safety lowering brake serve both the main and the auxiliary hoisting drums, through this arrangement. The boom-hoist motor is of 30 hp., as is also the swinging motor. The travel motor is of 75 hp.; it has a solenoid brake.

The main hoisting rope is rigged in 12 parts between the hoist block and the end of the boom. The boom hoist has 11 parts in the tackle between the boom and the mast.

The entire machine is operated through four drum controllers.

Heyl & Patterson, Inc., Pittsburgh, designed and built the machine. Under contract taken in November, 1917, the crane was erected and ready for operation by August, 1918. Its cost was about $120,000, erected. The total weight of the crane is 190 tons.

Urges Electrification of the California Railroads

D. F. Folsom of Oil Division of Fuel Administration Points to Oil and Capital Economy—Purchase of Power

ELECTRIFICATION of the mountain divisions of California railroads has been recommended to Director-General of Railroads McAdoo by D. F. Folsom, director of the Pacific Coast section of the Oil Division of the Fuel Administration, as a means of conserving fuel oil and reducing the operating expenses of the sections of the railroads involved by $4 923,300 a year.

The recommendation, based on a report of W. F. Dietrich, engineer of the Oil Division of the Fuel Administration, shows that the electrification of 510 miles of railroad would mean an annual saving of 3,062,000 bbl. of fuel oil, the total cost of which is $6,147,000, and that the cost of power to operate the trains over these sections at 0.75c. per kilowatt-hour would be $2,000,000, indicating a reduction in the bill for motive power of $4,147,000 annually. The first cost of the electrification is placed at $23,012,000, on which there is estimated an annual profit of 9.4%, after allowing for depreciation, amortization, taxes and interest.

The railroad divisions affected by the recommendation are the Sacramento division of the Southern Pacific, 157 miles, from Roseville, Cal., to Sparks, Nev.; the Shasta division of the Southern Pacific, 215 miles, from Gerber, Cal., to Ashland, Ore.; and the San Joaquin combination division of the Southern Pacific and Santa Fé railroads, 138 miles, from Bakersfield to Saugus.

With oil valued at an average figure of $2.02 a barrel and electricity at 0.75c. per kilowatt-hour (a total of $2,000,000), the annual saving in the cost of power is $4,147,000 in favor of electrification. The purchase of hydro-electric power is contemplated throughout the report, but it is pointed out that even if the electricity were generated by oil there would be a saving of about half the consumption of oil now used as locomotive fuel. Thus 267,400,000 kw.hr. at 200 kw. per barrel would require 1,337,000 bbl. of oil, or 43.6% of the present consumption of locomotive fuel in the three districts.

COMPARISON OF OPERATING COSTS ON THE THREE DIVISIONS BY STEAM AND BY ELECTRICITY

	Sacramento Division		Shasta Division		San Joaquin Division	
	Electric	Steam	Electric	Steam	Electric	Steam
Substation labor and supply	$104,200		$73,200		$89,000	
Transmission and contact system maintenance	82,700		70,000		47,000	
Maintenance of way	490,000	$650,000	510,000	$680,000	285,000	$381,000
Locomotive repairs	260,000	390,000	230,000	461,000	194,000	388,000
Locomotive enginemen	185,000	258,000	400,000	530,000	172,200	231,900
Fuel or electricity..	783,000	2,200,000	549,000	2,065,000	688,000	1,882,000
	$1,905,400	$3,498,000	$1,832,000	$3,736,000	$1,456,000	$2,882,900
		1,905,400		1,832,000		1,456,000
Balance favoring electrification........		$1,592,600		$1,904,000		$1,426,900
Percentage of net investment		19.6%		23.7%		20.7%
Net profit, allowing 12% for depreciation, amortization, interest and taxes		7.6%		11.7%		8.7%

But if oil were used, it would cost $700,000 more than the cost of hydro-electric power at 0.75c. per kilowatt-hour, the report states.

The following table gives a summary of the power required and the fuel oil saved by the proposed electrification of the divisions considered in the report:

Division	Kw.-Hr. per Year	Maximum Kw. Demand
Sacramento......	104,200,000	47,600
Shasta...	73,200,000	33,400
San Joaquin	89,000,000	40,000

The saving of oil in each district, according to the report, would be:

Division	Barrels	Value
Sacramento	978,000	$2,200,000
Shasta	907,300	2,055,000
San Joaquin	1,177,000	1,882,000

The comparative low value of the oil used in the San Joaquin division as shown in the foregoing tabulation is due to the proximity of the district to the largest producing oil fields in California, making it possible to supply steam locomotives with fuel at a much lower rate than in the other two cases considered.

A summary of the first costs, the percentage of profit on the investment and the annual saving obtained in each of the three districts considered in the report is given as follows:

Division	First Cost	Annual Saving	Per Cent
Sacramento..................	$8,100,000	$1,592,600	7.6
Shasta..................	8,038,000	1,903,800	11.7
San Joaquin	6,784,000	1,426,900	8.7
Total....................	$23,012,000	$4,923,300	9.7

In calculating the profit on the investment in the report 12% is allowed for depreciation, amortization, taxes and interest.

No recommendation or suggestion concerning the source of the supply of power is contained in the report. Mr. Folsom stated, however, that should his reccommendation be adopted generating stations would have to be built to meet the demand. The installation of power plants to provide the necessary quantity of power at present costs is estimated at $150 per kilowatt. This would make the cost of generating plants in the neighborhood of $18,500,000 in addition to the cost of electrifying the railroads.

The question of purchase or generation of power for the proposed system is disposed of in the report with the statement that the monthly load factor for industrial uses averages 52% in California, while electric railways seldom exceed 40%. Purchase is therefore recommended, as the larger systems can more readily absorb the railroads' demand for power.

The total first cost for the three divisions is estimated and segregated as follows: Substations, $8,100,000; track bonding, $851,000; transmission line, $3,760,000; contact system, $6,620,000; block signal changes, $1,166,000; inspection shops and sheds, $45,000; electric locomotives, $8,910,000; credit for steam locomotive equipment released, $6,440,000; net total, $23,012,000. By divisions this total is distributed as follows: Sacramento, $8,100,000; Shasta, $8,038,000; San Joaquin, $6,784,000.

The estimate for locomotives includes twenty 150-ton passenger, sixty-three 100-ton freight and ten 100-ton switching locomotives. An allowance of $6,440,000 is made for steam locomotive equipment released by electrification.

The power requirements for the proposed electrification are estimated as follows: 730,000 kw.-hr. per day, 267,400,000 kw.-hr. per year, 121,600 kw. maximum demand and 30,400 kw. average demand.

Estimated comparative operating costs are indicated in the table so labelled.

The report says in part:

Railroads consume more coal and fuel oil than any other single industry. Over 20% of the annual production of coal and fuel oil in the United States is consumed by the railroads, and half this amount is wasted by the inherent inefficiencies of steam locomotives. Western railroads consumed 31.2% of California's 1917 production of fuel oil.

The great saving in locomotive fuel by the generation of power in central power plants is made possible by reason of the fact that the steam locomotive carries its power plant on its back and consumes a large portion of its energy in carrying its own fuel. Roughly, about 12% of the energy of the locomotive fuel supplied to the steam locomotive is used in hauling its own fuel in tenders and in coal cars or oil-tank cars to the distributing points along the line. Other large wastes of fuel are occasioned by the starting of fires, keeping hot and standing at sidings. In mountain districts there is the added waste of keeping up steam on the long downhill grades and more inefficient utilization of fuel on the uphill grades, especially in starting.

Motor Trucks Haul Coal from Mines

At present prices of coal many small mines in Tennessee, along the Cincinnati Southern line of the Southern Ry., are finding it profitable to reopen operations. Several of these mines which have no rail connections are using motor trucks of 1½ to 2 tons capacity for hauling coal to the nearest railway siding, where it may be dumped into a hopper or shoveled into a car.

Oiled Macadam Roads Resurfaced with Concrete

Los Angeles County, California, Builds Roads In Two Sections To Keep Traffic Moving—Center Joint Keeps Autos on Own Side

BY E. A. BURT
Assistant Engineer, Los Angeles County, California, Road Department

SEVERAL oiled macadam roads have been resurfaced with concrete in Los Angeles County, California, in the past two years, because they were breaking down under the increased traffic. As it was impossible to close entirely some of these roads, building them in two sections has been tried with excellent results. While this method of construction is slightly more expensive, due to the extra shifting of the equipment and the extra form work required, the advantages to the public are thought at least to counterbalance the extra expense.

CENTER FORM PLACED FOR BUILDING FIRST HALF

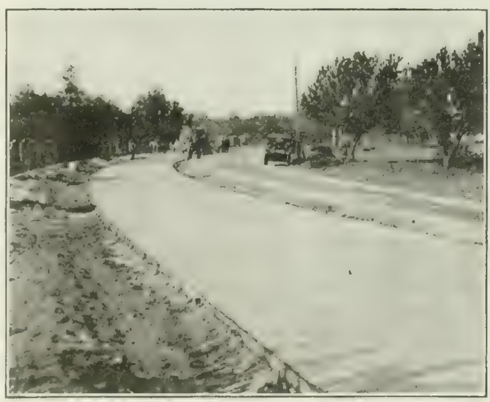
An example of this form of construction is the Long Beach Boulevard, the original improvement of which was completed in 1910 and 1911. The construction was typical oiled macadam, 16 ft. wide and 6 in. thick, with 7-ft. oiled earth shoulders. It was laid directly on the adobe or fine silt soil of the region.

The natural slope of the country from Los Angeles to Long Beach averages about 0.2%, and is practically uniorm for a mile or more on either side of the road. Consequently, satisfactory drainage was not obtainable. The general situation of the road left the ground-water level within two or three feet of the surface during the dry months (May to November), with more or less water all over the road and adjoining land during a considerable part of the rainy season.

The suitability of macadam for use under the conditions described was perhaps doubtful, but up to the end of the season of 1913 the surface of the road developed only the defects generally found in new macadam, and it was felt that it would continue to give good service for a reasonable number of years. However, early in 1914, with a traffic shown by census to be 1970 tons per day, it began to give signs of failure, and in 1915 a considerable number of ruts and waves developed. While it was still possible to maintain the road at a rather heavy expense, it was deemed advisable to reconstruct it. However, no funds were available. These unfavorable conditions were further aggravated by the closing of a parallel road, the Harbor Boulevard, on account of floods. The traffic over the road was thus increased to 3200 tons per day, the increase consisting mainly of motor trucks of 3 to 10 tons capacity. Under this sudden and unforeseen traffic, the roadbed being saturated with water from heavy rains, large sections were rapidly pounded into deep ridges, practically destroying 3½ miles of the surface. The previous method of patching with heavy asphaltic oil and rock was now found to be inadequate and entirely too expensive. Finally, in the absence of other funds, it was decided to use for reconstruction money set aside for paved highway maintenance.

After examining several stretches of concrete road which had previously been built in the county, this material was selected for the resurfacing, and in April, 1916, work was begun. The concrete was laid directly on the old macadam surface, no grading being done other than knocking off a few of the high humps and filling up a few of the deeper ruts with loose gravel. Wherever the smooth oiled surface remained it was swept clean with street brooms.

In developing methods of construction it was realized that suspension of traffic on the boulevard was out of the question, it being the only through road to the harbor. Detours along the sides were also impossible, unless a temporary road could be constructed, as the light, silty soil would not support the traffic. Furthermore, highly improved farms bordering the road prevented detours over adjoining land. To solve the problem it was decided to construct one-half of the pavement at a time, the traffic using the old half until the new was finished, and then shifting to the finished half. It was sometimes necessary to build shoulders on the portion being used by traffic, as 12 ft. was not a sufficient width; but as these shoulders had to be constructed eventually, no loss was involved.



HALF SECTION COMPLETED, SIDE ROAD AT RIGHT

Before work was actually started a center-line profile

was run, cross-sections were taken and a grade was established which would bring the finished crown 5 in. above the old surface. The new pavement received a crown of ¼ in. per foot, or a total of ¾ in. for a 24-ft. width. As the old surface had a crown of about 6 in., it is probable that the thickness of the new slab varied from five to nine inches.

In staking out the work 2 x 2-in. hubs were driven to 5 in. below finished grade on the center line of the road. This was found very convenient, as the 2 x 5 in. header boards, used along the center line, could be laid directly on the hubs, thus eliminating all further leveling. This method of setting header boards on the center line, and building one-half the road at a time, has proved so successful that it has been adopted for all work of this character.

Screened river gravel, washed sand and portland cement, mixed in the proportion of 1:2:4, was used for the concrete surfacing. On the first 3½ miles finishing was done with steel and redwood floats. Either type appeared to give good results in riding and wearing surface. All concrete was mixed in an 8-cu.ft. paving mixer. A straight-line crown from the center to the shoulder was used on the work.

ROLLER AND GRADER PUSH MACADAM TO SIDE WHERE GRADE IS TO BE LOWERED

No expansion joints were used on the first 3½ miles, the shrinkage cracks, which occurred about every 25 ft., being filled with heavy asphaltic oil to prevent ravelling. On the parallel half these cracks were much further apart, but so far no explanation has been found for the difference. About one mile of the first work was covered with oil and screenings, making a ¼-in. oil mat. A comparison of this with the remainder seems to indicate that the added expense for oil mat is not warranted.

The longitudinal joint down the center of the road formed by building the pavement in two sections, was also filled with heavy asphaltic oil, and gives the pavement, where it is not covered with oil and screenings, the appearance of being divided into two drives. This feature has been favorably commented on, as it tends to keep motorists on their own side of the road.

On many of the country roads it would be impracticable to lay a 5-in. slab directly on the old paving, as the resulting surface would be too high for the adjoining property. In the case of Long Beach Boulevard, which was 80 ft. wide, it was possible to give the earth shoulders a gradual taper down to the original ground.

MATERIAL AND LABOR COST ON LOS ANGELES COUNTY ROAD

Length 7076.5 ft (1.34 miles)	Average haul 0.6 miles
Width 24 ft	2593 cu.yd. concrete
Area 169,836 sq ft	Thickness 5 in.

COST OF LABOR	
Camp expenses	$350.00
Care of traffic	409.85
Preparation of sub-grade	[illegible]90.19
Unloading sand and gravel from cars	688.30
Hauling sand and gravel from cars	1,212.95
Cement, loading, hauling, storing	378.14
Headers, placing and removing	430.64
Mixing, placing, finishing	1,235.92
Covering, uncovering, watering	671.55
Watchman	221.75
Foreman	416.87
Time-keeper	63.75
Miscellaneous trucking	192.03
General repair and warehouse work	550.11
Surveying, drafting and staking	109.26
Miscellaneous	266.01
Overhead and supervision	762.21
Total	$9,350.03
COST OF MATERIALS	
Gravel, 2,330 tons	$1,796.39
Sand, 2,280 tons	812.56
Cement, 3,807 bbl	6,091.20
Lumber (header boards and stakes)	462.00
Total material	$9,162.15
Total labor	9,350.03
Total	$18,512.18
Cost of labor per cu.yd. concrete	3.61
Cost of material per cu.yd. concrete	3.54
Total cost per cu.yd. concrete	$7.15
Cost of labor per sq.yd. of paving	0.50
Cost of material per sq.yd. of paving	0.48
Total cost per sq.yd. of paving	$0.98
Cost per mile	$13,800
RATES OF WAGES	
Foreman	$5.00 per 8-hr. day
Mixer operator and finishers	3.50 per 8-hr. day
Laborers and teamsters	3.00 per 8-hr. day
Teams	2.50 per 8-hr. day

Recently resurfacing has been carried on under a slightly different plan, the new features being the breaking up and lowering of the old oiled macadam, the use of a roller and belt for finishing the concrete, and the placing of expansion joints at the end of each half-day's run, or about every 325 feet.

Laying the concrete directly on the old pavement was abandoned for two principal reasons: First, it was necessary to lower the grade in many places in order to conform with curbs already built; second, it was found by trial that the extra expense of grading was more than offset by the saving in concrete. The plan in use at present is to root up the macadam with a steam roller and rooter, spread out the material to the proper width and grade, remove any excess, set the header boards and bring the macadam sub-base to the proper grade by rolling. In some cases it has been necessary to push the entire rock surface to the side with a grader, remove the excess soil and push the rock back into proper position. The grader being used with a steam roller is shown in an illustration.

The table gives the quantity and cost of the work on one of the more recent jobs, but of course these prices are only comparative when costs of material and labor are changing so rapidly.

The work described was carried on under the general supervision of F. H. Joyner, road commissioner of Los Angeles County, and under the direct supervision of Walter Moore, Jr., district engineer, the writer being assistant engineer.

Some Experiences With Large-Capacity Reservoir Outlets

Specially Designed Gates Control Discharge of Immense Volumes of Water Under Pressures Above 200 Feet—Difficulties and How They Have Been Overcome

BY JAMES M. GAYLORD
Electrical Engineer, United States Reclamation Service, Denver, Colo.

This paper, the substance of which was presented informally some months ago before the Colorado Association of Members of the American Society of Civil Engineers, admirably supplements D. W. Cole's review of the development of high-pressure gates in waterworks and irrigation reservoirs, published in Engineering News-Record of last week, page 880.—EDITOR.

WHEN the United States Reclamation Service began the construction of its first large dams, there were no well established precedents which could be followed in the design of the large-capacity outlet works required, and it was therefore necessary to do much development work before this problem was solved. The data obtained during the course of the earlier developments were applied to later designs and led to some very successful installations. It is the purpose of this paper to describe some of the phenomena observed and the methods used in overcoming the early difficulties. One of the most successful later installations is also described.

It is not a very difficult matter to discharge a few second-feet of water under a head of one or two hundred feet, nor does the releasing of thousands of second-feet cause the designer much anxiety where the head is less than, say, 50 ft., but when thousands of second-feet must be released under any head from empty reservoir to two or three hundred feet, and when the flow must be regulated to a nicety at all times, the problem becomes one which must be approached with due respect, as the results of many installations eloquently testify.

ENORMOUS AMOUNT OF POWER INVOLVED

The source of the difficulty is mainly the enormous amount of power involved in the discharge. In some cases, this reaches hundreds of thousands of horsepower, millions of foot-pounds per second. If the discharge can be passed through waterwheels, a large portion of the energy can be put to useful service, but the problem at a storage dam usually is to find a means of throwing this power away without damaging the structure. With high heads, the velocities of the flowing water become very great, and it appears that the troubles, like many other hydraulic functions, increase as a high power of the velocity.

The close regulation of discharge to meet the varying demands of irrigation adds difficulty to the problem; it requires that a movable part of the valve must be continually in contact with the highest velocity of the water since it is at this point that regulation must be effected. Silt also contributes its share of difficulties, for not only does it erode metal surfaces by sand-blast action, but in many cases it deposits a scale which fills up close clearance spaces and causes sticking of the valve.

The experience of the United States Reclamation Service in the construction of large reservoir outlets clearly establishes the fact that the design of the outlet channel, pipe or tunnel is of no less importance than the proper design of the regulating devices themselves. In fact, the valves have, as a rule, withstood the service better than the other parts of the outlet works.

ROOSEVELT DAM GATES UNDER 226-FOOT HEAD

One of the first high head-gate problems was at the Roosevelt Dam, where regulation of the discharge up to a maximum of 3000 sec.-ft. is required, and where the head reached a maximum of 226 ft., measured from the crest of the spillway to the stream bed. In the construction of this dam, the stream was diverted through a sluicing tunnel, 12 ft. wide, 10 ft. high and 490 ft. long, driven through solid rock at the south end of the dam about river-bed elevation. This tunnel was to be closed by gates of special design, and it was attempted to make these gates adequate in strength and capacity to regulate the outflow from the reservoir. The installation includes two sets of three gates each, the downstream set for regulation and the upstream set for emergency closure to inspect or repair the regulating gates. Each gate closes an opening 10 x 5 ft. and is operated by a hydraulic cylinder located in a well extending down from the top of the dam to a point 33 ft. above the flow of the sluicing tunnel. The installation was fully described in *Engineering News* of May 30, 1907, p. 589. The gate and frame is provided with battered bronze facing strips. The batter of the stationary face corresponds to that of the movable strip, and, when the gate is closed, these faces come into contact. As soon as the gate is raised slightly the load is transferred to roller trains operating between the stationary and the movable track. Under maximum head (226 ft.), the total water load on each gate leaf amounts to 800,000 lb. and on each 4-in. roller the load is 13,000 pounds.

OUTLET WORKS DAMAGED

Water was turned through the gates for the first time in June, 1908. All the gates were opened wide and allowed to discharge freely for several months, during which time the head reached a maximum of 90 ft. In the following May an examination was made of the tunnel and gates, and damage to the outlet works was discovered. All the roller trains were broken or gone. Some of the deflection plates belonging to the walls above the gates had been carried away or loosened. The bronze gate seats were all damaged by blows from loose parts. Practically all of the nuts and bolts had been loosened, apparently by the vibration, and even the large nuts fastening the leaves to the piston rods were turned, one being 4 in. out of place. The concrete in the roof, floor and piers was badly damaged; a piece about 10 ft. in diameter had fallen from the

roof about 20 ft. below the gates. The concrete floor, extending 20 ft. below, had been undercut several feet back toward the piers.

Temporary repairs were made, and in an attempt to supply an urgent demand for water the gates were operated for two days. At the end of this time it was found that the entire concrete floor and much of the concrete in the piers had been washed out and in one case a passage made under the sill of a gate.

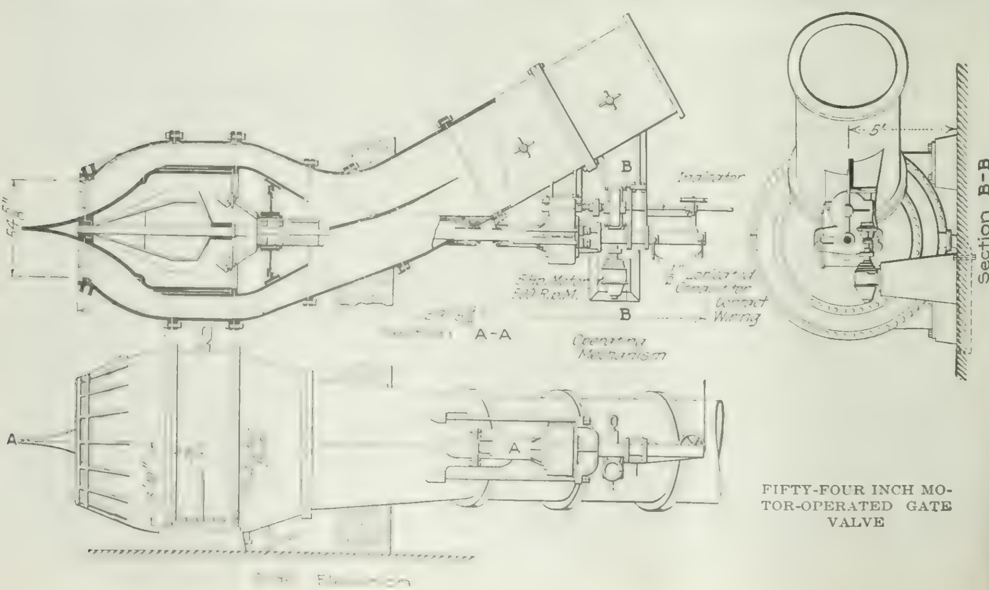
Ensign Balanced Valves

These results, together with unsatisfactory reports from the operation of sliding gates elsewhere, indicated the advisability of attacking the problem from a different angle. It was apparent that the damage had resulted not only from the scouring action of the high-velocity discharge but also from violent disturbance caused by the obstruction which the gate leaf, in partially opened position, offers to the flow of water. The nature of these disturbances received further study, and certain relief measures were taken in connection with the sliding gates at the Pathfinder Dam which will be described later. At the Roosevelt Dam, however, regulation by means of the sliding gates was abandoned, and new designs were prepared in which the central idea was to produce an efficient device; that is to say, one which would destroy the least possible amount of the energy, thereby protecting itself from violent disturbances and destructive forces which the sliding gate had experienced. The new devices have given remarkably good service and are still in operation. Their efficiency, however, has proved something of a disadvantage, since it has transferred the damage from the regulating devices to the outflow conduit. A new class of difficulties has also arisen with the valves, but these are mainly in the details of construction and not of a fundamental nature.

The new valves are known as the Ensign balanced valves. They have been made in several different designs, the most successful of which is the type for mounting on the face of the dam, completely submerged in the reservoir. Three valves of this type are installed at the Roosevelt Dam. The device consists essentially of a cylindrical piston with one end pointed to guide and regulate the discharge. The other end is provided with a bull ring of larger diameter, fitting a stationary cylinder in which it moves. The cylinder is attached to the circular base casting by a supporting grillage through which the water flows in a radial direction. Striking the pointed end of the plug, the flow is turned through an angle of 90° and discharged axially through the base casting into the circular outlet pipe.

Easy Control Feature of Balanced Valve

One of the principal advantages of this type of valve is the ease with which it can be controlled. While a sliding gate requires for its operation external power to overcome very heavy forces due to frictional resistance and weight of moving parts, the balanced valve is operated by means of the pressure of the water in which it is submerged, by simply balancing or unbalancing the pressures acting on the movable piston. The bull ring fits the cylinder with a clearance of 0.005 in. on the diameter. Through this clearance, the pressures inside and outside of the cylinder will be equalized, provided the outlet from the cylinder is closed. Given equal pressures inside and outside of the cylinder, the valve piston will be held against its seat like a check valve, since the pointed end is in this position subjected to atmospheric pressure only—the pressure in the empty discharge conduit. The pressure in the cylinder can be reduced by opening a drain larger than the clearance space around the bull ring, and can be reduced below atmosphere by applying a vacuum. With the pressure in the cylinder reduced to atmosphere, the atmospheric pressure on



FIFTY-FOUR INCH MOTOR-OPERATED GATE VALVE

the pointed end of the piston will be balanced by the equal pressure on a corresponding area inside the cylinder. The annular space between the circumference of the plug and the circumference of the bull ring will be subjected to reservoir pressure tending to move the plug from its seat, and the corresponding area in the cylinder has only atmospheric pressure. The resultant is a net opening force on the piston which will slowly move it from its closed position.

Valve Closed by Unbalanced Pressure

If it is desired to close the valve, the outlet from the cylinder is closed, and as the pressure accumulates in the cylinder through the clearance space the valve is unbalanced in the opposite direction, since the pressure in the cylinder is the same as that on the annular ring and the pressure on the pointed end is less than reservoir pressure on account of the velocity of the water. The reaction of the jet also enters into this calculation as an opening force, but the net result is a force tending to close the valve.

For regulating service, some means of establishing equilibrium at the desired gate opening must be provided. At Roosevelt, this was attempted by means of a resistance tube arranged to increase the frictional resistance to outflow of water from the cylinder as the valve opens. The increase of friction tends to build up the pressure behind the piston and check its further movement. The resistance tube consists of a stationary tube connected with the control pipe and extending through the head into the main cylinder. The outer surface of this tube is grooved, and it closely fits a corresponding bored recess in the main piston. The control water must pass through the clearance between the tube and the recess, and the resistance at this point increases as the valve opens and forces the tube farther and farther into the bore. This increase of resistance increases the pressure in the cylinder and tends to reëstablish equilibrium of the forces acting on the piston.

Needle Valves Used to Adjust Control Valves

The use of this device requires careful adjustment of the control valve, and for this purpose needle valves are used. For each setting of the control valve the main valve will stop at that point in its stroke where the forces acting on the piston find equilibrium by adjustment of the hydraulic pressure gradient through the several resistances at bull ring, resistance tube and control valve.

The balanced valves at Roosevelt have given good service. They have been operated under heads up to 110 ft. during seven years and are still in serviceable condition. Certain phenomena have, however, been observed in this installation which have been of much assistance in studying the valve problem and which have necessitated further changes in the outlet works. The resistance tube control has proved unreliable as a means of close regulation, owing to the fact that the point of equilibrium is not well defined and a slight accumulation of sediment at any one of the resistance points will disturb the balance and cause a movement of the piston.

The setting of the valve for a certain desired discharge requires much patience and, after being set, the valves will sometimes change position without apparent cause. Another unexpected difficulty has been the chemical action of the water on the cast iron of the cylinder. The reservoir water contains salt in considerable quantities as well as gases in solution. These chemicals have caused the scaling of the inner surfaces of the cylinder, and the scale thus formed is gradually wearing the cylinder lining and piston and increasing the leakage clearance around the bull ring, making it difficult to open the valves. As they are submerged in the reservoir and therefore inaccessible except at low water, repairs cannot be made when required.

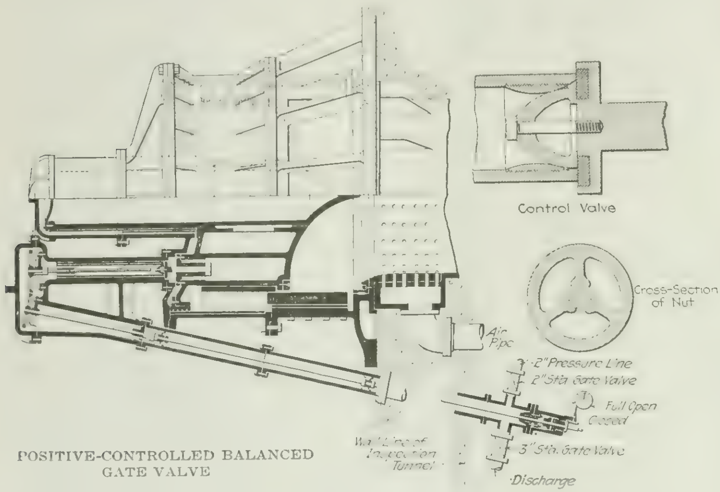
The most serious damage has occurred in the conduits below the valves. These conduits are lined with cast-iron bell-and-spigot pipe 5 ft. in internal diameter for a distance of about 80 ft. to a point where the three pipes converge into the outlet tunnel. At the point of convergence some erosion has taken place, but it has been possible to patch this with concrete. Immediately below the valves the cast-iron pipes began to show serious wear and cavitation after two or three seasons of operation. This action, which is attributed to the formation of a vacuum at this point, continued until the pitting extended entirely through the metal and for some distance into the surrounding concrete. This phenomenon has received much thought, and two cures have been very effectually carried out at other installations. The damage being apparently due to the effect of vacuum, means were sought to prevent the formation of a vacuum. This has been accomplished by the admission of air to this point of the jet and by installing throat pieces to approximate the shape of the contracted vein. Neither of these methods appeared wholly practicable at Roosevelt, and it has been decided to install within the outlet tubes steel linings connected to the valves by bronze throat pieces and to extend these pipes through the tunnel to the face of the cliff where motor-operated needle valves are to be installed. The steel linings are fitted with outside butt-strap joints for both circumferential and round seams, and countersunk rivets and patch bolts are used so that the finished pipe will be perfectly smooth on the inside. The space between the steel lining and the cast-iron pipe is to be filled with grout through holes provided for the purpose in the steel lining. Beyond the cast-iron pipes it is planned to continue the outlets as reinforced-concrete pipes connecting with the valves at the face of the cliff.

Motor-Driven Screw and Nut

The new valves are of the needle type and are operated by means of a screw and nut driven by a motor. This valve was designed to meet the following requirements: (1) A positive self-locking operating mechanism; (2) no close fits under water except at narrow guides; (3) free access of air to the jet; (4) absorption of energy at a point safely below the works, and (5) a valve accessible for inspection and repairs.

The valve has a free opening equivalent to 54 in. in diameter and is designed to produce a clear solid jet with maximum efficiency. The needle is provided with four bronze shoes and slides in a bronze-lined

cylinder supported in the center of the water passage by means of radial ribs. The upstream end of this inner, stationary cylinder terminates in a conical casting which serves to prevent impact of the incoming water against the rear end of the needle. The shaft extends through a stuffing-box and is threaded for a bronze nut which operates between heavy roller-thrust bearings. The nut is driven by a motor and worm gear, all gearing being submerged in oil. The end of the shaft is squared to prevent rotation, and is provided with an indicator and limit switch contacts. A certain amount of water pressure can be removed from the needle by venting the space behind the needle, and for this purpose 6-in. motor-operated valves are to be installed. These valve motors as well as the main needle valve operating motors are to be controlled from the power house across the river by means of electrically operated remote control contactors. The operating motors are designed for limited stalling torque to protect the mechanism against excessive strain, and limit switches and overload circuit breakers are provided as additional protection.



POSITIVE-CONTROLLED BALANCED GATE VALVE

These valves will probably be installed during the winter of 1918-19, and it is hoped that the final solution of this problem has now been found.

At the Pathfinder Dam in Wyoming sliding gates were installed when the dam was built. The installation is, in many respects, similar to that of the Roosevelt Dam but the gates were of a different type, being sliding gates of very massive construction and special design.

As was the case at Roosevelt, it was the intention to install two sets of gates, but only the upper or emergency set of four gates was ever put in.

The Pathfinder gates have clear openings 3 ft. 8 in. x 6 ft. 2 in., and are operated by hydraulic cylinders 24 in. in diameter. The gate leaves are of massive construction, the frames are very heavy and the piers were lined with heavy boiler plate. The head above the gate sills attains a maximum of 180 ft. with full reservoir, and the discharge has been regulated by means of these gates up to this maximum.

The installation of the gates was completed in April, 1908, and during the summer of that year they were operated wide open. During the season of 1909 the gates were operated at full and partial discharge up to heads of 175 ft. In June, it was discovered that water was backing up in the gate chamber through a 2-in. pipe connecting with the tunnel below the gates, indicating that the tunnel was operating under pressure at this point and that something had gone wrong. The reservoir was emptied in the fall of 1909 and the tunnel carefully inspected. The floor of the tunnel was found to be torn up for a distance of 130 ft. below the gates, the steel plate linings were about one-third gone and a portion of the concrete lining was destroyed. A large slab of rock had rolled into the tunnel, partially blocking it and causing the pressure indications above noted. In marked contrast with these conditions, a straight concrete-lined conduit through the dam, discharging continuously and without obstruction or valve under heads up to 140 ft., showed no sign of wear. Two straight cast-iron pipes 3 ft. in diameter had also been discharging freely under heads up to 158 ft. and showed no damage. The boiler-plate linings were replaced by heavy iron castings anchored into the concrete and provided with weep holes to relieve internal pressure, but during the season of 1911 these castings fared no better than the steel plates in 1909, and it was found that the floor of the tunnel again suffered damage from the heavy discharge.

A careful study was made of the various phenomena, and it was concluded that the major part, if not all, of the trouble with the gates and outlet chambers could be attributed to vacuum effects of the jet and the resulting vibrations and disturbances. This conclusion was supported by the observation that a discharge through the gates of sufficient volume to cause the sealing of the tunnel below these gate chambers, and the consequent exclusion of air therefrom, would at the same time cause an increasing series of disturbances in the tunnel below these outlet chambers, ranging from tremendous periodic surging of air with an accompanying booming noise resembling distant thunder, to explosive gusts accompanied with peals and detonations of great violence, apparently in proportion to the volume of water discharged and the degree of air exclusion effected.

The cure for the greater part of these troubles was very simple and effective. The tunnel was repaired, air was admitted through the lower gate shaft mentioned above, and the discharge limited to an amount which does not seal the tunnel outlet. This has effectually eliminated the vacuum below the gates and the

gates have been operated to date, as occasion demanded, without material damage. As regulating devices under heads above 60 or 80 ft., the use of a sliding gate is not recommended, and the operation of these gates for nine years under heads up to 180 ft. is cited as a remarkably good showing.

Balanced Valves Displace Sliding Gates

The sliding gates, as a means of regulating the outflow from the Pathfinder reservoir, have been superseded by six balanced valves installed in the south tunnel in the spring of 1912. These valves are duplicates of those installed at Roosevelt and discharge through cast-iron pipes and flaring castings into a tunnel 13 ft. wide by 14 ft. high, driven 360 ft. through solid rock around the south end of the dam. The valves are mounted on the face of a concrete plug at the upper end of the tunnel and are protected by a grillage. The control pipes were embedded in concrete in the floor of the outlet tunnel, the lower ends of the pipes being brought out to a control house on the face of the cliff below the dam.

At the time of the installation of these valves the agencies which caused the destruction below the sliding gates were not understood. No provision was made for the free admission of air below these gate chambers, with the result that the concrete floor below the discharge tubing was destroyed mostly after a sufficient volume of water to exclude free access of air was discharged, and with the destruction of this floor the control pipes became exposed and opened, making the further control of these valves impossible for the season. By this time the cause of the difficulty had been discovered, and a remedy was promptly applied by admitting air to the tunnel just below the discharge tube and locating the control pipes in an auxiliary tunnel which also serves to admit the necessary supply of air. The trouble with the 5-ft. discharge pipes, however, continued until the pipes were worn through and the concrete showed serious damage. This wear was undoubtedly due partly to cavitation, partly to attrition and partly to poor material in the linings. The tubes have been lined with riveted-steel pipes, 4 in. smaller in diameter, grouted into the tubing and attached to the balanced valves by bronze throat pieces. These linings have withstood four years' service with practically no damage beyond a slight pitting of the throat pieces. The balanced valves themselves have shown no signs of wear.

Variable Head at Arrowrock Dam

When the design of the outlet works of the Arrowrock Dam in Idaho was undertaken, the experiences at the Roosevelt and Pathfinder Dams were available precedents, and the successful operation of the Arrowrock high-pressure valves is proof that progress has been made toward the solution of this difficult problem.

The head at this dam varies from 60 to 230 ft. and the regulated flow reaches a maximum of about 9000 sec.-ft. The dam is of the concrete gravity type, arched upstream on a radius of 660 ft. The main outlets consist of 20 straight tubes 52 in. in diameter extending on radial lines through the dam, the jets being allowed to fall freely into a pool below the toe. The tubes are arranged in two horizontal tiers, 66 ft. and 153 ft., respectively, above stream bed, and each tube is controlled by a 58-in. Ensign balanced valve. Of each set of 10 valves, three are provided with special sleeve controls and are used as regulating valves, while the remaining seven are provided with plain controls and are used only for full open discharge. The lower valves are provided with trash racks while the upper valves have none. The recorded history of the Boise River, studied in connection with the irrigation demands, makes it almost certain that the reservoir will be practically emptied every year, so that the valves will be accessible for frequent inspection and repairs, if necessary. This fact, together with the absence of silt, makes the Arrowrock Dam especially favorable for the installation of this type of valve.

Sleeve Control for Regulating Valves

In general design, the valves are almost identical with those at Pathfinder and Roosevelt, but in the method of control of the regulating valves there is a radical difference. In the sleeve-controlled valve, the control pipe connects at the cylinder head with a movable sleeve extending into the main cylinder and operated from a chamber inside the dam by means of shafting and gears. On the main piston, opposite the movable sleeve, is an acorn-shaped seat which, when in contact with the inner end of the sleeve, cuts off all outflow from the cylinder. The control shaft is carried inside of the control pipe to the chamber in the dam where it passes through a stuffing-box and terminates in a crank and indicator.

When it is desired to open the valve the sleeve is withdrawn from its seat, which relieves the pressure in the cylinder and allows an opening movement of the piston. This motion continues until the seat approaches the movable sleeve, partially closing the outlet and building up the pressure in the cylinder until the movement of the piston is checked. To close the valve, the control crank is rotated fast enough to keep the sleeve in contact with its seat and the outlet through the control pipe entirely closed while the piston is forced to its seat by the pressure accumulating in the cylinder.

Air Supply Provided

The six sleeve-control valves, all of which are operated at partial opening for regulation, are provided with throat pieces of semi-steel just below the valve and air is supplied at this point through a large number of small holes extending half way around the pipe. The air-inlet castings connect with pipes extending to the top of the dam. The outlet tubes are perfectly straight and extend radially through the dam. They are lined with semi-steel pipes for a distance of about 27 ft., the remainder of the pipe being unlined. Great care was taken to make these pipes perfectly smooth, and they are painted with water-gas and coal tar throughout their entire length.

The operation of the valves for three seasons under heads as high as 130 ft. has been perfectly satisfactory. The control of the discharge is absolute, and no damage has occurred either to the valves or to the outlets. This excellent record is attributed largely to the efficiency of the outlets, which permits the greater part of the energy

of discharge to be passed on and absorbed in the pool below the dam. The perfectly straight alignment of the tubes and the admission of air at the throat of the regulating valves have materially improved the efficiency and have made the satisfactory operation possible.

In addition to the regulating outlets, there are 5 x 5-ft. sluice gates in straight radial passages through the dam, 15 ft. above stream-bed elevation. These gates are operated by hydraulic cylinders in an inspection gallery in the dam and are arranged so that with empty reservoir the leaves can be hoisted into this gallery, if necessary, for repairs. The sluice gates are not designed for regulating service, but are intended for wide open discharge only under heads of less than 70 ft. They can be opened, if necessary, under heads of 125 ft. or more. This design provides for the admission of air at the top of the gate just below the leaf, in order to prevent the formation of a vacuum, with its resultant disturbances, while the gate is being opened. The operation of these gates has been equally as satisfactory as the balanced valves, and if the entire outlet works were to be redesigned today few, if any, changes would be made.

One Set of Wood Forms Used Three Times Completes Concrete Foundry

Form Units Assembled on Ground With Reinforcement In Place Erected by Derrick—Telescoping Chute Placed Concrete

By J. M. Villadsen
Salt Lake City, Utah

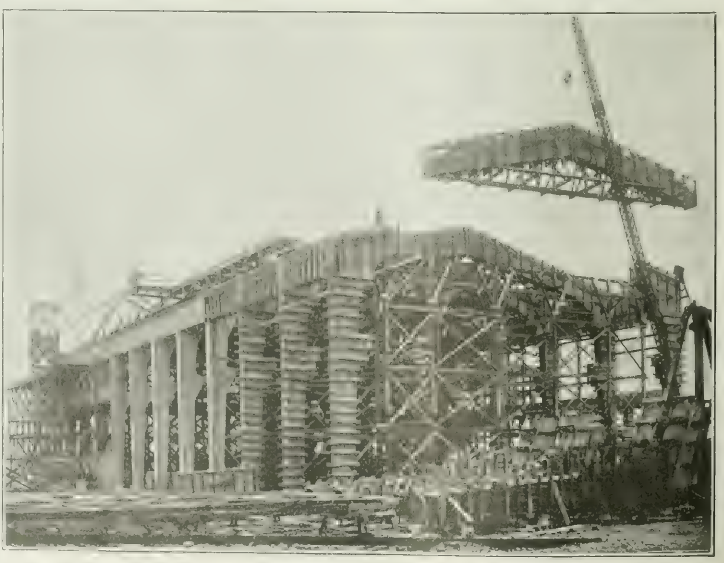
TWO-HINGED arch bents concreted in two lifts form the supporting frame of a new foundry building recently completed for the Garfield Smelting Co. This type of construction, besides permitting attractive architectural treatment and giving ample light and an unobstructed interior, as shown by the views, greatly simplified concreting operations. All concrete was chuted directly into the forms. They were assembled and erected in a few large units with reinforcement in place, and one set of forms was used three times for the whole building.

Arch-bent concreting was the governing condition. There were 14 of these bents, each with a span of 70 ft. and a height of 44 ft. Forms were constructed for the first four bents; reused, with an additional form, for the middle five bents, and again reused for the remaining bents. This reuse of forms is a very important factor in the low cost of construction of the type of structure illustrated. On account of the unusually heavy form sections and the great ceiling height, it was necessary to plan the exact sequence of all erection operations very carefully. To help visualize the exact working conditions a form model, representing the first two bents of the building with all scaffolding and supports, was built on a scale of ½ in. to 1 ft. The erection derrick, represented on the same scale, was used to manipulate the form units. From these studies piling diagrams were laid out, locating the position of every piece on the ground. An interesting item in the form construction is the use of double-head nails for joints which must come apart again on stripping. On these nails, the second head is placed about ¼ in. below the first. The nail may be driven home but still leave a head projecting to be pulled, thus effecting a considerable saving in lumber and labor.

The forms were cut in the construction saw mill and partly assembled on a large platform at the mill site into sides, ends and bottoms, leaving the final assembly into complete form units to be done under a 6-ton traveling stiff-leg derrick with a 70-ft. boom, a 30-hp. boiler and a single-drum hoist. The principal use of the derrick was to hoist the completed form units into place, as shown by the illustration. Reinforcing rods were all in place in the forms before they were raised. This method of form erection necessitates form designs as perfectly worked out as if they represented steel structures.

Concrete was distributed by carts running on scaffolding above the roof. Telescoping sheet-iron spouts were provided to chute the concrete down the long columns; these telescoped as the concrete rose in the forms. Traps or openings were left in the sides of the column forms, for tamping.

A section of form bents was concreted in two suc-


DERRICK ERECTED FORM UNITS WITH REINFORCEMENT IN PLACE

cessive working days, the first day being devoted to the legs from the foundation up to the haunches, about 29 ft., and the second day to concreting the arch beams. An interesting deviation from this schedule was necessary on one occasion when a breakdown of the mixer made it impossible to carry out the plan of concreting two of the legs in the second section of the building. On the following day the concreting of the whole section was completed; this required the pouring of one bent from foundation to ridge, a height of 45 ft., in nine hours. The forms were carefully watched to make sure that they would not burst under the heavy pressure, but no signs of weakness developed.

The rate of erection was 11 working days per section, a section, as previously explained, being about one-third of the building. In other words, it took 11 working days to strip the form in section 1, repair it, reerect in section 2 and fill it with concrete again. It was found very beneficial, in getting smooth casting, to add hydrated lime in the proportion of about 5% of the cement, to make the material flow more freely.

TWO-HINGE ARCH-BENT FRAME PERMITS LARGE WINDOWS AND UNOBSTRUCTED INTERIOR

Upon the decision of the Garfield Smelting Co. to erect a foundry building, Villadsen Brothers, Inc., were asked to submit a design and proposal in reinforced concrete, in competition with structural steel. The advantages of the low first cost, fire-resisting quality, speed of delivery, large window area, and negligible maintenance expense, were so marked in favor of the concrete design that it was accepted, and the contract was awarded to its designers, on the recommendation of F. M. Martin, chief mechanical engineer of the American Smelting & Refining Co., and C. F. Buck, chief engineer of the Garfield Smelting Company.

The unusual feature of the design is the rigid-frame concrete construction over the main foundry floor. This frame is designed as a two-hinged arch provided with brackets for crane beams at a height of 24 ft. above the floor. A 20-ton traveling crane of 60-ft. span is carried on the brackets.

The concrete frame with long, high spans, as shown in these illustrations, is a type of structure which has probably come to stay. Its development might have been delayed longer if the price of steel had remained normal, but the high price of steel, especially in the structural and plate forms, accompanied by a feeling that it has been unpatriotic to use up much of it, has therefore made the extension of concrete construction logical.

Special Paints for Concrete Ships

OUTSIDE coatings of protective paint for all the Government's concrete ships, and varnish coats for the inside of the oil tankers, have been developed by the concrete ship department of the Emergency Fleet Corporation.

Rudolph J. Wig, head of the department, describes them as follows in a paper presented before the Society of Naval Architects and Marine Engineers Nov. 14:

A priming coat of magnesium fluosilicate ($MgSiFl_6$) is applied to the entire hull. The solution shall contain not less than 15 per cent. by weight of salt and not more than one per cent. of any other substance in solution nor more than 0.2 per cent. of total chlorine. The paint which will give the best service has not been determined upon.

Two types of paint are being tried. One of them is a high-grade spar varnish which is applied in two coats, and the other a bituminous paint consisting of asphalt base thinned with petroleum distillate. One or two coats of this latter are applied, followed by a coat of the same paint thickened with about 15 per cent. of finely powdered siliceous matter and 15 per cent. short-fibered mineral asbestos. An antifouling paint is applied on under-water parts and a boat topping paint on the upper portion. While the concrete does not require any special treatment in order to make it impervious to water or ordinary crude oils, it will not hold the lighter oils unless the concrete is of exceptional quality. As a further guarantee of imperviousness, it is proposed to apply to the concrete a coating of spar varnish which will make it impervious to all mineral oils.

Seattle Makes Record in Sale of Municipal Bonds

A record in the rapid selling of municipal bonds was recently made by the City of Seattle in disposing of $1,500,000 worth of 5% bonds for $1,383,900 in less than three hours from the time they were placed on the market. The bonds, known as "Skagit Utility," were authorized by the Capital Issues Committee of the War Finance Corporation for the development of the Skagit waterpower project, as mentioned in *Engineering News-Record* of Aug. 15, p. 336, the requirements of the City of Seattle for additional power having been outlined in *Engineering News-Record* of Aug. 1, p. 248.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

The City as an Ally of Business

AMERICAN CITIES, THEIR METHODS OF BUSINESS—By Arthur Benson Gilbert, M.A., Formerly with the Extension Division, State University of Iowa. New York: The MacMillan Co. Cloth; 5 x 8 in.; pp. 234. $1.50.

Making the city help its local business interests so that they have a "differential" over business in other cities, and so that the city as a whole will lead others, is the unusual theme of this book.

After an introductory chapter, the author considers external costs, the proper object for city promotion, costs of material and labor, land, capital, public ownership of utilities, city government and the manager plan, and the industrial survey—all in relation to the main theme. A closing chapter, entitled "The Force of Circumstances," deals with various conditions which, in the author's opinion, inhibit city and business growth.

The author deprecates acquisition of wealth through mere ownership, in so far as it places a burden on production. He favors municipal ownership, taxation of land rather than improvements, liberal treatment of labor, and the newer schemes of city government, including both the commission-manager plan and proportional representation.

The book deserves thoughtful attention, with allowances for the one-sideness common to propagandists, and with patience for lack of clearness at points. The author ignores the fact that his production "differentials" in favor of a given city would disappear if all cities were to adopt with full success the various measures which he advocates. True, there is no immediate danger that this will occur, but some attention might well have been given to making the most of natural local advantages.

Railway Track for Mines

MINE TRACKS, THEIR LOCATION AND CONSTRUCTION: Treating Briefly on the Materials Used and the Principles Involved in the Design and Installation. With a Set of Rules for a Standard Practice.—By J. McCrystle, E. M. New York: McGraw-Hill Co., Inc., London: Hill Publishing Co., Ltd. Leather; 5 x 8 in.; pp. 105; illustrated. $1.50.

That improvement in mine haulage and equipment should lead to greater consideration of track layout and material in the interest of economical operation is the viewpoint of the author. The book is somewhat of a pioneer in a special line, therefore, and its subjects are treated both analytically and descriptively. It deals particularly with the main underground lines, and to some extent with the surface tracks, but as much track work in mines is necessarily of a rough-and-ready character some notes on improvised or special methods and devices might have been included. Omission of reference to portable tracks is rather surprising, and more information as to steel ties and their fastenings would have been appropriate.

Of particular interest are the rules for track work and maintenance, since such work in mines left usually to the personal ideas of the foremen. The rules follow the general line of those used in regular railway track work, but are modified to meet the special conditions. Nothing is said, however as to the organization of the track forces. Typographically, the book is good, but the comparisons of rails on p. 3 might have been expressed more clearly in tabular form.

Economics of the Motor Truck

THE MOTOR TRUCK AS AN AID TO BUSINESS PROFITS—By S. V. Norton. Chicago, Ill.: A. W. Shaw Co. Cloth; 7 x 10 in.; pp. 498; illustrated. $7.50.

As the title of his book implies, Mr. Norton has undertaken to set forth the conditions and methods to be followed in making the motor truck pay. To quote from the coverlet, "What will it do in dollars and cents is a natural question," and this is the question the book proposes to answer. The first book of its kind published, so far as we know, it contains a mass of information on its subject; so much, in fact, that it might be considered a handbook for the industry.

The book is written primarily for the motor-truck operator, and the author treats the question on a plane requiring no extensive technical or mathematical knowledge. For this reason the explanations and illustrations will seem elementary to the engineer or the automobile designer, but will be appreciated by the nontechnical business man who wishes to learn how to get the most out of his trucks. In style it reads like a story and is free from that dryness which characterizes most reference handbooks.

The subject matter is treated under five main heads. The author states that the information and plans suggested have been collected from those who have actually tried them out and found them to work. It is therefore not an expression of the individual idea of any one authority, but of hundreds.

Part I covers the general subject, "Fitting the Motor Truck Into Your Business," and includes such topics as "The Field of the Motor Truck in Modern Business"; "When to Change from Horse to Motor Delivery"; "Cost Keeping," and "Selecting the Right Trucks for Your Work." Part II treats of "Making Your Motor Truck Do More and Better Work," under chapter heads such as "Planning the Delivery System"; "Effective Scheduling and Routing"; "Principles Governing the Use of Trailers," and "How to Get Your Drivers' Coöperation." Part III deals with the subject of "Maintenance that Lowers the Cost of Upkeep," and covers topics such as lubrication, tires, overloading, and garage problems. Part IV describes various methods of "Building New Business with Your Motor Truck," and Part V takes up "Present Tasks and Future Problems," dealing with coöperation, legislation, etc.

The book is instructively illustrated both by half tones and drawings. Treating as it does practically every phase of the economic operation of trucks and trailers, it is well worth owning by those interested both for reading and as a book of reference.

A Monumental Discussion

A STUDY OF ENGINEERING EDUCATION: Prepared for the Joint Committee on Engineering Education of the National Engineering Societies—By Charles Riborg Mann. The Carnegie Foundation for the Advancement of Teaching. New York: The Carnegie Foundation. Paper, 7 x 10 in.; pp. 139. Copies furnished upon request.

This report is the culmination of an investigation instituted in 1907 by the Society for the Promotion of Engineering Education. The national engineering societies joined with that society in the appointment of a committee to study the problem of engineering education, and subsequently the Carnegie Foundation was induced to take up the investigation on a large scale. Dr. Mann was retained to give his entire time to it, and this report follows three years devoted to the study.

Dr. Mann finds much to criticise in present-day engineering education. His theory is that the primary purpose of engineering is to increase intelligent production. On that basis he finds present-day curricula, while adequate as to the technical side, badly deficient in teaching judgment, understanding of men, appreciation of the relation of values and costs. Among the changes proposed by Dr. Mann are closer coöperation and better coördination of the prospective engineer's needs among the several departments of instruction; the introduction of practical experience with engineering materials into the freshman year, and more emphasis on humanistic studies. He also advocates a better system of testing and grading students, not only at entrance, but during their entire course of study.

A lengthy abstract of the report was printed in *Engineering News-Record* of Oct. 24, p. 742. The report is probably the most comprehensive discussion of the subject ever published, and deserves the widest distribution and most careful study.

Engineering Societies Offer Library Service

Engineers outside of New York City are served by the Engineering Societies' library in several ways, according to statements made by Alfred D. Flinn, secretary of the Engineering Council, during a trip through the West. Letters from outside engineers are turned over to a special assistant, who searches for the answer to questions and compiles a list of references to books and articles which seem pertinent. This is mailed to the inquirer. In many cases much of this material is available in local libraries. Whenever it is not, the Engineering Societies Library will make copies of any or all of the references, will translate those in foreign tongues, and will, in fact, use any method that it can devise to get information to the inquirer. For these special personal services fees are charged sufficient to cover the cost of the time spent on them. The present price for searching is $1.50 an hour; for copies, 25c. a page, and for translations from $3.50 upwards a thousand words. Some 2200 inquiries have been handled in the three years that this service has been in operation.

Tests of Large Brick Piers

A study of the strength of large brick piers has been published by the United States Bureau of Standards, Washington, D. C., under the title, "Compressive Strength of Large Brick Piers." It is written by J. G. Bragg, assistant physicist of the bureau. Forty-six piers, $2\frac{1}{2}$ x $2\frac{1}{2}$ ft. x 10 ft. high, were tested, and also four other piers of the same cross-section and half the height. Two or more grades of brick were used from each of four districts east of the Mississippi River. Three kinds of mortar and three grades of bond and workmanship were employed. The paper by Mr. Bragg first outlines four earlier investigations on the strength of brick piers, then describes the investigations reported in his paper, and finally discusses the results of the later tests. The type of failure observed in the present investigation, Mr. Bragg states, "is in agreement with previous studies of the compressive strength of brick masonry." Some conclusions are drawn from the results of this latest investigation and of the earlier investigations as regards various methods of laying the brick, the introduction of wire mesh at the joints, the thinness of the mortar joints, and the kind of mortar used. Copies of the bulletin may be obtained from the Bureau of Standards, Washington, D. C., without charge, or from the Superintendent of Documents, Washington, D. C., for 10c. each.

The Proposed Arizona Water Code

A brief for water-right legislation in Arizona similar to the code of Wyoming, Oregon and a number of other states in the irrigated area has been written by Prof. G. E. P. Smith, irrigation engineer, University of Arizona, and issued as a circular by the extension service of the College of Agriculture (Tucson, Ariz.). The proposed code was introduced in the last legislature, but was not enacted. It is expected that it will be reintroduced in the next legislature. Professor Smith outlines briefly the proposed legislation and discusses some features of the codes of the other states.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. TRANSACTIONS FOR 1917-18.—Bloomington, Ill.: The Society, Charles Carroll Brown, Secretary. Paper; 6 x 9 in.; pp. 239; illustrated.

AMERICAN RAILWAY ENGINEERING ASSOCIATION: Proceedings for 1918, Vol. 19. Chicago: The Association. Paper; 6 x 9 in.; pp. 1569; illustrated.

ANALYSIS OF THE LAWS AFFECTING MUNICIPAL AND COUNTY FINANCES AND TAXATION. Published by The Commission for the Survey of Municipal Financing of New Jersey—By Arthur N. Pierson, Author of the Laws. Trenton, N. J.: The Commission. Paper; 6 x 9 in.; pp. 117.

BOILER AND FURNACE TESTING—By Rufus T. Strohm, Associate Editor of *Power*. Washington, D. C.: Bureau of Conservation. Paper; 6 x 9 in.; pp. 20; illustrated. Upon application copies may be obtained free of charge from the administrative engineer of the state in which applicant resides, or, Washington, D. C.: Conservation Bureau of the United States Fuel Administration.

CANTONMENT CONSTRUCTION—By Morris Knowles, Consulting Engineer, Pittsburgh; Supervising Engineer, Camp Meade and Camp McClellan. Reprinted from the *Proceedings* of the Engineers' Society of Western Pennsylvania. Pittsburgh, Penn.: The Society. Paper; 6 x 9 in.; pp. 24; illustrated.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING: Twelfth Annual Report of the President and

of the Treasurer New York The Carnegie Foundation. Paper; 7 x 10 in.; pp. 146. Copies furnished upon request.

COMMERCIAL ARBITRATION AND THE LAW—By Julius Henry Cohen, Author of "Law and Order in Industry," "The Law Business or Profession?" "A League to Enforce Industrial Peace" New York: D. Appleton and Co. Cloth; 6 x 9 in.; pp. 329. $3

COMPARISON OF WORKMEN'S COMPENSATION LAWS OF THE UNITED STATES UP TO DECEMBER 31, 1917—By Carl Hookstadt. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 101; with tables.

ECONOMIC OPERATION OF STEAM TURBO-ELECTRIC STATIONS—By C. T. Hirshfeld and C. L. Karr. Washington, D. C. Bureau of Mines. Paper; 6 x 9 in.; pp. 29; illustrated 5c. from Superintendent of Documents.

ENGINEERING PRACTICE: The J. E. Aldred Lectures, 1917-18—Baltimore, Md.: The Johns Hopkins University. Paper; 6 x 9 in.; pp. 236; illustrated. $1.

Among the nine lectures in this series were: "The Relation between Civil Engineering and Military Engineering," by Maj. Gen. William M. Black, "The Development of Concrete Road Construction," by Arthur N. Johnson, consulting highway engineer; "The Control of Stream Pollution," by Earle B. Phelps, Hygienic Laboratory, American Public Health Service, Washington, D. C.; "The Manufacture of Structural Steel," by Bradley Stoughton, secretary, American Institute of Mining Engineers

EVENING INDUSTRIAL SCHOOLS—Washington, D. C.: Federal Board for Vocational Education—The Board. Paper; 6 x 9 in.; pp. 54.

EXCESS CONDEMNATION: Why the City of Chicago Should Have the Power, in Making Public Improvements, To Take Property in Excess of Actual Requirements; Lessons to be Drawn from Certain Unfortunate Aspects of the Twelfth Street and Michigan Avenue Widening Projects and the Proposed Ogden Avenue Extension—Chicago: Chicago Bureau of Public Efficiency. Paper; 6 x 9 in.; pp. 58; illustrated.

THE FACTOR OF SAFETY OF WIRE ROPES USED FOR WINDING IN MINE SHAFTS—By J. A. Vaughan, Chief Inspector of Machinery, Department of Mines and Industries. Reprinted from the *Journal* of the South African Institution of Engineers. Johannesburg, South Africa: The Author. Paper; 7 x 10 in.; pp. 11; illustrated.

FINANCIAL STATISTICS OF CITIES HAVING A POPULATION OF OVER 30,000, 1917—Washington, D. C.: Bureau of the Census. Cloth; 9 x 12 in.; pp. 369.

THE FLORIDA TANK PRIVY—By George W. Simons, Jr., Chief Sanitary Engineer, State Board of Health, Jacksonville, Fla.: The Author. Paper; 6 x 9 in.; pp. 7; illustrated.

HIGHWAY COST KEEPING—By James J. Tobin and A. R. Losh, U. S. Engineer Economists, Reviewed by Halbert P. Gillette, Consulting Cost Engineer. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 52; illustrated. 10c., from Superintendent of Documents.

Gives a detailed classification of items under the four main heads of labor, materials, service of plant and equipment, and general expense or overhead. A code number is assigned for each item and complete cost-account forms to be used with the code numbers are suggested. An appendix contains various conversion tables to facilitate computation of quantities and costs.

HOW TO IMPROVE THE HOT-AIR FURNACE—By Charles Whiting Baker. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 20. 5c., from Superintendent of Documents.

LOW-RATE COMBUSTION IN FUEL BEDS OF HAND-FIRED FURNACES—By Henry Kreisinger, C. E. Augustine and S. H. Katz. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 52; illustrated. 10c.

THE NATIONAL FIRE PROTECTION ASSOCIATION: Proceedings for 1918—Boston, Mass.: The Association—Paper; 6 x 9 in.; pp. 294.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS—Financial and Miscellaneous Statistics Compiled from the Annual Reports Made by Public Utilities To the Board, 1916—Trenton, N. J.: The Board. Cloth; 6 x 9 in.; pp. 222.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Report for 1917—Trenton, N. J.: The Board. Cloth; 6 x 9 in.; pp. 236.

OUR NATIONAL FORESTS: A Short Popular Account of the Work of the United States Forest Service on the National Forests—By Richard H. Douai Boerker, Arboriculturist Department of Parks, City of New York. New York: The MacMillan Co. Cloth; 6 x 9 in.; pp. 238; illustrated. $2.50.

RAND WATER BOARD: Report for 1918 to the Honourable the Minister for the Interior, Union of South Africa. Johannesburg, South Africa: The Board. Paper; 9 x 12 in.; pp. 37; illustrated.

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS—By Edmond Earle Lincoln, Instructor in Economics, and Tutor in the Division of History, Government and Economics, Harvard University. Boston and New York: Houghton Mifflin Co. Cloth; 5 x 8 in.; pp. 478; illustrated. $3.

SAVING COAL IN BOILER PLANTS—By Henry Kreisinger. Washington, D. C.: Department of the Interior. Paper; 6 x 9 in.; pp. 24; illustrated. 5c., from Superintendent of Documents.

STANDARD SPECIFICATIONS FOR QUENCHED AND TEMPERED CARBON-STEEL AXLES, SHAFTS, AND OTHER FORGINGS FOR LOCOMOTIVES AND CARS: Text as Adopted by the American Society for Testing Materials; Spanish-English Edition, Prepared under the Supervision of the Bureau of Standards, S. W. Stratton, Director. Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 21. 5c., from Superintendent of Documents.

STATE ENGINEER AND SURVEYOR OF THE STATE OF NEW YORK: Report for 1917—By Frank M. Williams, State Engineer and Surveyor. Albany, N. Y.: The Author. Cloth; 6 x 9 in.; pp. 382; illustrated.

STEEL SHIPBUILDER'S HANDBOOK: An Encyclopedia of the Names of Parts, Tools, Operations, Trades, Abbreviations, etc., Used in the Building of Steel Ships—By C. W. Cook, M. A., B.S. in C.E., Jun. M. Am. Soc. C. E. New York and London; Longmans, Green and Co. Leather; 5 x 7 in.; pp. 123; illustrated. $1.50 net.

TESTS TO DETERMINE THE RIGIDITY OF RIVETED JOINTS OF STEEL STRUCTURES—By Wilbur M. Wilson, Assistant Professor of Civil Engineering, and Herbert F. Moore, Research Professor of Engineering Materials. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 55; illustrated.

WAR TIME CONTROL OF INDUSTRY: The Experience of England—By Howard L. Gray, Professor of History in Bryn Mawr College. New York: The MacMillan Co. Cloth; 6 x 9 in.; pp. 304. $1.75.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

St. Louis Club Reports to Commerce Body on Concrete Ships

Coöperation between the St. Louis Engineers' Club and the Chamber of Commerce is such that the war board committee of the chamber recently asked for and obtained a report, which was favorable, on the feasibility of concrete ship building in St. Louis. Briefly, the report states that suitable yards can be economically developed; that all materials are available without adding a burden to transportation; that the draft of a 5000-ton concrete ship is 8 ft., the limiting depth of channel to Cairo, but that heavier ships could be lightered to Cairo by pontoons at a cost of only $500 per trip; that the handicap of cold weather is largely offset by a superior supply of labor and material; that engines and boilers can be built in St. Louis shops without interference with present war work. H. C. Toensfeldt was chairman of the committee.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Mechanical Engineers Organized for Reconstruction

Sir—Responding to your editorial on p. 695 of your Oct. 17th issue asking which society will be first in reconstruction work, I am pleased to say that since February the American Society of Mechanical Engineers has had an active committee on war industries readjustment, working in coöperation with the War Industries Board, Resources and Conversion Section, of which Charles A. Otis is chief.

Whereas the present activities of our committees have had to do with adjustment for the purpose of winning the war, you can easily see that we had in mind the conversion back again to a peace basis as soon as the work of winning the war ceased, and for a month or more we have already been planning the reconstruction program.

Utilizing our local sections organization, President

Charles T. Main has appointed the following members of the society to act as its representatives on each of the regional committees of the Resources and Conversion Section of the War Industries Board: Atlanta, Robert Gregg; Baltimore, William W. Varney; Birmingham, W. P. Caine; Boston, A. C. Ashton; Bridgeport, Harry E. Harris; Chicago, A. D. Bailey; Cincinnati, Fred A. Geier; Cleveland, F. H. Vose; Dallas, A. C. Scott; Detroit, G. W. Bissell; Kansas City, J. L. Harrington; Milwaukee, W. M. White; New York, G. K. Parsons; Philadelphia, C. N. Lauer; Pittsburgh, Ivar Lundgaard; Rochester, F. W. Lovejoy; St. Louis, R. H. Radcliffe; St. Paul, Oliver Crosby; San Francisco, B. F. Raber; Seattle, R. M. Dyer.

The central committee consists of G. Kingdon Parsons, chairman, 29 Pine St.; Fred A. Scheffler, 85 Liberty St.; and Erik Oberg, 140 Lafayette St., all of New York City.

CALVIN W. RICE,
Secretary, American Society of Mechanical Engineers.
New York City.

Give the Technical Men a Chance

Sir—There are in the employment of the railroads of our country many technical men who would develop into excellent operating officials if they were given a chance. Some of the Eastern railroads appreciate the value of technical men in the operating department. The practice in this respect on many Western railroads is quite the reverse; in fact, the technical men are too often considered as only draftsmen, surveyors and mechanics, and not as competent railroad men.

The average technical man engaged in railroad work has spent four years in high school, also the same amount of time at some university or technical school preparing a broad foundation for the future. In many instances the state as well as the Federal Government has partly paid for his education, that he may be of greater value to the country in general. He has usually spent considerable time in charge of construction and maintenance work. This work has given him an insight into many railroad problems, including operation and the direction of men.

The incentive for technical men to enter railroad employment may not continue unless they receive more of a chance in the future, especially by Western railroads, to enter the operating department. The large construction problems on the Western railroads formerly attracted technical men to the railroads. Many of the larger construction problems have been solved, whereas there remain many problems of maintenance and operation that require investigation and study. The number and the compensation of positions in the operating department, together with the opportunity for advancement to the higher executive positions, surely would be an incentive to high-class technical men to enter railroad work.

Recently the following incident came to my attention, and may serve to illustrate my point of view. An engineer, by ability and hard work, had advanced to an important position in the engineering department of a large railroad. The outlook ahead in his department was not very bright—not that he was not capable, but because there were only a few higher positions ahead of him in that department. A large contracting firm realized his value and obtained his services. The railroad lost a valuable man, one who was thoroughly competent to have been advanced as an operating official, yet the railroad did not know his value.

A plan could be developed by the railroads so that full advantage of all latent ability in the engineering department could be obtained. Technical men could be classified according to their education, experience and ability. To the men who have reached the grade of assistant engineer or master mechanic might be offered the first chance to enter the operating department. They could be started as trainmasters and assistant superintendents, or as understudies of superintendents of important divisions. The classing of technical men should not be left entirely to any one individual, but rather to several, some of whom know his qualifications from personal contact.

I do not believe that all technical men will make excellent operating officials. Some men may be better suited for the engineering department. On the other hand, it stands to reason that the man who has technical training, combined with railroad experience, will, in general, be of much more value than one whose training has been entirely practical. There are many positions in the operating department that should be open to technical men. I believe that if opportunities were afforded to technical men in the operating department they would soon prove their value and advance to the higher executive positions.

F. D. YEATON.
Oak Park, Ill.

Norwich the Oldest Civil Engineering Institution in the Country

Sir—In view of statements made in the bulletin entitled "A Study of Engineering Education," by Dr. C. R. Mann, Norwich University lays claim to being the oldest civil engineering institution in the country. Dr. Mann makes the statement that Rensselaer Polytechnic Institute, Lawrence Scientific School and Sheffield Scientific School were the only engineering institutions opened before the Civil War.

As early as 1825, Norwich University was giving a full course in civil engineering, and has maintained such a course from that date to the present day. Norwich graduates were pioneers in early engineering. The first steam railroad in this country was built by a Norwich graduate, Moncure Robinson, in 1827-8. Among many prominent Norwich engineers we may mention Alfred W. Craven, '25, one of the founders of the American Society of Civil Engineers; Gen. Grenville M. Dodge, '51, who was chief engineer of the Union Pacific R.R. during the period of construction, made surveys of nearly 200,000 miles of railroad and actually constructed 20,000 miles; William Parker, '25, who was consulting engineer on the first suspension bridge at Niagara Falls; Randolph Coyle, '28, who was engineer in charge of construction of the bridge over the Potomac River at Little Falls, Va., in the year 1857; Leonard J. Wright, '52, who was on the construction of the Poughkeepsie bridge; and a large number of engineers who took important part in the early engineering of the country, a record which has been maintained.

Northfield, Vt.

ARTHUR E. WINSLOW,
Professor of Civil Engineering, Norwich University.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Inner Body on Rollers Converts Fixed-Body Truck Into Dump Truck

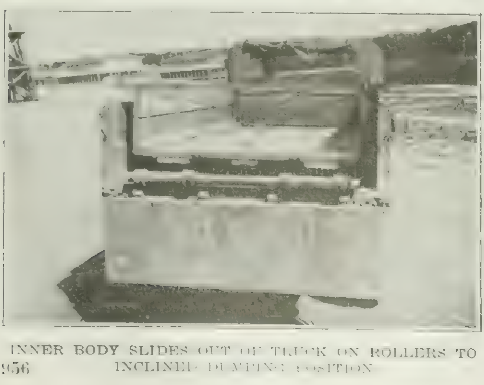
By C. F. Lewis
Highway Engineer, Office of Public Roads, Washington, D. C.

STANDARD fixed-body Army trucks were successfully converted, by inner bodies on rollers, into end-dump trucks, for handling materials for several miles of roads built recently on a large Government reservation. As is shown quite clearly by the accompanying views, an inner body of the proper size to fit loosely in the standard truck body was constructed. Realizing the strain to which this inner body would be subjected in loading and dumping, it was built of 2-in. planks and was well braced with vertical sidepieces and longitudinal steel bands. The steel bands not only strengthened the body, but prevented the side braces from catching when the body was slipped back into position after dumping. On the under side of the body, in the view showing the body in place, can be seen the ends of three longitudinal planks. Each of the two outer planks rests on the rollers of a section of roller gravity conveyor. Mounted on the rear edge of the truck body is a roller over which the center plank passes. Around this roller, on each side, is a fixed pipe, flanged, over which the side planks slide, being guided by the flanges. The body is held in place by a $\frac{3}{4}$-in. pin passing through loops in the front end of the inner body, the end of the pin being held by a block fastened to the floor of the standard truck body.

Other Articles of Interest to Contractors In This Issue:

A slight jerk of the truck usually suffices to start the body moving on the rollers. After moving a varying distance, depending on the position and the amount of the load, the inner body drops to the dumping position shown. Attached to the under side of the center plank, and forward of the center of the body, is a strong hook which catches on the roller guide at the rear of the truck and prevents the inner body from dropping out of the truck as the latter moves forward discharging and spreading the load. Two men can easily lift the rear end of the body and roll it back into place after dumping.

This construction, devised by Capt. A. Rogers, Q.M.C., U.S.A., supervising road construction for the Quartermaster Corps, and R. Philpot, road superintendent for the contractor, permitted the use of available fixed-body Army trucks, and also released the labor which would have been required to unload the truck by hand. The same arrangement can be applied to other types of trucks, changing the details to fit the conditions.



INNER BODY SLIDES OUT OF TRUCK ON ROLLERS TO INCLINED DUMPING POSITION

Force Pump Effective in Pulling Piles

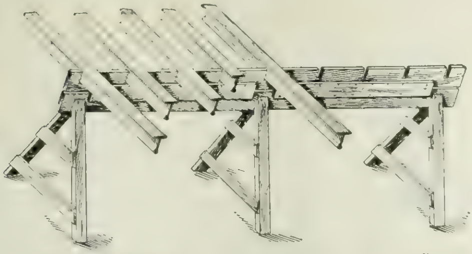
By C. H. Cotten
Lieutenant, Corps of Civil Engineers, United States Navy

TO PREPARE the site of a new quay wall for pile-driving and dredging operations, it was necessary to pull a number of piles which had supported a platform under an old sea wall. The piles had been driven 35 ft. below cutoff through silt, mud and stiff clay.

A chain attached to the pile was secured to blocks and tackle fastened to the piledriver leads. A duplex force pump with a 2-in. suction, 1-in. steam connection and a 1-in. discharge was hooked up to a boiler on the driver. About 30 ft. of steam hose with 25 ft. of 1-in. pipe on the end was used for discharge. A strain was taken on the chain, and the pipe end of the discharge line was forced in the mud alongside of the pile. The mud and clay was loosened for a depth of 20 to 25 ft., and very little pulling was needed to bring the pile up.

Ship Bulkheads Assembled on Trestles Notched to Take Stringers

IN ASSEMBLING the bulkheads for the 9000-ton steel ships it is building, the Groton Iron Works, of Groton, Conn., makes use of wooden trestles or horses,

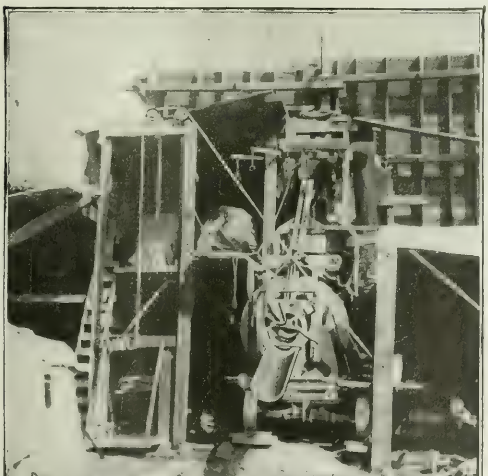


TRESTLES NOTCHED TO GIVE PROPER SPACING TO BULKHEAD STRINGERS

as shown in the accompanying sketch. These trestles carry a stringer notched in the top at the proper spacing to take the stringers of the bulkhead. The horses are set up in the pre-assembly yard, spaced about 10 ft. apart, leveled up and with the notches lined up. The steel bulkhead stringers are then placed in the notches which have been cut so that the upstanding flanges are level. On the stringers so placed the plate locating and riveting are readily done.

Mixer Engine Operates Cement-Bag Elevator

CEMENT for concrete pavement base at Edison Park, Ill., was hoisted about 10 ft., to mixer-charging level, by an elevator operated by the mixer engine. The mixer was set at ground level under ele-



ELEVATOR CAGE OPERATED BY MIXER ENGINE HOISTS CEMENT BAGS

vated sand and stone bins, as the picture shows. A cement house was built at the ground level close to one side of the bins. The mixer was a standard paver set as a stationary mixer by blocking the wheels and supporting the carriage by jacks. It had, therefore, a high charging level to which the cement had to be raised.

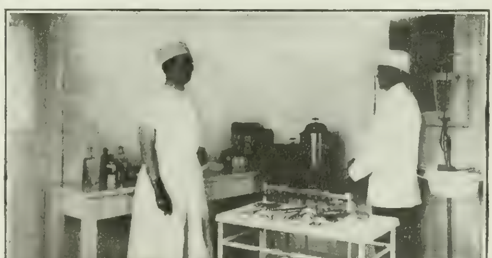
As shown in the view, the cage and guides were located between the mixer and the cement house. A rope from the mixer engine hoisted and lowered the cage, as illustrated. Concrete was carried away in motor trucks which backed into the pit shown in front of the mixer. The contractors for the paving work were R. F. Conway & Co., Chicago. Ill.

Eight Hundred Dollars for Field Hospital

FIELD hospitals, costing fully equipped less than $825, and entirely adapted for use on construction work, are employed by the Ralston Steel Car Co., Columbus, Ohio. The building is a one-story, steel-clad, sec-

SECTIONAL BUILDING MAKES ATTRACTIVE HOSPITAL

tional structure set on a concrete floor. It is 15 x 24 ft., and has two rooms. One, into which the entrance opens is fitted for treating minor injuries, and the other is fully equipped for more serious operations. The exterior and the interior are painted. The building is piped for water, steam heat and gas, and is wired for electric lights. Including necessary furniture and appliances, it cost $823.73 in 1917. Itemized, the costs



EQUIPMENT FOR FIRST-AID AND EMERGENCY OPERATIONS

were: Building with concrete floor, $484.14; steam heating, $102.54; water, $9.59; sewerage, $29.40; gas, $4.01; electric lighting, $21.55; equipment, $172.50; total, $823.73.

NEWS OF THE WEEK

New York, November 21, 1918

Nonwar Building Revival Moving Slowly

Prospects of Increases in Construction, Due To Removal of Priorities, But Little Work Yet Reported

Actual results from the removal of building restrictions on nonwar work have not yet begun to appear. Following the War Industries Board's circular No. 57, which exempted after Nov. 12 a number of building activities from the necessity of obtaining material licenses, and further permitted the unlimited manufacture of building materials, there has been much talk, mostly in the financial sections of the daily press, of the enormous amount of construction immediately to be undertaken. So far little of this work has materialized, mainly because there has not been time for the ordinary machinery of new building to function. Even though the approval of various Government bodies is not now required for certain work, the interests contemplating new construction have to adjust themselves to the new conditions and to determine upon the present desirability of this construction and the details of its design, if thought desirable. Furthermore, much new work, under the recent order, still has to go through the state Councils of Defense, which takes time, especially as these local bodies are not yet completely advised concerning their proper policies.

There are, however, several indications of increased building operations. The War Industries Board announces that deferred building projects amounting to more than $20,000,000 were released Nov. 12. The projects comprise a very large number of buildings of comparatively small size. This means a wide distribution of work all over the country from coast to coast.

Secretary of the Treasury McAdoo also rescinded, Nov. 16, previous orders suspending all public building during the war. This applies to all post offices and other Government buildings which come under the jurisdiction of the Supervising Architect. No specific building has yet been affected by the order.

Portland Votes for $5,000,000 Harbor Improvement Bonds

The city of Portland, Ore., at the recent election, passed the charter amendment that will allow Portland to issue bonds in the sum of $5,000,000 for harbor improvements. Among the improvements contemplated are the building of a 12,000-ton dry dock, enlarging the present piers, and erection of large coal docks.

Ship Problems Discussed by Naval Architects at Twenty-Fifth Anniversary Meeting

Electric Welding in England and America—R. J. Wig Reports the Concrete Ship a Structural Success

At its 25th meeting since the society's formation in 1893, the Society of Naval Architects and Marine Engineers last week elected its fifth president. Admiral W. L. Capps succeeds Lieutenant-Commander Stevenson Taylor, who has served the society for nearly ten years. The meeting was held at Witherspoon Hall, Philadelphia, on Nov. 14 and 15. About half the technical program was occupied by subjects connected with the problems of the present shipbuilding epoch. Most prominent were electric welding, concrete-ship construction, and simplified or straight-line shape for ships. Wooden shipbuilding, the unsinkable ship, the work of the Newark Bay and Hog Island shipyards, and launching methods, also found representation in technical papers.

Secretary of the Navy Speaks

Over 800 members of the society, and other shipyard men, gathered at the annual banquet, held Nov. 15. Josephus Daniels, secretary of the navy, expressed the thanks of the administration to the shipbuilders for their large contribution to victory. "No man now living will see, unless wisdom departs from us, the Government retire from the business of building and operating cargo-carrying ships," he said, concerning our maritime future. A navy of great power is also to be constructed, according to Mr. Daniels, who feels certain that before Mar. 4 Congress will authorize the new three-year program asked for.

President Taylor on Shipbuilding

Strongly voicing his faith in the future development of American shipping and shipbuilding, President Stevenson Taylor, in the annual address, affirmed that the nation would find ways to deal with each of the obstacles confronting it, as soon as the obstacles reveal themselves. Figures show that a shortage of 14,000,000 tons of shipping exists at the present time, there being only 41,000,000 tons of shipping at hand as against a tonnage of 55,000,000 that should have been reached by this time in the normal development of ocean commerce (the figures are in gross register tons). The United States will soon be the possessor of 10,000,000 tons of shipping, said Mr. Taylor. Referring to the numerous instances of phenomenal performance in shipbuilding, whether in speed of completing a given ship or in number of rivets driven in a day, he expressed the view that all of these records had been artificially prepared for, and that moderate performances steadily maintained are of greater value; yet he paid special tribute to the maintained reduction in time of completion of ships as evidence of distinct advance in the shipbuilding art.

Electric Welding in Ship Construction

Tests of the strength of welded parts of ships were carried out for the technical committee of Lloyds' Register of Shipping in England a short time ago and were reviewed by H. Jasper Cox, of Lloyds' Register, in a paper entitled "The Application of Electric Welding to Ship Construction." Briefly, the welded pieces gave good strength and endurance results, though in bend tests ½-in. plate failed at a bend of 80° and 1-in. plate at 20°, while unwelded ship steel could be bent 180°. Experiments which are being carried out in this country by the welding committee of the Emergency Fleet Corporation were also referred to by the author. A design by J. W. Isherwood for a longitudinally framed vessel with welded connections, and a design by C. P. M. Jack for a welded ship with transverse plating, were shown. The British "welded ship," it was stated, is a cross-Channel barge of 275 tons, and no trial in sea service is yet available to demonstrate the robustness of welded plate and frame connections. H. M. Hobart, H. A. Hornor, J. W. Isherwood and others discussed the paper. Mr. Hornor, speaking for the Fleet Corporation, emphasized the element of skill involved in successful welding; craftsmen in welding must be developed virtually as artists. The subject was discussed mainly from the viewpoint of continuous welding, spot welding finding little favor.

Concrete Ship Is a Structural Success

In a full review of the Emergency Fleet Corporation's work in developing concrete ships—as abstracted briefly on p. 903 of last week's issue—R. J. Wig, head of the Concrete Ship Divi-

(Continued on page 960)

World Needs Twenty Million Tons of Shipping

Chairman Hurley of Shipping Board Says Shortage Is Eight Times Last Year's Production

Large demands will be made on the shipbuilding industry of the country for years to come, according to a statement issued by Edward N. Hurley, chairman of the United States Shipping Board, on his departure for Europe, Nov. 15, to arrange ship-administration details. He predicted an increase in the need for new ocean tonnage saying:

"The need for ships was never so great as it is now, and this demand will continue for years, until the world shall catch up with the tonnage it requires to transact its normal commerce. At present we are nowhere near providing that urgently needed tonnage. Ship construction needed to make up for losses and for the lapse in meeting the normal growth of shipping will be about 20,000,000 dead-weight tons, or eight times the total of seagoing-ship construction in the United States during the calendar year 1917.

"The 160 new shipyards which have been created under the Emergency Fleet Corporation have been busy day and night. There are now about 386,000 employees in these shipyards and 250,000 in allied trades. If, with this immense force working at top speed, our ship production is each year less than a tenth of the 20,000,000 dead-weight tons the world will imperatively need by 1920, it is clear that instead of being at the end of shipbuilding requirements we are only at the beginning.

"In 1914, the seagoing American merchant marine comprised only 391 vessels, of 1500 dead-weight tons and over, totaling 1,660,679 dead-weight tons. Today our seagoing fleet, of 1500 dead-weight tons and over, totals 1389 vessels of 7,043,210 dead-weight tons. All told, within the jurisdiction of the Shipping Board, including requisitioned and chartered ships, there are, at the present time, 2312 seagoing vessels totaling 10,114,334 dead-weight tons. Since August, 1917, nearly 4,000,000 dead-weight tons—to be exact, 3,912,836 dead-weight tons—of new shipping have been launched, and 2,894,510 dead-weight tons have been completed and delivered for service. Nearly nine times as much seagoing tonnage has been built in the United States, this year, as in the banner pre-war year of American shipbuilding. This is only the beginning of a program calling for 25,000,000 dead-weight tons."

Defines Technical Engineer

To facilitate the work of the engineering division of the United States Employment Service, it was necessary to have a workable definition of the term engineer which would be all-inclusive of the many branches of technically trained engineers and still distinguish him from the engine driver or flat janitor. The definition, which is the work of a committee of engineers appointed by the Service and headed by W. H. Finley, president of the Chicago & Northwestern Ry. Co., is as follows:

"An engineer is one who economically directs man-power and, by scientific design, utilizes the forces and materials of nature for the benefit of mankind."

United States Highways Council Lessens Its Activity

A telegram has been sent out by the United States Highways Council, announcing a curtailment in its control of highway construction and maintenance. No further applications need be made to the council for release for highway materials, and those desiring them should follow the same procedure as before the war. Even in cases where the council has refused permission to build highways this refusal is no longer in force; but the telegram does not affect the issuance of bonds for new construction, as this phase of the highway problem has been taken care of by the Capital Issues Committee. The text of the telegram, which was sent to all state highway departments, follows:

"The United States Highways Council announces that no further applications need be made to it for approval of highway projects, that disapprovals previously made and revoked, and pending applications will require no further action. Procedure as to securing materials and transportation should follow normal practice.

"The removal of restrictions does not affect highway bond issues, as this question of finance is by law under control of the Capital Issues Committee.

"State highway departments will not be asked to submit programs for next year's work."

This action has been taken as a result of the general release of bituminous road materials by the Fuel Administration and the general release of other materials, except steel, by the War Industries Board. The use of steel in highway structures is still under restriction, and it is impracticable at this time to furnish information concerning the future control of the use of this material for road purposes.

Housing Association to Hold Conference in Boston

The National Housing Association will hold its seventh conference on housing in America at the Copley Plaza Hotel, Boston, Nov. 25-27. Among the subjects to be discussed are "Government Ownership of Homes," "Reconstruction and Housing," "Rent Profiteering," "Labor and Housing" and "Management of Industrial Housing Projects."

Reconstruction Discussed at City Managers' Convention

Problems of reconstruction and measures for insuring a safe return of cities to a peace basis held a prominent place in the discussions at the fifth annual convention of city managers held at Roanoke, Va., Nov. 6-8.

On the first afternoon of the convention Myron H. West, president of the American Park Builders' Association, delivered an address on "City Planning for After-War Conditions."

At a dinner given by the Roanoke Chamber of Commerce Louis E. Wilson, New York City, general manager of the American City Bureau, delivered a paper on "Establishing and Maintaining the Commission-Manager Government." At another session of the convention R. S. Childs, United States War Department, contributed a paper on "Uncle Sam's Call to City Managers," advocating careful planning for the return of the city to a peace basis.

At a luncheon session O. E. Carr, city manager, Springfield, Ohio, discussed "Progress, Prospects and Pitfalls of the New Profession," basing his conclusions on five years' experience in the management of cities. Mr. Carr pleaded for a sane working out of the manager idea and careful administration.

The last day of the convention included the most important round-table discussion of the meetings. Duties and problems of a city manager, the finance department, the public welfare department, the public service department and the public utilities department were included in the subjects of discussion.

The following officers were elected: President, C. A. Bingham, Waltham, Mass.; vice-president, H. H. Sherer, Glencoe, Ill.; secretary and treasurer, H. G. Otis, Auburn, Maine.

Atlantic Coast Shipbuilders Meet, With Piez in Chair

Under the chairmanship of Charles Piez, vice-president of the Emergency Fleet Corporation, the Atlantic Coast Shipbuilders' Association held a quarterly meeting at the Bellevue-Stratford Hotel, Philadelphia, Nov. 14. On invitation, most of the members of the Society of Naval Architects and Marine Engineers were present at the meeting. No association business was transacted, but the present shipbuilding situation was discussed quite openly. Mr. Piez and Admiral F. T. Bowles, Lieutenant Commander Stevenson Taylor and Homer L. Ferguson, of Newport News, were among those taking part in the discussion.

Mr. Piez said that no cancellation of steel-ship contracts was in prospect. At only one yard have orders been canceled, and even that yard has enough work ahead to run well into 1920. All other yards have enough Emergency Fleet contracts to keep busy throughout 1919 and through part of 1920.

Economy will now have to take the place of speed in the shipyard, he said, and this means a return to the peace-time relations of shipyards as soon as possible. The only opportunity for re-adjustment probably is in the sizes of the ships to be built.

Admiral Bowles and Lieutenant Commander Taylor spoke in favor of an American registry for shipping. A bill has already been introduced in Congress to provide the machinery for this.

Engineering Education Society To Meet with British Mission

A joint meeting of the British educational mission to the United States and the Society for the Promotion of Engineering Education will be held at the Massachusetts Institute of Technology, Cambridge, Mass., Dec. 6-7. The principal topics for discussion will be "The Organization of Engineering Education in Great Britain and the United States," "The Effect of the War on Engineering Education in Great Britain and the United States" and "The Liberal Element in Engineering Education."

Each discussion will be led by a member of the British mission representing Great Britain and by a member of the Society for the Promotion of Engineering Education, including Charles S. Howe, president, Case School of Applied Science; Dr. C. R. Mann, Massachusetts Institute of Technology and Carnegie Foundation for the Advancement of Teaching, and Prof. George F. Swain of Harvard University.

United States Public Health Reserve Authorized

Congress has passed and the President has signed a joint resolution providing for a reserve of the United States Public Health Service. The resolution was originally introduced in Congress in June, 1917. Its scope was subsequently enlarged, but the resolution as finally passed seems to be more restricted than in its earlier stages. It authorizes the President to commission, for five years, officers in the United States Public Health Service Reserve who pass examinations prescribed by the President, these officers to form "a reserve for duty in the Public Health Service in time of national emergency." None of the officers commissioned shall have higher rank than that of assistant surgeon general. The reserve officers "shall be distributed in the several grades in the same proportion as now obtains among the commissioned medical officers of the United States Public Health Service, and shall at all times be subject to call to active duty by the Surgeon General, and when on such active duty shall receive the same pay and allowances as are now provided by law and regulation for the commissioned medical officers in the said regular commissioned Medical Corps."

National Highways Bill Introduced in Senate

A bill providing for the taking over, improvement, relocation, construction and maintenance of a system of national and state highways, to facilitate the movement of troops, equipment, munitions and supplies, has been introduced in Congress by Senator Chamberlain. The bill if passed will authorize and direct the Secretary of War to take over a comprehensive system of roads throughout the United States, with the primary purpose of maintaining roads for the movement of military forces and equipment.

When the chief consideration, military expediency, has been served, the roads are to be selected further with reference to their utility in the transportation of mail, facilitating interstate and foreign commerce, aiding agricultural and manufacturing pursuits, and promoting the general welfare of the people. The Secretary of War is instructed to confer with the authorities of the several states, to the end that unnecessary duplication of highways may be avoided and that non-military highways may be located strategically wherever such location is reasonably possible.

Engineers Pay Honor to Ambrose Swasey

A dinner in honor of Ambrose Swasey, of Cleveland, who has recently made an additional gift of $100,000 to the Engineering Foundation, as mentioned in *Engineering News-Record* of Oct. 17, p. 735, took place at the Engineers' Club in New York City on the evening of Nov. 14. The dinner was given by the United Engineering Society, and the president of that Society, Charles F. Rand, presided. In his opening remarks Mr. Rand stated that the United Engineering Society, as the representative of the four Founder societies (the several societies of civil, mining, mechanical and electrical engineers) now holds and administers for the benefit of the engineering profession property valued at about $2,700,000.

British Imperial Water-Power

A committee of British engineers headed by Sir Dugald Clerk declares that rapid development of the empire's latent resources is imperative to enable it to recover from the financial losses of the war, and that the cornerstone of such development is an ample supply of cheap power. With the exception of Canada, South Africa, New Zealand and a part of Australia, the committee finds that no systematic attempt has been made even to investigate the latent water-power resources of the British possessions. The committee roughly estimates the potential water power of the Empire at 50,000,000 to 70,000,000 horsepower, only a small percentage of which has been developed.

Naval Architects' Meeting

(Continued from page 958)

sion, led up to conclusions highly favorable to this type of vessel. The new light-weight aggregate has made it possible to reduce the weight of concrete even below the 110 lb. per cubic foot reported heretofore, the present figure being under 100 lb. A weight efficiency of 60% is obtained in a 7500-ton tanker, as compared with 53% for a wood ship and 53 to 56% for a ship of ordinary concrete, steel ships showing approximately 70 per cent.

Considering strength, taking into account calculation as well as the excellent performance of the "Faith," the concrete ship must be regarded as the equal of the steel ship, in Mr. Wig's view. Furthermore, its frictional resistance is no greater than that of the steel vessel. Nevertheless, the future of the concrete ship cannot be predicted at present, as we do not yet know from experience that the saving in first cost can be made large enough to counterbalance the reduced carrying efficiency.

New Shipbuilding Equipment

Larger capacity of yards building naval vessels has been urgently needed during the past few years, in view of the present navy program and that contemplated by the naval authorities for the immediate future. How this requirement is being met was reviewed briefly by Naval Constructor S. M. Henry under the title "Recent Developments in Shipyard Plants." Building berths are laid out for a maximum ship 1000 x 110 ft. The supports are of concrete, with cambered slope averaging ½ in. per foot; bridge cranes over the berths are provided for handling ship material. One building berth of the dry-dock type has been constructed, capable of floating a vessel at drafts up to 20 feet.

Why the "Unsinkable Ship" Sank

Recent dispatches telling of the loss of the "Lucia," a ship fitted with buoyancy boxes according to proposals of W. T. Donnelly, came to notice in connection with a paper by Mr. Donnelly describing the installation. Some 12,000 wooden boxes placed along sides, decks and bulkheads gave this 9600-ton, deadweight, vessel an artificial buoyancy of 5500 tons, providing a reserve of 1140 tons when the entire hold was flooded. The double bottom, the propeller tunnel and the peaks were assumed to remain intact. To refute charges that the ship when flooded lacked stability, the author gave the calculations in his paper. This latter had been prepared before the vessel was sunk.

Straight-Line Ship Forms Found Advantageous

Tests by Prof. H. C. Sadler and T. Yamamoto on models of ships designed with straight-frame shape showed that the propulsive resistance is about the same as that of regular ship-shape models, ranging from 2 to 3% lower to 4 or 5% higher.

According to tank experiments reported by Naval Constructor William McEntee, the best position for the parallel middle body of a 400-ft. cargo ship is that which places its center 43% of the length aft of the forward perpendicular. The length of middle body used in the tests was 33% of the ship's length, which had been found from previous experiments to give the lowest resistance at the speed of freight steamers.

The use of soft wood crushing strips in the launching cradles of heavy ships, to prevent the occurrence of undue concentration of load on the ways at the moment when the stern of the ship enters the water, was recommended by William Gatewood in a paper entitled "Notes on Launching." Edward Hopkins, reviewing the side-launching methods used on the Great Lakes, stated that the only danger in the method lies in giving the ways too small a slope. Practice agrees in making the slope 1¼ to 1½ in. per foot, or twice that used in end launching.

Other Papers and Addresses

The plant at which the air rock drill was developed and Ericsson's "Monitor" built, the Delamater Iron Works, was treated in a historical paper by H. F. J. Porter, from its foundation in 1838 to its abandonment in 1890. Some of the methods and work of the Tacoma and Portland yards of The Foundation Co. were described by Carlos de Zafra in a paper entitled "Revival of Wooden Shipbuilding as a War Industry." H. R. Sutphen, in "Structural Steel Standardized Cargo Vessels," described the development of the Submarine Boat Corporation's yard at Newark Bay and the designing and fabricating methods adopted there. Mathematical problems arising in connection with the study of synchronism between engine speed and hull vibration were considered by N. W. Akimoff under the title "Vibrations of Beams of Variable Cross-Sections." The great Hog Island yard was described by W. H. Blood, Jr., in an elaborately illustrated paper.

Serious troubles have been encountered in the operation of turbine reduction gears, it was stated in the discussion of Francis Hodgkinson's paper, "Progress in Turbine Ship Propulsion." W. L. R. Emmet stated that thorough investigation of the troubles is in progress, and a successful solution is hoped for. Excessive tooth pressures are not believed to be a factor, as he has run a gear of the rigid-frame type continuously for 1500 hours at tooth pressures double those recommended by Mr. Hodgkinson.

Reclamation Service Moves Its Washington Office

The United States Reclamation Service has moved its Washington office from Eighth and E Sts. to the sixth floor, west wing, of the Interior Department Building, Nineteenth and F Sts., Northwest.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary, Dec. 9-12, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 West 39th St., New York City, Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

The American Road Builders' Association will hold its 16th annual convention in New York City, Feb. 25-28, inclusive. The place of meeting will be the Hotel McAlpin, and the program will include technical sessions every forenoon and afternoon. The machinery exhibit will be omitted, as it was last year, but exhibits by means of photographs and models will be held.

The Detroit Engineering Society was addressed by D. L. Turner, chief engineer of the Public Service Commission, New York City, at the meeting held Nov. 15. Mr. Turner read a paper on "Subways as a Means of Metropolitan Transportation," illustrated with stereopticon views.

The Engineers' Club of Philadelphia will be addressed by Charles N. Knight and the superintendent of the aërial mail service, Washington, D. C., on "Aëronautics and the Aëroplane Service Now in Effect Between Washington and New York," at the weekly luncheon to be held Nov. 26.

The Harvard Engineering Society of New York will hold a meeting Nov. 22. H. E. Breed, first deputy commissioner, New York State Highway Commission, will give an illustrated lecture on New York State's highway system and the problem of motor-truck transportation.

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting Nov. 16 in Denver, at which Charles W. Comstock spoke on "Development of the Modern Military Rifle." An informal dinner preceded the meeting.

The Engineers' Club of Trenton, N. J., was addressed Nov. 14 by Captain Blaise of the French High Commission to the United States, who spoke on "French Industrial Effort During War." Captain Blaise's address was supplemented by war motion pictures. On account of the influenza epidemic it was necessary to postpone the opening meeting of the club season one month.

Personal Notes

CHARLES P. RICHARDSON, assistant engineer of track elevation of the Chicago, Rock Island & Pacific Ry., has been appointed engineer of water service, succeeding J. M. Brown, whose appointment as corporate engineer of maintenance and construction is noted elsewhere. Mr. Richardson, who was graduated from Dartmouth College, began railway work in 1907 as assistant engineer with the Missouri Pacific R.R. In 1909 he became assistant engineer, and in 1912 he left the Missouri Pacific to take the post from which he is now promoted.

E. L. WILLIAMSON, New York City, has become assistant engineer for the Degnon Contracting Co., in connection with its contract with the Board of Water Supply of New York City, for Shandaken Tunnel.

COL. FREDERICK W. ALSTAETTER, Corps of Engineers, U. S. A., has been appointed engineer of the Southeastern Division, with headquarters at Savannah, Ga., succeeding Col. John Millis, who has been transferred to the office at Chicago, as noted elsewhere.

ERNEST G. WILLEMIN, resident engineer, Michigan State Highway Department, with headquarters at Ionia, Mich., has been commissioned as a first lieutenant in the Corps of Engineers and assigned to duty at Camp A. A. Humphreys, Virginia.

FRANK T. MILLER, office engineer of the assistant to vice-president of the Southern Ry. System, at Washington, D. C., has been appointed engineer in charge of the engineering under the assistant to the president, at Richmond, Va.

JOHN F. GREATHEAD, formerly section engineer for the Public Service Commission on the New York City subways, and division engineer for the city on the Philadelphia subway, has been appointed field engineer at Mare Island, California, in charge of plans and surveys.

M. H. MCLEOD, general manager and chief engineer of the Canadian Northern Ry., with office at Winnipeg, Man., has been appointed vice-president of operation, maintenance and construction, with office at Toronto. He has jurisdiction over the entire Canadian Northern system. Mr. McLeod was born in Scotland in 1857. He was

educated at Franklin, Penn., and entered railway service in 1878 as chainman on the Victoria Ry. For the next 22 years he was on various railroad location and construction in Canada. In 1900 he was appointed chief engineer of the Canadian Northern Ry., and in 1907 he was also made general manager.

JOHN H. SAWKINS has severed his connection with Henry Steers, Inc., contracting engineers, New York City, to become assistant professor in engineering drawing, surveying and descriptive geometry at Union College, Schenectady, N. Y.

WILLIAM C. BEUSCHER, formerly city engineer of West New York, N. J., has been appointed to the staff of the county engineer of Hudson County, N. J.

J. M. BROWN, engineer of water service of the Chicago, Rock Island & Pacific Ry., has been appointed corporate engineer of maintenance and construction.

E. ROY WELLS, civil engineer, Aurora, Ill., will carry on the business of the Wells Engineering Co., in which he was a partner with his brother, Harry L. Wells, whose death is noted in the last column of this page.

COL. JOHN MILLIS, Corps of Engineers, U. S. A., has been transferred from the office at Savannah, Ga., where he has served as engineer of the Southeastern Division since 1916, to the Chicago office.

W. F. RECH has been appointed bridge engineer of the Chicago & Alton R.R. and other railroads in the same Government operating group, with office at Chicago.

S. D. MOSES, resident engineer of the Southern Ry., at Alexandria, Va., has been appointed superintendent of buildings and structures in the office of the assistant to the president, at Richmond, Va.

W. C. WANGLER, assistant city engineer of Dayton, Ohio, is to succeed George F. Baker as bridge engineer for the city engineering department. Mr. Baker has reported for duty at Camp A. A. Humphreys, Virginia, with the rank of lieutenant.

A. J. WHARF, chief engineer of the Peoria & Pekin Union Ry., with office at Peoria, Ill., has been appointed assistant chief engineer of the Chicago & Alton R.R., the Chicago, Peoria & St. Louis R.R., the Peoria & Pekin Union Ry. and the Peoria Railway Terminal, with headquarters at the same point. Mr. Wharf has been chief engineer of the Peoria & Pekin Union for the last five years, prior to which he was with the Union Pacific R.R. for fourteen years. He was graduated from the University of Illinois in 1898.

WALTER H. TAYLOR has been appointed director of public works of Norfolk, Va., by the city manager.

W. E. NICHOLSON, assistant to the chief engineer of the Norfolk Southern R.R., has been appointed chief engineer for the corporation.

OBITUARY

LIEUT. WARD H. REAM, company C, 2nd Battalion, 305th Engineers, was killed in action on the west front Oct. 4. For the past eight years Lieutenant Ream had been a bridge designer for the Delaware, Lackawanna & Western R.R. Co. He had attended the Webb Academy of Naval Architecture, after which he took a postgraduate course at Columbia University.

JAMES C. HALLOCK, formerly deputy chief engineer, Board of Public Works, Newark, N. J., died in Ecuador, Nov. 2, in his 50th year. Mr. Hallock was graduated from the Rensselaer Polytechnic Institute in 1891 and became assistant to the general superintendent, Troy Steel & Iron Co., Troy, N. Y. In 1893 he was employed by the United States Coast Survey Corps, engaged in deepening the channel of the Hudson River. A year later he went to Ecuador as Government engineer and surveyor for the Province of Esmeraldas. In 1895 he went to San Francisco, where he practised as a mining engineer until 1901, when he became general manager for the Southern Exploration & Commercial Co., of Ecuador. Afterward he became director general of public works and chief engineer for the Government of Ecuador. Returning to this country in 1906 he became engineer in charge of the work on the Passaic Valley Flood District Commission, and later assistant chief engineer of the State Water-Supply Commission. He entered the service of the City of Newark in 1909 and became chief deputy engineer for the Board of Public Works in 1910.

A. A. ROBINSON, formerly vice-president of the Atchison, Topeka & Santa Fé Ry., and later president of the Mexican Central Ry., died Nov. 7, at the age of 74, at his home in Topeka, Kan. Mr. Robinson was born in Vermont, and was graduated as a civil engineer from the University of Michigan in 1869. The same year he entered the employ of the St. Joseph & Denver City R.R. Two years later he went to the Santa Fé system as assistant engineer, and in two years more was made chief engineer. Subsequently he became successively division superintendent, superintendent of bridges, buildings and water service, assistant general superintendent, general superintendent, general manager and second vice-president. During his connection with the Santa Fé he had charge of the construction of more than 4500 miles of line. In 1893 he left the Santa Fé to assume the presidency of the Mexican Central Ry., from which he retired in 1906. Mr. Robinson was a member of the American Society of Civil Engineers and of the American Railway Engineering Association.

T. AIRD MURRAY, sanitary engineer, Oakville, Ont., died recently at Regina, Sask. Mr. Murray went to Canada about 10 years ago, after a long practice of his profession in Great Britain. He was born at Dumfries, Scotland, in 1866. He was consulting engineer to the Saskatchewan Government, a member of the Canadian Society of Civil Engineers, and past vice-president of the Canadian Public Health Association. He was also a member of the American Public Health Association.

AUGUSTUS WILLIAM NEWELL, JR., who was a surveyor on the Massachusetts state survey of the Cape Cod Canal, and on Government work in Idaho, Arizona and elsewhere, died Oct. 26. Mr. Newell had traveled quite extensively, his last work being on railroad location in Western Haiti and irrigation canal surveys in Santo Domingo. He was a brother of Prof. F. H. Newell of the department of civil engineering, University of Illinois.

SHIRLEY ONDERDONK, civil engineer and contractor of New York, died in that city Nov. 16, at the age of 46. After his graduation from Yale University Mr. Onderdonk joined his father in the contracting business, and later became associated with the New York Tunnel Co. He was employed several years ago by the Government in the dredging of Ambrose Channel at the mouth of New York harbor. He had been in charge of the construction of subway tunnel work under the East River.

HARRY LEWIS WELLS, city engineer of Aurora, Ill., and county surveyor of Kane County, died Nov. 7, at the age of 33. He had been engaged in municipal and drainage engineering in that district for the past ten years. He was a partner with his brother, E. Roy Wells, in the Wells Engineering Co., Aurora and Geneva, Ill.

JOHN T. HUETTER, president of the Huetter Construction Co., Spokane, Wash., died in that city Nov. 6 following an accident. Mr. Huetter was 52 years of age.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Lumber Association to Study Economic Conditions

Proposed that Board of Direction be Authorized to Increase Assessment to Cover Cost of Study

For the purpose of extending its activities the National Lumber Manufacturers' Association has issued a call on the affiliated regional associations for larger assessments. It is proposed by the executive committee that the board of directors assemble Dec. 16, and that they authorize that the rate be ¾c. per thousand feet for the first three months of 1919, increasing ¼c. every three months until the rate is 1½c., and to continue at that rate.

The executive committee, at its meeting Oct. 24, concluded that national and international conditions demand wider activities, for the following reasons: The economic conditions of the world are completely upset by reason of war conditions; the policies of nations are now being considered and changed to conform to war needs and to economic evolution; the life and the future of all industry are being affected and molded, and the lumber industry to no less extent than any other.

Industries Must Thrive

It is asserted, furthermore, that the costs of war pyramided and accumulated, requiring drastic methods of taxation, thus creating additional burdens to industry, which in some cases are destructive of incomes; the governments of the world, in order that they themselves may live, desire industry to thrive and consequently require the best informed counsel from industries; post-war conditions require the coöperation of industries within themselves and with the Government to aid in reconstruction.

The essential character of the lumber industry as an instrument of war was a live issue, and the essential character of the industry as a post-war business will be a dominant subject soon; the necessity of having the facts of the industry was never so great as it is now and as it will be in the near future; none of these efforts can be undertaken by the individual in the industry; the regional associations cannot make a national survey of the conditions of the industry and carry on this work as effectively as it can be done by concerted national effort, supported by the allegiance of the whole industry.

Therefore, the committee asserts, the national association cannot protect the individuals in the industry or the regionals without sufficient funds to sustain its services.

Reconstruction Problems Will Receive Close Study at Atlantic City Conference

Questions Sent Out Cover Post-War Labor, Material Supply and Marketing Problems and Government Control

Reconstruction problems, covering labor, materials, marketing, and Government control, will receive attention at the war emergency and reconstruction conference of War Service Committees at Atlantic City next month. It is announced that problems of special interest to each of the committees, numbering 350 or more, will be discussed at separate meetings. A list of questions has been distributed, embodying suggestions for the deliberations of each individual committee on Dec. 3, when they meet as separate units. Further discussion of the questions will follow at 35 group meetings scheduled for Dec. 4, 5 and 6.

It is expected that these deliberations will result in a concrete program, formulated by the business men of the United States, for the solution of the problems of the reconstruction period. The announcement that accompanies the list of questions states that they are suggestive and not exhaustive, and that the general committee will be disappointed if the members of the individual committees do not suggest other subjects which can be discussed with profit.

It is stated that the committees have been appointed for the period of the war. This period is interpreted as extending until the peace treaty has been signed.

Subjects of Discussion

The following are some of the questions proposed for consideration:

What legal methods or means could be introduced in the crafts better to stabilize prices, during the reconstruction period, affected by the following: (a) Inventories on hand; (b) orders placed at war prices but not delivered; (c) labor costs and conditions; (d) increased taxes; (e) increased rates of interest; (f) an estimated increased demand for nonwar materials restricted during the war period; (g) will an increased production of your commodity increase the price of material or labor, or will a controlled redistribution of material and labor from war industries prevent such an increase? (h) discuss the practice of the sale of commodities at a price less than the cost of production; its injury and disturbance on the industries and the ultimate consumer; what methods would you suggest to remedy this evil? (i) if the Government sees fit to dispose of used materials and products in the open market, what effect will it have on your production and the sale of new goods? At home? Abroad? (j) if it is not advisable for the Government to sell these goods on hand, either home or abroad, what shall it do with them? (k) in this connection, what point of contact should business interests have with the Governmental departments in the sale or disposition of these various commodities?

What is your financing problem during the reconstruction period? Do you recommend Governmental aid? Is financial legislation needed? Should the Capital Issues Committee be continued during this period?

What method would you suggest for the cancellation of Government war orders with your craft that would create the least amount of hardship for the industries and permit a readjustment to normal commercial conditions?

Have you any suggestions to make as to the continuation of the War Industries Board or any of its divisions, or any other Governmental departments during the period of reconstruction—such board or departments to have the authority to control materials and regulate prices. If so, for what period?

What intelligent control of materials during the reconstruction period could the War Service Committee suggest which would prevent an over or under supply and avoid a demoralization of the market? Should this be controlled by the crafts or by a Governmental agency?

The value of a uniform method of cost accounting for the individual

(Concluded on page 964)

Road Machinery Manufacturers Have War Service Committee

A war service committee of the manufacturers of road machinery has just been certified to the Government by the Chamber of Commerce of the United States. Nearly 400 war service committees, representing as many industries, already have been formed and have been accepted by the War Industries Board and by other Government departments. The road manufacturers' committee consists of the following: W. R. Wilson, American Road Machinery Co., Kennett Square, Penn., chairman; S. T. Henry, Western Wheeled Scraper Co., Aurora, Ill., secretary; S.

F. Beatty, Austin Manufacturing Co., Chicago, Ill.; Roy E. Adams, J. D. Adams & Co., Indianapolis, Ind.; C. O. Wold, The Russell Grader Mfg. Co., Minneapolis, Minn.

Reconstruction Conference

(Concluded from page 963)

manufacturer and the craft as a whole. What suggestions of the conservation division made to your craft might, with financial profit to your craft, be continued during the readjustment period? Is it possible to maintain a conservation schedule after the war, without legislative authority?

What methods and practices, other than those your craft has already introduced, would simplify production, save materials, eliminate wasteful practices, reduce the number of styles, without destroying individual creativeness?

What effect will foreign competition have on your business? Will it increase or decrease your production?

What disposition should be made by the Government of her merchant marine?

Would you recommend the appointment of a committee of United States manufacturers to confer with similar committees from our allies, to learn of their plans for protecting industry during the reconstruction period? Also to obtain information regarding commodities and supplies needed by them and ourselves during this period?

When the demobilization of military forces takes place, how can these men best be returned to their former industrial pursuits, and how will it affect your labor situation?

What suggestions have you to make to encourage and stimulate public work, such as the building of roads, pavements, water and sewer extension, the construction of public buildings, school houses, etc.? What effect will it have on the labor market? In this connection consider the building program in the United States and especially the utilization or destruction of new plants built for war purposes. Location of convalescent and reconstruction hospitals near industrial centers, so that these men can be trained in the factories nearest to the hospitals without creating new vocational schools.

General Goethals in Charge of War Contract Cancellation

Major General Goethals has been placed in charge of adjusting cancellation of War Department contracts. These adjustments and cancellations will be made in accordance with the views of the War Industries Board, and only orders given since Oct. 1 or those regarding which the contractor states in writing that no disturbance of labor will be caused, may be canceled without reference to General Goethals, it is stated. Contractors are cautioned, however, that no new labor may be engaged on pending war work, and that no new subcontracts shall be let without the approval of General Goethals.

Important Key Industries Shown at Exposition

London Exhibit Aims at Future Development in England and Shows Progress Made During War

The Key Industries Exhibition held in London during October had as its object the preservation, protection and future development of the vital industries of Great Britain, according to Philip B. Kennedy, commercial attaché in London, in a recent issue of *Commerce Reports.* The exhibition was held under the auspices of the Tariff Reform League, and illustrated what the English industries had accomplished during the war in developing the manufacture of essential commodities which had formerly been almost completely controlled by Germany. The exhibition will subsequently be transferred to other industrial centers.

The recent Scientific Products Exhibition, it is stated, dealt with the scientific aspects of the question from an educational point of view, but the stated aim of the industries exhibition was to illustrate the organization side. By organization is meant the Government action for the future protection of the firms which have put capital and energy into the development of these key industries. The term "key industries" is applied to those which in themselves are relatively small, but are of vital importance to the development of greater industries.

German-Controlled Industries

A typical example is presented by the dye industry in its relation to explosives, also by the manufacture of the Bosch magnetos, which prior to the war were manufactured entirely in Stuttgart, Germany, and were used almost exclusively for airplanes, submarines and motor cars. It is stated that magnetos which have been perfected in Great Britain during the war are such that it will be neither necessary nor probable for the demand to revert to Germany. Optical glass is another key industry, making the country independent of Germany for ordinary glass and for glass used in telescopes, searchlights, periscopes, etc. The manufacture of tungsten for use in making high-speed steel, and nickel for armor plate, as well as manganese, lead, graphite, spelter, rubber and antimony, were representatives of other key industries or materials that were exhibited. All of these essential key products, the raw materials of which are largely produced in the British Empire, had been manufactured in Germany and resold to Great Britain.

The British Government has already taken measures to protect many of these essential materials through Parliamentary action. From this it is believed that it will be difficult, if not impossible, for Germany to recover any of its former control. The exhibition was an object lesson in the country's progress toward complete independence.

Bridge and Structural Output 43 Per Cent. Contracted For

The records of the Bridge and Structural Society, as collected by its secretary, show that during October, 1918, 43% of the entire capacity of the bridge and structural shops of the country was contracted for.

Business Notes

The Walter A. Zelnicker Supply Co., St. Louis, Mo., announces the appointment of R. H. Wilson, recently representing the company in Houston, Tex., as assistant to the president, with office in St. Louis. E. O. Griffin succeeded Mr. Wilson at Houston.

C. Nesbit Duffy has accepted the position of vice-president of the Visayan Refining Co., Manila, P. I., one of the largest cocoanut oil companies in the Philippine Islands. He was formerly vice-president of the Manila Electric Railroad and Light Company.

J. C. Rockwell, the present general manager of the Manila Electric Railroad and Light Co., has been placed in full charge of the company's affairs in Manila by the J. G. White Management Corporation, New York, operating the property.

Arthur R. Calvo, for the past five years manager of sales of the Permutit Co., has resigned to become an officer and director of the Hercules Engineering Corporation and its affiliated interests, the Electrolytic Engineering Corporation and the Technical Products Company.

Trade Publications

The Duplex Engine Governor Co., Inc., 36 Flatbush Ave., Brooklyn, N. Y., has issued bulletin 101, describing and illustrating its Duplex and Simplex precision governors, for gas and gasolene engines and motor trucks.

The Independent Pneumatic Tool Co., Chicago, Ill., has issued a folder illustrating and describing pneumatic drills and hammers manufactured by the company. The folder bears a notice to the effect that, at the suggestion of the United States Government, to conserve material and increase the production of pneumatic tools for war purposes, a number of types and sizes have been eliminated, and only the essential types have been retained. The company believes that the sizes and types retained will meet all requirements.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

November 28, 1918

In this issue:

Highway Motor Truck Problem
From Viewpoint of User,
Manufacturer and Engineer


Nearly
Two Million
Square Yards of
KREOLITE WOOD BLOCKS
"The Paving that's Saving"
Are now seeing Service in all parts of
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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Stirring Up Labor Troubles

HOW badly high ideals are needed for the reconstruction program has already been shown by the outburst, in the very week of the armistice, of William H. Barr, president of the National Founders' Association, regarding labor, and the immediate, belligerent reply of Mr. Gompers. It is exceedingly unfortunate that Toryism should so foolishly have shown its head, and Mr. Barr's belated word that he was not seeking strife cannot remedy the situation. The evil has been done. By taking a conciliatory attitude in the first instance, by urging that "justice and humanity" rule in the adjustment of the labor situation, he could have helped instead of hindered the orderly solution of this very difficult problem. There are many Tories still in the employing ranks, believers in the divine right of kings to do as they please, but happily the leaders among our business men see that for the best interests of our country "justice and humanity" must prevail. But how much it would help if this slogan were universally adopted and the outbursts of the Barrs be thus prevented!

A Highway Issue

THIS issue, devoted in large part to highway matters, is published to anticipate by a week the great highway convention which is to convene in Chicago in the week after next (Dec. 11 and 12). By its appearance a week in advance it will serve to emphasize again the importance of that meeting. The convention, coming as it does after a period of curtailment in highway work, after the marvelous war-demonstration of the utility of highway transportation, and at the beginning of an era of probably unprecedented highway expansion, pulls strongly upon every man who is concerned with highway problems. The principal questions to be discussed will be the public road policy of the future and the relation between the two instruments of highway transportation—the road and the vehicle. As a contribution to the discussion of the latter question there are given, beginning on p. 968 of this issue, the views of representatives of the three chief parties at interest in highway transportation—the user, the vehicle manufacturer and the engineer. We commend most heartily these articles to our readers, particularly as all three interests agree that the five-ton truck is the desirable maximum under present conditions. We commend, too, the vigorous introductory paragraph of Mr. Breed's article and that paragraph in which he urges the use of those types of pavement only which have proved equal to the heaviest traffic. Every engineer and taxpayer should be at one with him when he says: "The demands of traffic are upon us. We have lagged behind since 1902. For the sake of national prosperity, we can't afford to lag behind any longer; we can't afford to squander wealth and energy upon experimentation with unsatisfactory types." We must all agree that there has been not only too much experimentation but too much blind persistence in the use of types that clearly have no place in present-day trunk highway construction. This view will surely be one of those that will be emphasized at the Chicago convention.

Efficient Shipbuilding Along the Great Lakes

MEN accurately informed about shipyard work throughout the country say that the yards on the Lakes are building ships at lowest cost. These same yards have established a remarkable record of output, as told on page 978, by contributing during many months one-third of the entire steel-ship tonnage delivered to the Emergency Fleet Corporation. Because of this twofold distinction, the methods of the Lakes shipyards have a peculiar claim on the attention of shipbuilders. A series of articles on those methods, beginning in this issue, has been prepared, to furnish a basis for study. Economy of hull construction is certain to become steadily more important in the development of the American shipbuilding industry. Full exchange of knowledge between the various shipyard districts of the country is the best means of furthering progress in this direction. But in any analysis of the work along the Great Lakes one point must be taken into account: Perhaps outweighing method, the spirit of energy animating the shipbuilders of the inland seas is an essential part of the secret of their achievements.

Shipyard Efficiency Reflected in Riveting

PROGRESSIVE improvement in shipyard rivet-driving, despite a continuing shortage of trained men, is an index of efficiency in yard management. In the development stage of the yards, shipbuilding operations could not be organized in such a way as to yield a high output per man. This was as true of shops, transportation and erection work as of riveting, but the detailed recording of performance for the latter made it the outstanding element of the shipbuilding situation. Improvement of the production system in the yards correspondingly finds expression in higher

riveting figures. Piecework payment is one of the instruments of efficiency. Yard tests have proved conclusively that time payment gives inferior rivet outputs; yet during the period when the yards were not fully organized for the extra burden of work placed upon them, when speed had to be secured at the cost of efficiency, piecework riveting was not everywhere practicable—in some instances it was impossible even to supply work regularly enough to enable the gangs to make fair earnings on piecework. Since then, extension of piecework and rise in rivet output have gone hand in hand. The shipyards are working under full pressure, and specialist training is helping to solve the remaining difficulty of labor supply.

Concrete Consistency Criterion Needed

TESTS have demonstrated that there is such a thing as precisely the right amount of water to mix in a batch of concrete. More or less than this amount reduces compressive strength. On the actual job, however, such things as the method of placing or the size and congestion of the forms make it usually necessary to use a different proportion of water than that which will give the greatest strength in an isolated specimen of the same concrete under laboratory conditions. This variation from the optimum amount of water must be regulated by the skill and experience of the director of the concreting, so that in spite of the accepted necessity for a definite water content there is today more difficulty in determining the proper consistency of a concrete mix than there was in the old days when the amount of water used was a more or less negligible factor. What is lacking is some definite criterion of consistency which may be used as a measure of future strength. The need for this criterion is nowhere more clearly seen than in the manufacture of the numerous concrete barges and ships now under way. Ship concrete must be of the best. The thin walls must be of maximum density and strength. Both engineers and contractors in the various yards are at one in their efforts to produce the best possible material under the conditions, but in practically every yard during concreting there is a controversy, generally amicable—though sometimes toward the end of a thirty-six-hour continuous run somewhat acrid—between the engineer who is insisting on a mix of what he considers optimum dryness and the contractor who wishes to put in sufficient water to insure the easy flow of the concrete around the steel. So long as the measure of consistency is in the eye of the expert, just so long will there be this difficulty.

Is the Shipping Program to Be Ruthlessly Cut?

RUMORS credit the Shipping Board with reducing the number of concrete ships at each of the five Government yards from eight to two, and with putting the full responsibility for construction and costs into unfriendly hands. We hope that the report is not true. Such action will brand the board as definitely unfair to the concrete ship and, what is more vital at this critical period, will unsettle the whole shipbuilding industry. The successful completion of the 12,000-mile voyage of the concrete freighter "Faith" lifts the concrete ship from the plane of the experimental. Concrete vessels can be built that will safely carry ocean freight; their future depends on cost, not on structural stability. Unless the new Government concrete ships are made in sufficient numbers to absorb the cost of the yards already built and material already purchased for multiple ship production, the few ships assigned to each yard by the reported curtailed program will be commercially impracticable. Is the Shipping Board willing to take the responsibility for killing so promising an addition to the American merchant marine by such a subterfuge?

If the concrete ship is a failure, let the board cancel all the contracts and shut down all the yards. This is no time to send good money after bad. If it is economically doubtful, let the new construction program be concentrated in one or two yards, so as to assure efficient production. But we are entitled to know how and why the concrete ship has failed, if that is the opinion of the board.

But the greater danger from this rumored action lies in the evidence it would afford of a thoughtless cutting of our shipbuilding program. If the concrete ship program is to be so summarily dealt with, who knows what will be done with the other programs? The fabricated ship is also an experiment, an experiment in construction methods. Will the capital and labor interested in the fabricating yards soon have to look to other fields of endeavor? As we pointed out last week, this is no time for hasty action in shipbuilding control. Every move today will be reflected in our industrial conditions and our marine position a year from now. The gentlemen at Washington and Philadelphia who administer our ship program are responsible to the people not only for this mortgage on the future but for the money they are now spending. Their trust today is quite as solemn as it was when all that was required of them was to produce ships regardless of cost.

Minute Mix Justified by Extensive Tests

FOR some years "a batch a minute" has been a slogan of concrete-mixer manufacturers. It implies a time allowance which on the one hand was rarely reached in rush concreting or under lax inspection, and on the other was frequently condemned as too short by the theorists. These latter, backed by a few tests, assumed that increase in time of mixing made a proportionate increase in the dispersion of the cement through the mass and consequently a proportionate increase in the strength of the resulting concrete. The limit of this proportionality was not definitely fixed, nor was the curve of increase assumed to be a straight line; they believed that 2 min. was enough better than one to justify its specification, and that 5 min. was better still, though perhaps not warranted economically. Tests of unprecedented extent are now available to show that the mixer makers were the nearer right of the two. The tests, of course, refer only to the present state of the art and to the drum type of mixer. In other words, they tell nothing about the possibilities of long-time mixing with different types of incorporation.

Those tests, a part of a most elaborate series on the whole subject of concrete making reported by Prof. D. A. Abrams of Lewis Institute before the last meeting of the American Concrete Institute, are now just about to be made available in the *Proceedings* of the institute. They show that while there is an increase in strength with time of mixing in a 3½-ft. batch mixer, the curve of increase drops off quickly after from 45 sec. to 1 min. For instance, the average of all the tests, numbering more than 3000, shows that the increase in three months' strength from 1 to 2 min. mixing is about 7%; from 1 to 5 min., about 15%, with no further increase for the 10-min. mix. Between ¾ min. and 1 min. the increase was about 6%. Many of the tests showed no important gain in long-time strength by mixing longer than 1 min., although the 7-day and 28-day strength seemed to be raised. On the basis of these tests Professor Abrams rightly concludes that 1 min. in the mixer gives maximum concrete efficiency in so far as mixer output is concerned, and recommends that this period be adopted as standard. So many other factors enter into the strength of concrete that prolonging the mixing period is of doubtful economy. Then, too, the occasional inevitable failure to meet that time by a few seconds will not cause any dangerous loss of strength.

One minute of turning in the drum, the logical deduction from the tests, is not, however, the same thing as "a batch a minute." The manufacturers' slogan is justified only to the degree that the mixing plant is operated efficiently. In some plants the mixer's inactive moments are practically negligible, so rapidly does loading follow dumping, but to turn out 60 batches per hour and yet approximate a 1 min. mixing time for each requires a fine coördination of all parts of the plant, in which the mixer is only a small part. The 1-min. mix will give good concrete, acceptable to any engineer, but the contractor working to such a specification must have the best of plant design and operation if he expects to approach the mixer manufacturers' standard of economical operation.

A New Era in Highway Transportation

LOOKING back over the period of the war, one is amazed at the increase in the use of the highways for motor transportation. The four years of conflict have put us in a new era. The various problems involved in carriage over the roads have increased immensely in importance. The danger is that we may fail to grasp the true import of the war's lessons and think and plan on a scale far below the demand or the opportunities.

Before the war who could have suggested without incurring ridicule the transportation of an army division of 38,000 men, with all its equipment, over a distance of 160 miles in 16 hours? Who could have anticipated a motor-transport system, such as saved Verdun, when for two and a half months, day in and day out, a truck passed a given point in each direction every 22 seconds? Who could have said without being dubbed a dreamer that the inadequacy of our rail transportation system would force the use of motor trucks for long-distance express service between points as far apart as Washington and New York? Such developments were beyond the expectations of even the most enthusiastic highway advocates five years ago; today even the man in the street regards them as commonplace.

Nor is the mere number in use or the length of runs the full measure of the motor truck's value. It has demonstrated an adaptability that is truly staggering. At home no service has seemed too severe for it, nor any commodity—the most delicate, the most unwieldy, or the most bulky—impossible of accommodation. In the war zone motorized ambulances and operating rooms, motorized artillery and ammunition supply trains, motorized kitchens and ice-making plants, motorized sanitation apparatus and even bath-houses, testify to the universality of its use. Carrying its terminal facilities with it—picking up its load at point of origin and discharging it at ultimate destination without the mediation of any other mode of carriage—it has proved immensely superior to rail transportation for speedy service on the relatively shorter hauls.

The vehicle, then, has demonstrated its value. But it is only one factor. What of the track, the highway? Has it proved equally satisfactory? Has it kept pace with the development of the truck or with the demand put on the roads?

We need not make answer. The facts are spread plainly before all who would see. Road work has not kept pace. It was under restriction, but we are sure that even had there been no war-imposed curtailment the highway would have fallen behind. As it is, roads with inadequate surfaces or foundations, or weak in both respects, have gone to pieces, and states are reckoning in millions of dollars the money necessary to restore them ever to their former condition, while the aggregate sum necessary for bringing trunk highways up to the standard required by the new vehicle runs into billions.

What of the future? With the past four years of surprises behind us, who can say what the next decade will develop? Certainly, the problem is one of national scope; it affects the average citizen just as directly and seriously as does rail transportation, which was once a subject of Federal subsidy and has always been one of national concern. Only a national attack is commensurate with the magnitude and importance of the road problem today.

With these facts undisputed, and the great after-war reconstruction period opening before us, it is fortunate that the American Association of State Highway Officials and the Highway Industries Association are inviting the highway interests of the country to meet in Chicago, Dec. 11 and 12, to discuss the plans and policies necessary for meeting the highway situation of the minute. Both associations have displayed a broad and vigorous conception of road necessities during the war, so that the atmosphere carried to the meeting by the sponsors will be favorable to a progressive and adequate presentation of the subject.

That highway construction must be expedited is conceded by all. Upon it depends not only the conservation of the present investment in roads, but the giving to the people of the benefits of reduced transportation charges. Broad plans and vigorous action alone have place today. The Chicago convention, we believe, will be instrumental in developing the one and offering the needed inspiration for the other.

Highway—Motor Truck Problem as Viewed by User, Manufacturer and Engineer

In the following articles will be found the views of representatives of the three parties most directly interested in highway transportation—the user of the road, the manufacturer of the vehicle and the engineer responsible for the track. Happily, the articles agree as to the desirable maximum size of truck—that of 5-tons capacity. Mr. Pride, as a user, argues on grounds of utility and economy, Mr. Viets, who through close association with the industry is familiar with the manufacturers' problems, bases his conclusion on structural considerations, while Mr. Breed declares that roads can be constructed and maintained economically for the 5-ton truck. If this agreement between user, manufacturer and engineer is general—and we believe that it is—it should not be difficult, through vigorous coöperation, to secure legislation which will be satisfactory to all parties and insure the conservation of the interests of the public, both as the owner of the roads and the ultimate beneficiary of economical highway transportation.—EDITOR.

Limitations To Be Placed on Trucks, From User's Viewpoint

BY GEORGE H. PRIDE
President, Heavy Haulage Company, New York City

MOTOR trucks, by whomsoever considered, must be viewed from the point of view of their utility. This utility is the logical basis for good-roads expansion to accommodate any means of transportation, and the motor truck is preëminently utilitarian. Roads should not be built unless they can be made productive, and the only way to make them so is by economical transportation. Trucks have come to stay, and the time is ripe for the burying of antagonism between those interested in them, and for coöperation in determining the characteristics of the most economical truck and providing a track to carry it.

The history of the growth of motor-truck operation follows very closely the precedent of passenger-car operation. That this should be the case is very natural, because at first motor trucks were built, almost without exception, by companies which manufactured passenger cars, and they were merchandised by passenger-car selling organizations.

Great Change in Public Opinion with Respect to Motor Car

It requires no strain on one's memory to recollect that less than ten years ago the owner of a passenger car was looked upon by the general public as a privileged person, who was using the roads for his own benefit, causing excessive wear and tear by the speed of the vehicle and the friction of the tires on the road surface, and jeopardizing the lives of the community at large. The antagonistic attitude of the general public was shown very plainly by laws and ordinances which the owners of automobiles regarded as unduly restrictive. That they were so is generally indicated by the modification of these laws as the years have passed. As the use of passenger cars became more general, owing to the greater prosperity of the country and the decrease in the cost of cars, the viewpoint altered, changing so completely that it is only when one thinks back several years that one realizes what a tremendous modification has taken place in the minds of the public.

Motor trucks have been produced commercially for more than a decade, but their growth has been very slow, as compared with the growth of the passenger car, and consequently they have not as yet become so closely interwoven into the lives of the people at large as to eliminate the prejudices which are so prevalent in the initial stages of the development of any mechanism.

Probably the first converts to the belief in the utility and desirability of passenger cars, and the greatest supporters of their development, aside from those owning them, were the officials of the state highway departments. This was logical, because they realized that the use of passenger cars would increase considerably the wear on road surfaces, and they appreciated the fact that the use of these vehicles would serve to stimulate the interest of the general public in their work. This would mean that they would get greatly increased funds for their road-building plans.

Another feature favoring the development of the automobile was its pleasing appearance, and it is perhaps to be regretted that the motor truck seldom is a comely sight. Because it is made for purely utilitarian purposes, the same effort is not made to secure noiselessness of operation, and, on account of its more or less objectionable noisiness, the motor truck tends to produce a rather unfortunate impression on the minds of those who look at it as a vehicle rather than as a medium for transportation of freight.

Roads Must Be Productive

Obviously, money expended in the building and maintenance of highways would be a hideous economic waste, if, after the highways were built and bettered, they were not productive, and the only general way in which a highway can be productive is by furnishing a means for transportation. The use of highways by passenger cars is utilitarian to a certain degree, but it must be remembered that the use of the highways by motor trucks is always for business purposes; in other words, nobody ever engages in the operation of a motor truck for pleasure. It must also be remembered that when passenger cars were first operated it was purely for pleasure, but as their use became more general they developed a distinctly utilitarian purpose,

while the useful function of the motor truck always has been its sole function and always will be. For this reason the farsighted highway official, judging from his past experience with the passenger car, can look forward to the motor truck as a force, infinitely greater than the passenger car—great as that has been—to strengthen his efforts toward increased highway development.

Apparently, to the minds of some highway officials who have regarded it from a somewhat antagonistic viewpoint, the motor truck has appeared in the same light as the passenger car used for pleasure purposes—that is, it has been considered as using the highways for purely private gratification. This, of course, emphatically is not the case. It is quite plain that this is not so with respect to motor trucks operated as express vehicles or common carriers, because these vehicles afford transportation for the public at large. It might appear to be the case with those which are used for transporting a commodity manufactured by the company which owns the trucks, but even there it is not so, for, owing to severe competition, no commercial organization will employ motor trucks unless they transport goods more economically than any other means requisite to meet the situation. In the effect on the selling price of their goods, the general public benefits to this extent. Therefore, no motor truck is a private utility, because, either directly or indirectly, the ultimate consumer pays the cost of all transportation of the commodities that he uses. If the cost of transportation is lessened by the motor truck, he gets the benefit of the decrease; or, conversely, if it should be increased by unduly restrictive legislation, he would be penalized to the extent of the added expense.

Antagonism Between Interested Parties to Be Deplored

There has been a great deal of discussion in various sections of the country in the past few years regarding the size, weight and speed of trucks which should be permitted on the public highways. There was even a question in the minds of some people as to whether it was not desirable to prohibit their use entirely, but since the war started they have so plainly exhibited their value that this last question can no longer be considered. The motor truck has come to stay, and within the past two years has become more closely interwoven in the commercial fabric of this country than is generally realized. But there has grown with its use a most unfortunate feeling of antagonism between the truck operators and the state highway officials. Nothing could be more deplorable, because, instead of their interests being antagonistic, they are absolutely identical. It is obvious that motor trucks cannot operate unless there are good roads, and under the economic pressure of the reconstruction period, while we all anticipate an enormous road-building campaign, assuredly no roads will be built in the coming time of stringent economy unless the money so invested will be greatly productive to the community which provides the funds.

In some states it is considered that the 3-ton truck is all that the roads of the state can adequately carry. In other states, a limitation of 28,000 lb. per vehicle (which means the 7½-ton motor truck) has been decided upon as the maximum. Now, whatever is enacted in any of these states, unquestionably those concerns operating trucks in that territory will comply with the law, but, generally speaking, the smaller the tonnage of the motor-truck unit, the greater cost per ton for the freight it transports. Therefore, those communities which pass the 3-ton law will obligate their citizens to pay a considerably increased transportation cost over that paid by the communities where heavier units are permitted. Granted that there is a given volume of tonnage to be hauled, it means that a greater number of trips will be required to carry this tonnage if 3-ton trucks are used than if 5- or 7½-ton trucks are used. Where the 3-ton limit is in force, it unquestionably means greater surface wear, although there is the converse that there is less disturbance of the road foundation than with the heavier unit.

Transportation Costs Greater with Smaller Trucks

In considering this increased cost of transportation by 3-ton units, it might appear to the layman that if there would be less deterioration of the roads with the 3-ton than with the heavier units, it would be desirable to place the limit at 3 tons. There, again, a very dangerous situation arises. It has been said, and is probably true, that the majority of commodities, before they reach the ultimate consumer, are transported over the highways from five to ten times during their process of evolution, and in many instances much more frequently. Therefore, if the cost of transportation, owing to the limitation of motor trucks to 3-ton units, were increased 20% (and this I think is a very conservative estimate), and if this 20% increase in transportation cost were multiplied the number of times all these commodities are so transported before they reach the ultimate consumer, an added transportation expense that is quite amazing is developed.

From the foregoing, it has seemed to me that the test as to whether or not a highway is justified is not determined solely by the number of years that it exists before it needs to be resurfaced, but rather by its productivity as measured by the tonnage carried, together with the degree of economy with which this is accomplished. With the advent of the motor truck, the highway ceases to be a mere line of communication between two points; it becomes part of the transportation system of the United States, and its value should be estimated by its yearly tonnage and the cost of haulage per ton-mile, rather than by the cost of building the road and its life in years.

Do Trucks Cause the Damage Ascribed to Them?

There are many opinions expressed as to the damage done to the highways by motor trucks. Some of these are true, but many of them are gross misapprehensions. I cannot help feeling that the development of the motor truck has reached such a point, and its future use is going to be so enormously increased, that the time has come when a series of tests and observations should be made by a committee composed of highway engineers and those interested in the operation of motor trucks,

to determine what effect the motor truck has on all types of highways. From observation of the condition of roads of many descriptions for a period of years, I have formed conclusions which I hesitate to cite here, as they are utterly at variance with opinions that are so popular at present.

I feel that the antagonism between those interested in highway construction and those interested in highway operation should be buried, and that the time is now ripe for the utmost coöperation—first, in finding out what is and what is not detrimental in the way of weight, speed and size of motor trucks, and, second, in making a united effort to put the results of these findings into effect. This should be done for two reasons: First, that the country as a whole may be benefited, and second, for the greater success of both interests involved.

In conclusion, it is my opinion that the 5-ton truck, which, when loaded, weighs about 25,000 lb., has been the most economical unit for general use in haulage. Among the many reasons found for this there are two general reasons which may be stated. In the first place, the larger trucks, above the 5-ton capacity, as constructed today, move much more slowly than the lighter trucks. Therefore, though they are able to carry greater loads, the time lost on account of the lower speed about counterbalances the saving effected. Whether or not this is a mechanical feature which cannot be corrected I do not know, but it has been the case up to the present time. The fact that many companies which formerly made 7½-ton trucks have now dropped back to the 5-ton capacity might lead to the belief that there is a mechanical difficulty.

Merchandise Handled in 5-Ton Lots

A second reason why the 5-ton truck is more economical and convenient is found in the fact that it is natural to think in fives and tens, as in the decimal system. Merchandise is sold in 5-, 10- and 20-ton lots, and it generally happens that the motor-transportation company receives orders for transportation in these lot sizes. If it operates with 5-ton trucks, one, two, or four will fill the bill, but if it has 7½-ton trucks it is probable that one load will be short or all of them will be below capacity. However, it seems reasonable that an additional margin of about 10% over the 5-ton capacity should be provided, because it is unwise to bind too closely by present precepts an engineering development, thus inhibiting any possibility of its progress. I am therefore of the opinion that 28,000 lb. should be the maximum gross weight permitted on four wheels; that 15 miles an hour should be the maximum speed, and that the width of the motor truck should not exceed 7½ ft. at its widest point.

In the matter of speed, I feel that 15 miles an hour for the heavier trucks should be the maximum, because, owing to stops and starts, grades, the necessity of using care in passing vehicles, etc., it is necessary to have this rate of speed to enable the average truck in a 10-hour day to maintain the mileage of from 50 to 60 miles. (This figure, of course, does not refer to those trucks which are making long-distance hauls between two cities, but these are exceptions).

Whatever may be the immediate limit placed upon the motor truck, it is my judgment that it must not be considered final. We are on the eve of vast developments, and requirements of the future will demand greater weights, better and different types of roadbeds, reduced grades, etc. It is a matter for consideration whether tracks of steel or cast-iron channels, or the use of some other material which would combine great wearing value with greater tractive friction than these, should not be substituted for our present roads. If this were done, the material wasted in paving the central section of the roadway could be used in giving stability under the rails.

Factors Which Will Govern Future Road-Surface Design

By Edward L. Viets
Sales Manager, The Service Recorder Co., Cleveland

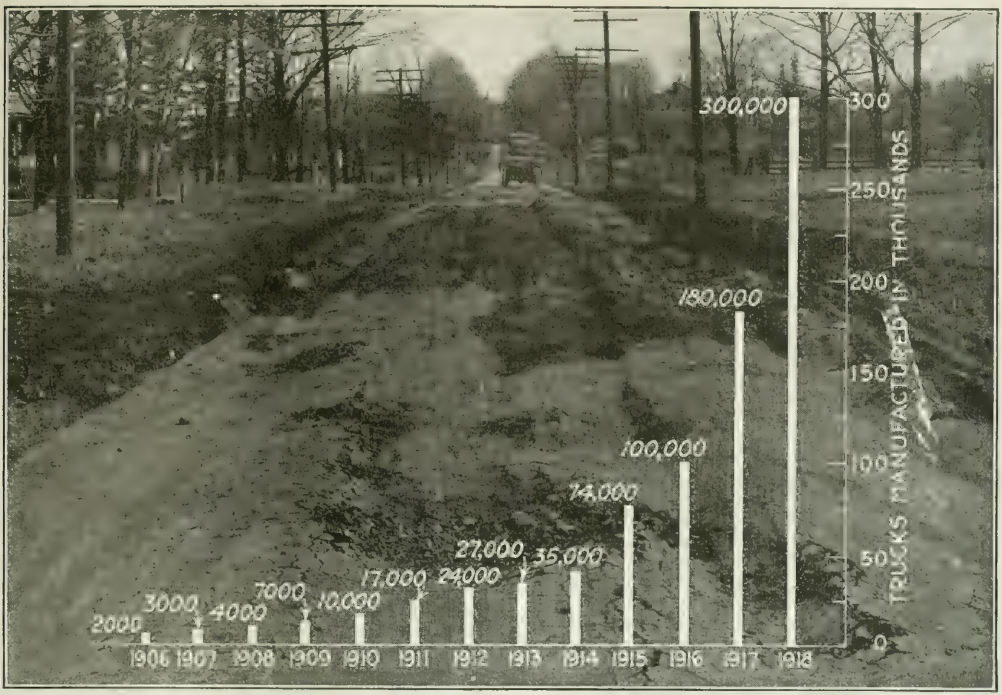
Roads, tires and economy are the factors which will determine the design of the road surfaces of the future, and not the possible size of motor trucks. Motor trucks of 100-ton capacity are mechanically possible, but how to build the roads, how to design the tires, how to operate economically—in any but a few cases—large-capacity trucks, are problems not so easily solved; in fact, they are practically unsolvable. With these facts admitted, it should now be possible, and it is the urgent need of the hour, to establish what is the reasonable working load for commercial motor transportation.

The road builders of the world are face to face with a new problem. Briefly, it is this—how to protect the hundreds of thousands of miles of roads which have been years, decades, even centuries in the building, from the tremendous wear and tear of a new vehicle which has made its appearance in great numbers only since 1912.

The roads which were built in the days of Rome served the modern traffic of the year 1900 and served it well, for in the eighteen centuries, more or less, which had elapsed since these roads were built by ancient masters of the art, no essential change in the construction or the weight of road vehicles had taken place. How has it been since 1900? First, the automobile made its appearance, and the numbers of this type of vehicle increased in a few years from a handful to many millions. Vehicle speed had suddenly been increased from the three to eight miles an hour of the horse to the 15 to 40 or even 50 or 60 miles an hour of the gasoline motor car.

Problems Solved and Unsolved

Consternation filled the minds of the road builders, because this new vehicle began to destroy even the best of the macadamized highways of the day. Soon, however, it was found that if a suitable binder were provided for the surface of roads—tar instead of water—this new vehicle could be rendered quite harmless. For its weight was not excessive, it rested on the road with broad, soft, air-filled tires, and it had previously worked its destruction only because of its speed and the clinging quality of its rubber tires, which whirled away road surfaces in a fine dust. It was well for the roads that this simple expedient was discovered, for this new vehicle descended upon them like swarms of locusts, suddenly and almost without warning.



EXPANSION OF MOTOR-TRUCK INDUSTRY IN ANNUAL OUTPUT, AND EFFECT UPON LIGHTLY CONSTRUCTED ROADS

This problem having been luckily solved, a new one appears—the motor truck. This new vehicle approaches with less speed than the passenger automobile, but it seems more formidable. It plods along with its heavy artillery wheels, its solid tires and its strong axles. It does not flit by in a cloud of dust; it does not merely disturb the surface of the road; instead, it shakes the earth. More than tar applied to the surface of the road is required to withstand the rolling of this vehicle. It requires a new foundation, heavier and stronger than any used before. And that means a new road, reconstructed from the foundation up.

As a result of this comparatively recent motor-truck traffic, many roads which were previously thought perfect have suffered serious damage. Such an instance, together with the cause, is shown in one of the illustrations. Present road conditions are probably much worse than the average person would believe possible. Highways connecting important cities are in many cases broken down or have stretches which are well-nigh impassable. News items such as the following, taken from a Cleveland paper under date of Oct. 2, are frequently read:

"Overland driving of Government trucks and creation of intercity motor-trucking systems are creating a problem greater than that of building roads to make such driving possible. It is the maintenance of the roads already built."

Even our crack highways have in certain cases broken down, as this note indicates:

"The Lincoln Highway across Pennsylvania, up to the time truck trains began to use it, was a veritable boulevard of macadam, and the pride of the commonwealth. It is rapidly disintegrating."

These facts have an ominous sound, for if some of our best highways are giving way under the strain of truck travel, what will become of our poorer roads, more numerous by far, and also used by motor trucks? And what will become of all of our roads, if motor trucks, which have increased from 60,000 in 1912 to 600,000 in 1918, pass the million mark next year and the two-million mark within the next three or five years?

The highway engineer of the present time is facing as big a problem as that which any public servant is grappling with. It is not only big, but it is urgent. It is not only urgent, but it is difficult. It seems, in fact, in many of its phases, unsolvable. But it must be solved, for the motor truck has proved itself to be a second railroad, and it promises to become one of the most important agencies of transportation of the near future. Its growth in the past five years of its existence has been more rapid than the fastest pace of railroad expansion, and, with roads leading everywhere, it may even outstrip the railroad in ton-mileage hauled yearly. The highway engineer recognizes the importance of motor-truck transportation, and has set himself the task of making highways which will carry trucks, and carry them all the year round. But do we in turn recognize the problem of the highway engineer?

Here are some of the difficulties of the road builder's problem—difficulties so numerous that the space avail-

able is sufficient only to list them and not to discuss them: What is the effect of trucks on road surfaces? on road foundations? What is the effect of speed? of weight per inch of tire width? of total wheel weight? of steel tires? of solid rubber tires? of pneumatic tires? of tires with flat tread? of tires with rounded tread? of solid tires of comparatively high section? of solid tires which are nearly worn out? What is the effect of trucks driven electrically? of trucks employing a four-wheel drive? What is the effect of density of traffic? (Take, for instance, the section of the Lincoln Highway referred to above; it is not likely that the first few hundreds of trucks driven over it caused much damage, but when thousands of motor trucks came, the highway broke down under the repeated blows.)

Let us assume that the road builder is able to judge the probable effect of density of truck traffic; then he must turn prophet and estimate what the future traffic is likely to be. But, you ask, why is it necessary to figure so closely? Why cannot the road builder lay down roads which will stand up under any kind of traffic, practically for an indefinite time? That brings us to another difficulty—the ever-present problem of expense.

There is no public work which compares with road building for absorbing the nation's money. The roads of the country count some two million miles, or, roughly, seven times the total railroad mileage of the nation. To build a modern highway, one with a foundation which will stand a vehicle weight of 15 or 20 tons, costs at least half as much per mile as the average expense of constructing a mile of railroad track. The Lincoln Highway is 3333 miles in length. This is not much in comparison with the two million and more road miles of the country; yet the construction of this highway was not to be undertaken in a holiday spirit. Work has been under way on it for three years; the highway is not completed; but a section of it which was constructed through a wealthy state, and without attempt to economize in materials and labor, broke down under the traffic of Army trucks—numerous, it is true, but none of them larger than five tons in capacity and many of them three-ton trucks or smaller.

Highways a National Problem

No attempt is here made to underestimate the work of those farsighted men who are building magnificent highways across the country. They are the Romans of the present day, and their work will be fruitful in producing lesser but more numerous highways which will spring up and intersect the great roads. But it is necessary to count the cost. To make permanent highways of the two million-odd miles of roads of the country would cost many times more than the construction of the Panama Canal. Of course, it is not necessary to improve all the roads of the nation in this way, but to modernize even a tenth of this mileage is a task not to be attempted by states, and not to be completed by the national Government inside of a dozen years.

So the seriousness of the problem becomes apparent. On the one hand a new kind of traffic, growing prodigiously and at an increasing rate, and throwing an enormous weight of tonnage on our roads; on the other hand a sum of money available which is large, but not nearly large enough to make roads suitable to carry this new traffic. The road builder, though he appreciates the economic importance of this new transportation, cannot satisfy its demands entirely. He is in the position of a man trying to live on an insufficient income, and must act accordingly. He must spend his money on certain roads and neglect others, or he must improve all his roads, but not up to the standard required by the new traffic. Who is to blame? Nobody. The situation is one produced by circumstances, and it cannot be overcome by mere policy or cleverness. We have with us a new system of transportation which promises to be as important as the railroad, but, if we utilize it, it will be necessary to make a roadbed for it.

What Will Future Truck Be Like?

But the greatest perplexity which confronts the road builder is yet to be stated. It is this: What will the motor trucks of the future be like? When we lay the foundation for a building, we must know the weight of the building to be supported. If extra stories are to be added later, provision must be made by constructing foundations of greater strength.

Now we are approaching the time—in fact, it is already here—when roads are made of masonry. Foundations 6, 8, or even 10 in. thick are being laid. These are meant to be permanent, or at any rate to last for an indefinite period. Unlike the old dirt or clay road, the modern highway, when broken down, cannot be repaired except at great expense. Suppose that after millions of dollars had been spent in constructing roads suitable for the present traffic, a new kind of motor truck should be built, weighing 20 or 30 tons when loaded, and capable of destroying in a short time even the best highways!

The importance of this question, if measured in money, may be said to represent many millions of dollars. Can it be answered? Shall we find ourselves, ten years from now, in possession of an enormously expensive system of roads which is obsolete and which will have to be rebuilt? Or shall we be able to plan today for the traffic of the future, and thus avoid a useless expenditure of public funds?

The writer does not pretend to be able to answer this question. It seems almost enough to state the question and to call attention to the fact that those who make roads and those who make vehicles must get together on this matter. In the meantime there are certain indications, which may be worthy of notice, pointing to an apparent limitation in the further increase of truck size.

Five-Ton Rating Seems Definitely Established

First, let us examine the vehicle itself. A recent list of the models turned out by more than 100 active motor-truck manufacturers shows that 47 different makers build trucks up to and including 5 tons in capacity. Only six make trucks rated to carry a heavier load than 5 tons. It will be of assistance in working out this problem to consider the 5-ton rating as a kind of dead-line beyond which truck makers hesitate for the present to step. Some of them have stepped over it, it is true, but in the past few years seven or eight have stepped back. The 5-ton rating, on the other hand,

seems to have been definitely established, for nearly half of all the active truck manufacturers build models up to that capacity.

But this is only an indication and not a law. Road builders, who in a few years can easily spend billions of dollars on new roads, require a more definite assurance. They know, for instance—or they should know—that one of the prime reasons why heavier trucks have not proved more popular has been the condition of the roads themselves, and that as soon as roads are improved there is a possibility that truck sizes will be increased, so that the race may go on again as merrily as ever, with the truck always a little ahead of the road, and the road struggling to keep up with the truck.

Physical Limitations of Truck Size

Why not put the case bluntly: "Is there any physical limitation to a further increase in the size or carrying capacity of motor trucks? We are about to lay down permanent foundations for them, and that is why we want to know."

The truck makers have replied in substance as follows: "So far as the truck itself is concerned, there is no engineering difficulty involved in increasing its carrying capacity almost indefinitely. We feel quite satisfied that the engineers of this country could eventually design and build trucks of 100 tons capacity, provided they were able to get roads and tires which would stand up under them."

What should limit them? Springs? Freight cars of 50 tons capacity are supported by springs. Wheels? They could be made of steel. Frames? They can be made enormously strong. Engines? An engine of 40 hp. is sufficient to operate a 5-ton truck—they are already putting engines of 200 and 300 hp. in airplanes. Axles? The 200-ton locomotive has axles also. Steering? That could be done by power if necessary.

Tires?

Yes!

And here you have a real limitation, and one which, so far as we can see at present, prevents the further excessive increase in truck size as absolutely as would a Federal law to that effect. There is a natural limit to the strength of rubber. Place a certain weight upon a rubber tire and it will yield without damage to itself. Increase that weight beyond a certain point, and the rubber breaks down. It breaks down completely and is ruined.

Manufacturers Agree on Tire Loads

What is that limit? It cannot be stated definitely in ounces or even in pounds. Manufactured rubber is a thing so compounded and made up of so many ingredients that the products vary enormously in their physical properties. The rubber chemist is like a cook with a thousand recipes at his disposal. Pure rubber is his basic material, but he gives it strength, or elasticity, or toughness, or hardness, according to the different elements which he combines with it.

But the question is academic. We do not need to have it answered. Far more pertinent to our problem is this: What is the limit to the strength of that kind of rubber which the rubber experts (the tire manufacturers), after a dozen years of experimentation, have found most suitable for truck tires?

Fortunately, the doctors have pretty nearly agreed on this point, and the schedule of carrying capacities shown in the table, issued by one large tire-manufacturing company, is practically the same as that subscribed to by all the tire companies. Moreover, these weights

MAXIMUM LOAD CAPACITIES FOR SOLID TRUCK TIRES

Single		Dual	
Width, in.	Maximum Load, lb.	Width, in.	Maximum Load, lb.
3	1,000	3	2,000
3½	1,300	3½	2,600
4	1,700	4	3,400
5	2,500	5	5,000
6	3,300	6	6,600
7	4,200	7	8,400
8	5,200	Dual tires	
10	7,000	impracticable	
12	8,800	beyond this size.	
14	10,600		

have stood practically unaltered for several years. But here again we are not interested in the exact poundage allowed by the different manufacturers. This is more largely a matter of guesswork than the average tire user thinks.

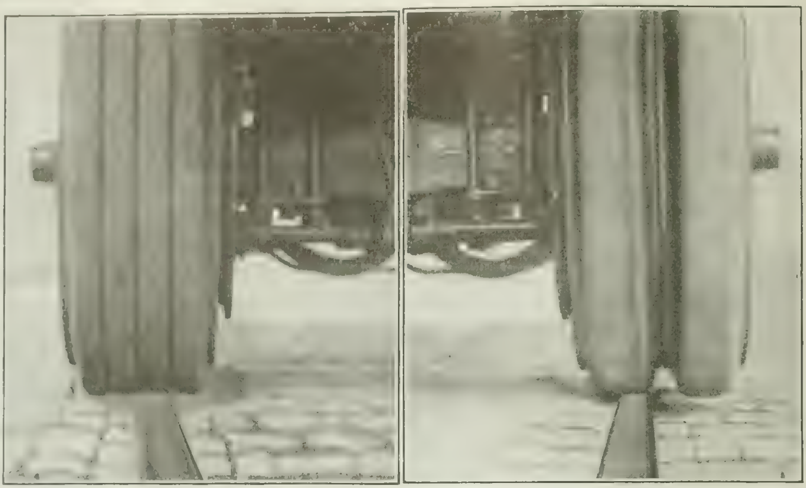
Uncertainties of Tire Strain

I do not mean by this that the processes inside the tire factory are irregular or the results obtained uncertain. The reverse is true, and the tire manufacturer is able by means of delicate instruments to "measure" the properties of his finished products to a nicety. The "guesswork," if we may so term it, comes when the tire is sent out for service. What carrying capacity shall the tire maker fix upon as the maximum which his tire shall bear? If roads were as level as bowling alleys, the tire maker could use his laboratory experience to good advantage. But such is not the case. Here is a 7-in. tire, let us say, which, when bearing on a flat surface, is capable of sustaining without injury so many thousand pounds. But after this 7-in. tire is fitted to a truck wheel, what happens? Perhaps on a boulevard the tire rests with its full width on the ground; but here is a sharply crowned road where only half of the tire bears; here is a rocky road where the broad tire passes over the tops of protruding stones; here the truck crosses a raised track, or runs lengthwise of it, as illustrated (see next page) and the tire may bear for the moment with only one-seventh of its tread supported.

Nobody can prophesy in advance what strains a truck tire will be called upon to stand; hence, after the tire maker has constructed his tire with all the aid which science can give him, after he knows what load his tire could safely support if all the streets were absolutely level—then he must close his eyes and guess what additional strains the tire is likely to encounter and provide a factor of safety to take care of them. That this can only be guesswork is proved by the astonishing variance in the performance of tires made by the same company. Some run as high as 40,000 miles, some 20,000 miles, some fail at 5000, some go to pieces in less than 1000 miles. This can only be accounted for by the great variance in the stresses which different tires encounter in service, for, concerning the tires themselves, they are made with such scientific accuracy, in so far as ingredients and cure are involved, that they come out of the oven practically identical products.

Now, while this explanation is necessary to show the true significance of truck-tire carrying capacities, it

is essential to note that, for the purposes of the present problem, we do not need to know how the tire makers arrive at their tire weight limits. The important point to grasp is, such limits do exist, and they are so restricted that it is entirely possible that the progress of motor-truck construction has already reached a point where these limits forbid further increase in truck weights. This is stated as a fact rather than an evil, for perhaps it will, in the long run, prove to be a benefit.



TIRES HAVE UNEQUAL BEARING ON IRREGULAR SURFACES

To make this point still clearer, consider for a moment the steel tire such as is used on wagons. It is true that a small wagon has narrow steel tires, and a large wagon has wider steel tires, but this is largely a matter of wheel strength, and so far as the strength of the steel tire itself is concerned, it is probable that a steel tire an inch wide would support the heaviest wagon it is possible to build. In other words, although even steel tires have their limits, these limits are so distant that they would probably never operate to prevent the growth of vehicle sizes. Rubber, on the other hand, is much more limited in strength, and its limits are such that they are always a matter of concern to the truck builder.

Steel Tires Impracticable for Motor Trucks

However, the use of steel tires on motor trucks is quite out of the question. Not only is it impossible to build trucks which would stand the terrific pounding of the road against steel tires, but if such tires were used they would destroy the roads so fast that legislators everywhere would take steps to limit the use of them, as they already have done in several states in this country, as well as in France and England. This matter comes up particularly in the use of the trailer, which, of course, in many cases could be equipped with steel tires without straining or injuring the motor truck which hauls it. This is a case where the only argument against the use of steel tires is that having reference to the preservation of the roads; but this argument is all-sufficient when the great destructiveness of heavy trailers equipped with steel tires is considered. Not long ago one trailer equipped with steel tires and hauling 5 or 6 tons broke through and destroyed several hundred yards of granite-block pavement in New York City. Such destruction, of course, is entirely out of proportion to any economy to be derived by the use of steel instead of rubber tires, and trailer manufacturers themselves have been among the first to realize this.

But, it may be said, if a 4-in. rubber tire is stronger than a 3-in., a 5-in. stronger than a 4-in.—if, in other words, tire strength is proportional to tire width—why is it not possible by building wider tires to increase tire strength indefinitely? The answer is important. The excessive strains due to uneven bearing, occasionally present in the case of small tires 3 or 4 in. in tread width, increase as tires are made broader, and they increase out of proportion to the increase in tire width, becoming a very serious factor in tires 10 in. wide or more, and practically prohibiting the construction of rubber tires of greater width than 15 inches.

To get a clearer idea of the unequal bearing of the tires on crowned streets, let us consider a 16-in. width of tire on a street having a crown of ½ in. to the foot. To get any bearing at all at the outer edge of this tire, the inner edge must be compressed about ⅔ in. On a tire 2 ft. wide, the compression necessary would be 1 in. Such a condition would rapidly wear the inner edge of the tire, if it did not destroy it outright by exceeding the elastic limit at the first operation. With an indefinite increase in the width, it is evident that a large part of the wide tire would soon be hanging in the air.

No Manufacturing Limit to Tire Size

This exaggerated example shows clearly the limitation which prevents the indefinite increase in tire sizes. The difficulty is not in chemistry. The wonderful tire builders of Akron, and those who, learning from Akron, have gone to other parts of the country to build tires, may be expected to solve any problem which relates to the chemical construction of truck tires. It has been said that insurmountable difficulties have been encountered in the curing of wide tires. It is true that the difficulties have been encountered, and also that they have been overcome. But that is not the reason why the width of solid rubber tires is approaching a limit. For that matter, if such a difficulty did exist, it could be overcome by putting three, four, or five small tires side by side on a single wheel.

We find, then, that the condition of our roads and the probable limitation in the size and strength of

rubber tires have tended and probably will tend to limit the weight of the motor trucks of the future. There is another consideration, fully as important. Let us state it briefly:

A dry-goods house owns five 1-ton trucks. They cost $10,000. Each truck needs a driver, perhaps a helper, garage space, care, etc. For $5000 this store could buy one 5-ton truck, employ one driver and helper, cut down expenses in other ways, and yet get the same load-carrying capacity. Why is this not done?

The reason is obvious. The big truck in this case would fail to give service. And not only that, it would probably take four or five days to deliver the parcels which five 1-ton trucks deliver in one day, and thus it would cost more in dollars and cents to deliver these goods with one unit than with five.

Here we have another satisfying factor which tends to limit the size of motor trucks. In any line of business where several stops have to be made in delivering goods, there comes a point where increasing the size—and hence the expense—of the carrier becomes unprofitable. Past experience has shown that this limit is under 5 tons.

An Alternative for the Large Truck

How about the man who hauls sand? How about the man who hauls asphalt? brick? almost any material used in contracting or building? He makes only one stop; it is to his interest to carry as much at a time as he can. The 5-ton truck, the 7-ton truck, even the 10-ton truck could be used profitably in such work, if it were not for the consideration of tires and roads. But these considerations do exist; one of them touches his own pocket-book, and the other will increasingly touch his civic conscience, or be made a matter of Federal regulation.

But here again there is a way out. It is concentrated weight, not distributed weight, which breaks down our roads. If a man has 10 tons to carry, let him put it in two carts instead of one, and the road will benefit by it. In other words, the trailer will provide the outlet for the future increase in truck loads. And, singularly enough, it is precisely in such kind of hauling, where there are heavy loads and few stops to be made, that the trailer works to best advantage.

Roads, tires, economy—these three factors, rather than any limitation in the art which American engineers use in building trucks of steel—are what prevent and will continue to prevent any great increase in the size of the motor trucks of the future. Nobody is blind today to the enormous utility of the motor truck. Nobody is going to try to legislate it off the earth, unless it be the road commissioner of Country Corners, or the sheriff of Buttermilk County. Prejudice has died away, and in its place has come a country-wide realization of what people only barely realized when they saw the first passenger trains steaming across the country. Highway transportation of freight is here, and it may outstrip highway passenger transportation—the automobile—soon.

But a great problem remains to be solved. A vast system of roads is about to be brought into being. Call them foundations, rather, instead of roads. If these foundations are too weak, or if these foundations, strong enough for today, are not strong enough for tomorrow, then billions of dollars will have been thrown away. As a general precept, roads should be built to stand the accepted traffic of the day. But we should be ready at this time to determine what this standard traffic is. We should distinguish between what is typical and what is freakish, and establish our maximum weight without hesitation. Roads are like bridges—especially modern roads—in that when they break down they break down entirely. The road builders have to know what weights these roads shall bear. They require an answer which will serve for several years. And, even more than a correct answer, they must have a definite answer. If they receive it, they will spend *our* money to better advantage.

Highways and Truck Loads They Can Economically Sustain

By H. Eltinge Breed

First Deputy Commissioner of Highways, New York State

MOTOR-TRUCK traffic is limited by the number of miles of highway able to sustain it. The motor truck marks a distinct transition in transportation facilities. It has made the highway as available for freight haulage as were previously the waterway and the railway. The service of the motor truck in the freight crisis of the past year established forever the importance of the highway as an integral part of the transportation system of this country. The modern vehicle is a magnificent tool for furthering the prosperity of the era before us. But so far it has been fatal to the very factor upon which its usefulness depends—it is the greatest destructive force the highway has ever encountered. Until we harmonize the "tool" and the "way," we shall secure no permanently satisfactory results. It is the object of this paper to show the reaction of various types of pavement to motor-truck traffic, and to make suggestions for the future.

Macadam Unsuitable for Motor-Truck Traffic

Our greatest mileage of improved roads is in water-bound macadam. We build it with a 6- to 9-in. stone sub-base bottom course, and a 3-in. top course, giving a road from 9 to 12 in. in thickness. In soft, unstable soil, additional sub-base is used, so that in some cases the depth is increased to 2 ft. or more. The surface must be waterproofed, and constant maintenance is required to keep it in good condition. The cost of maintenance on this pavement is $600 to $1200 a mile each year. For the past five years, the writer has had under observation a large mileage of this type. The results have been so uniform as to leave no doubt of the conclusion that water-bound macadam roads of our strongest present design will not sustain motor-truck traffic. In every case, as the traffic increased the pavement disintegrated and in times of unstable soil broke up. Of course, at additional expense we can redesign for greater thickness, but the wear on the crust and the abrasive action on the pavement would still be as great, so that at best we should obtain a road almost as high in first cost as a road of one of the permanent types, with maintenance charges six times as heavy, and with the additional necessity of frequently rebuilding the top course under the handicap of heavy traffic.

Bituminous macadam is in much the same class as the water-bound. Its surface is waterproofed. Due to the use of a binder, it has greater cohesion of the crust. It is higher in first cost than the water-bound, but not quite so costly to maintain. Good results in wearing qualities can be procured in it only by closest attention to such details as the selection of material, the assurance of uniform thickness through a smooth base, and insistence upon doing work at the proper season. Bituminous macadam has not shown up favorably under the heavy traffic of the past two years. This pavement, also at greater first cost, can be thickened to stand heavy traffic better, but as it would still have a higher maintenance cost than the durable types of pavement, its building would not be economical where there was any prospect of much motor-truck transportation.

More Durable Types of Pavement

These two are semi-durable types. Among the more durable types of pavement are included brick, concrete, granite-block, wood-block, asphalt-block and the asphaltic mixed type on concrete foundation. These pavements are more permanent because their crust is rigid as well as cohesive, and, therefore, unless broken through, it carries the load as a slab, a beam, or a cantilever.

The brick pavement has endured heavy traffic well. At least, the brick pavement of monolithic form has, where the brick form an integral part of the pavement by being placed on either a foundation of green concrete, or in a mortar cushion of cement and sand. Brick pavements with only a plain sand cushion have less claim to durability. The vibration from the impact of heavy motor traffic rapidly displaces the sand, the brick shift, depressions occur in the surface, and the pavement goes to pieces.

To secure greater resistance in brick pavements than any examples of it have yet shown, the brick should be selected and laid with respect to their hardness, i.e., brick of varying degrees of hardness should not be placed next to each other. Where the hard, brittle brick is laid alongside the soft and tough brick you get unequal wear.

Much better brick pavements could be secured if the brick manufacturer would select and sort his product according to the varying degrees of hardness, so that those within certain limits could be laid together. I do not believe that we shall get the best results from our brick pavement under heavy traffic until this is done.

Asphaltic Pavements Are Less Noisy

Asphaltic-concrete, sheet-asphalt and asphalt-block pavements have the advantage of being quieter than brick or concrete. This is due to the resilience of the surfacing material, which has drawbacks as well as advantages. Unless a proper selection and incorporation of the materials in the binder is made, and unless the binder is stiff enough, heavy, concentrated traffic is apt to cause further consolidation and wrinkle up the pavement. Action by impact is accelerated, and the day hastened when the pavement has to be rebuilt.

In granite-block pavement, smoothness of surface is desirable. The writer believes that this type should be laid with a cement-grout filler, to gain increased strength and smoothness. All these types require a strong concrete foundation of thickness approximating that for a concrete pavement and where they have been built in accordance with the above conditions they have have invariably given us good service under heavy traffic.

Concrete Pavement Has Lower First Cost

The great advantage that the concrete pavement has over them all is its lower first cost. While this statement is general, certain particular cases have proved the exception to the rule.

When I speak of concrete types of pavements here, I refer to concrete of the 1:1½:3 mix. The writer has had more than 300 miles of this type of pavement under observation for the past three years—some of it for a longer period. It has most satisfactorily carried the new traffic, without any failures due to the amount and the class of traffic upon it. It has shown one weakness that can easily be corrected, i.e., the cracking through of the corner of the slab, which is caused by the pounding due to impact and the unstable soil under the slab. The unevenness or the rise of one slab above another increases this action by impact, and by some it is cited as an argument against the use of joints. The writer believes that these joints are necessary to provide for expansion, a lack of which would allow the internal stresses to injure the structure of the pavement in such manner that there would be early disintegration. However, the few slabs that have broken at the corner points are still performing their full service without disturbance to traffic.

Concrete is the cheapest of the durable types of pavement. While its first cost is higher than that of either of the semi-durable types, its low maintenance makes its total cost at five years of age considerably less than theirs. Less than $100 per mile per year keeps it in repair.

By the application of the principles of mechanics, and figuring the corner of the slab as a cantilever, unsupported by soil directly beneath it, and with an allowance of 50% for impact, we find that a thickness of pavement of 8 or 9 in. gives a reasonable degree of surety that it will sustain motor trucks weighing 14 tons including load. It seems desirable, therefore, that we build our concrete pavements on an average of 8½ in. in thickness. High-speed traffic and the use of very wide motor-truck bodies makes it imperative that the road shall be 20 ft. wide, in order that vehicles may pass each other with safety. This would make our pavements 7 in. thick at the sides and 10 in. at the center. Width affects strength, greater thickness being required for greater width. Greater center thickness, compared with the thickness at the edge, can be obtained by dishing the subgrade, if desirable.

Great care must be used in the selection of the aggregates and in the workmanship on the concrete pavement, in order to secure uniformity in results. The smoothness of the surface is especially important, as imperfections in it increase the impact from the passing load.

Those are some of the things that we know about the highway in its relation to motor-truck traffic. Here

are some of the things we don't know; they are the variables in our problem for which we have to assume constants. The greater the number of assumptions, the greater are the chances of guessing wrong and building a pavement doomed to destruction. To meet the demands of motor-truck traffic, highway engineers must aim to develop their art from an empirical into an accurate science.

Some of the troublesome variables are: Cohesion of crust, bearing power of soil, smoothness of pavement, inequalities of pavement structure, lack of uniformity in the aggregates, moisture, and frost. How strong is a given thickness of crust? What is its cohesion, and what changes has it suffered between the passing of truck No. 1, and the passing of truck No. 100? We can gage the action of the wet and frost, but we cannot determine it, because it is complicated by factors in the load. Cohesion of crust and stability of soil are affected partly by vibration of wheel; which, in turn, is influenced by smoothness of tire and pavement. An overload causes greater compaction. The impact from the hammer blows of certain loads and tires upon the pavement crust exerts a pumping action which draws up water whenever the subsoil is wet. Impact depends upon springs, tires (pneumatic, cushion, solid or steel) and speed. Effect of load depends upon width of tire. Abrasive action depends upon the condition of the tires and the presence or absence of chains. The problem is an involved one.

Learning From Former Success

Now, I would make two points for future practice: First, admitting freely the undetermined factors, let us learn henceforth from our successes, as we have learned heretofore from our failures. We know now that certain types of pavement have proved equal to the heaviest traffic we have. Then let us go ahead and build those types without further palavering, and let us learn from observation of their endurance to supply the unknown quantities in our equation. The demands of traffic are upon us. We have lagged behind since 1902. For the sake of national prosperity, we can't afford to lag behind any longer; we can't afford to squander wealth and energy upon experimentation with unsatisfactory types. Let us take the sure thing. If success teaches us to devise something still better, good!

Second, we must definitely eliminate our worst unknown factor—the weight of the load. For the past 15 years we have built roads that have attracted to themselves traffic far greater than they were designed to bear, to the alarming depreciation of the investment in the road. The faster we build roads, and the better, the greater and heavier will be the traffic put upon them, until thousands of miles are destroyed and millions of dollars lost. Only within the past year have we in New York State caught up with the demands of the passenger car for completed through routes, and now the truck is upon us, and roads designed for three tons are having twenty put upon them. They are going to pieces. Five millions a year are being spent in repairs, where at least half of it should be going for new construction. The thing is inevitable until we agree upon some arbitrary limit of load for which we are to design the highways.

It was exactly the same with the railroads, the track and the engine forever outstripping each other with enormous economic loss, untill an arbitrary limit of load and speed was determined upon. Increases upon it since then have had to be of proved economy from the point of view of considering both the "tool" and the "way." In any system of transportation, those two must be reconciled before we can derive full benefit.

Look at our latest traffic reports on 15 highways in various parts of New York State. There is an increase in truck tonnage varying biennially from 50 to 400% and an average increase of 150% over the tonnage of 1916. To try to build highways in pace with a continuous advance of that kind would bankrupt the public.

Five-Ton Load Should Be Established by Law

The wiser motor-truck manufacturers have themselves adopted the broad policy of selling transportation service, rather than the exclusive one of selling motor trucks. These men, who have had every opportunity to study the economics of the problem, have agreed upon the desirability of the 5-ton load as a standard unit. This should now be established by law, and our highways designed to meet it. It will mean a total maximum load of about 12½ tons, of which approximately nine shall be applied to the rear axle. There should also be general regulations for other destructive factors, such as inadequate tires and springs.

We can build roads economically for the 5-ton load. We cannot afford to have them disrupted by a few excessively large trucks. Nor should we design them extravagantly to meet the requirements of a few individuals. The maximum loading must be restricted to the economic standard suggested by the manufacturers and desired by the big majority of truck users. Then will the highway be able to give to the motor and to the community its most efficient service.

Purchase Meters on Percentage Accuracy Above Ninety Per Cent.

Latest specifications for accuracy of six water-measuring devices, for installation in the Mayfair and 22nd St. pumping stations, Chicago, differ from those under which previous pitometers have been purchased in that the "marking" of the proposals for accuracy will be given "O" for 90% accuracy and a full mark for 100% accuracy. Formerly it was the practice to rate the bidders 90, 93 or 98%, as the case might be, giving the 90% machine an undue advantage when, as a matter of fact, such a machine would not receive consideration at all.

In marking the item of price, the lowest bidder receives the full mark, others in inverse proportion. Workmanship and dependability are judged by a committee of competent engineers, appointed by the commissioners of public works, who may make any tests determined upon by them to aid in reaching their conclusions.

The contract is awarded to the bidder obtaining the highest mark based on the following schedule: Price, 10%; accuracy of pitometer rod, 40%; accuracy of recorder, 25%; workmanship pitometer rod, 5%; workmanship recorder, 5%; dependability of recorder, 15 per cent.

Great Lakes Yards Lead Coast Districts in Building Ocean-Going Ships

Produce Canal-Size Steamers in Large Numbers—Spirit of Coöperation—Yard Capacity Doubled—Side Launching—No Outside Fabrication—Equipment of Varied Character—Labor Shortage

(Passed by the Publication Approval Committee, Emergency Fleet Corporation)

MORE than half the steel ships delivered to the United States Government in July, August, September and October, amounting to more than one-third the total in tonnage, were built in Great Lakes shipyards. The Lakes, District 9 of the Emergency Fleet Corporation, are at present the leading shipbuilding district in the country. They are doing their work with old yard layouts, old equipment and old methods, without help through bridge-shop fabrication or simplification of ship design. They are handicapped by inadequate steel supply, by constant draining away of the labor force on the part of other districts and by the limitation of size which arises from the necessity of locking the ships through the Welland and St. Lawrence Canals—a large vessel can be built more rapidly than a small one, in proportion to tonnage.

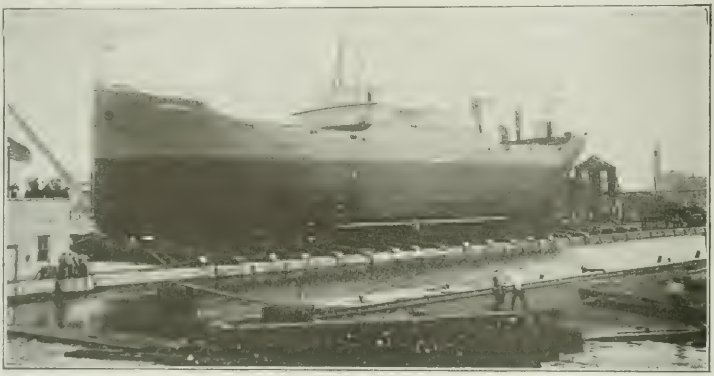


FIG. 1. SOME OF THE GREAT LAKES YARDS LAUNCH INTO DRY DOCKS—BERTH FITTED UP ALONGSIDE NEW SOUTH CHICAGO DRY DOCK

Not only are they building ships in quantity, but they are building them cheaply. Fleet Corporation officials state that very low costs are being made in the Lakes yards, though hours and wages are the same as in other districts. The highest riveting averages in the country are being made in District 9. For some time past the district as a whole has averaged nearly 400 rivets driven per gang per eight-hour day, and some yards are reporting 450 to 500 rivets per gang regularly, week after week.

Distinctive shipbuilding methods and equipment, which were developed during many years of lake steamer building, are used. They have been applied with surprising adaptability to the new class of work now demanded. But efficient management and a remarkable spirit of coöperation are prominent factors in the Great Lakes production.

Coöperation is the newest and most noteworthy force at work in the district. Under the direction of Henry Penton, district manager for the Emergency Fleet Corporation, the yards are working as a single organization. One manager said, "There is no more rivalry among the Lakes yards. We all help one another as much as we can." In place of aggressive commercial competition there is friendly rivalry for best performance. The Great Lakes Shipbuilders' Association, formed as part of the coöperation machinery, furnished means for standardization such as uniting on two designs of ship and a single design of engine, and has brought about exchange of drawings and essential information.

That the Lakes yards are managed efficiently was emphasized strikingly by several noteworthy speed performances in building ships. The Lorain and the Manitowoc yards each built a ship in 24 working days, keel-laying to launching. The Ecorse yard surpassed both of them and established a world's record by launching a ship 14 working days after its keel was laid, and then showed that it had further reserve of speed by completing the vessel in 15 working days more. The record ship, the "Crawl Keys," steamed away on its trip to the sea on the thirty-fourth calender day from the time the first piece of steel was laid on the keel blocks.

Steady pace of production also testifies to the capable management of the yards. Figures from one group of six yards are significant: In the hottest week of the past summer these yards drove 600,000 rivets, as against their maximum week's output in good weather of 718,000; only 16% drop-off was caused by the heat, though temperatures exceeding 100° prevailed for several days.

A prominent case of remarkable regularity of production is furnished by the Wyandotte yard, a yard building only hulls, which are equipped at Detroit. A graphical record of keel-layings, launchings and completions for this yard since the beginning of the war-time shipbuilding two years ago is shown in the diagram, Fig. 2. The curves prove a steadiness in production rate comparable to that of a smoothly working factory. Yet during the time covered by the curves the yard was almost wholly rebuilt and was enlarged to two and one-half times its former size. Throughout the whole period, moreover, the yard's efficiency was improving; the time required from keel-laying to launching was reduced in two years from 120 days to 75, and the total time from keel-laying to completion reduced from 190 days to 95. Further-

more, shipbuilding was not interrupted or delayed by winter conditions. In the winter of 1916-1917 the curve of completions flattened off, though the launching curve showed little disturbance; but in the following winter both curves maintained their slope most remarkably, in spite of exceptionally severe weather.

Four of the lakes share in the emergency shipbuilding, with yards scattered from Buffalo to Duluth. As listed in the accompanying table, their total equipment now comprises 81 building berths for the 261-ft. steamers of the Emergency Fleet Corporation. Expansion has been in progress from the start. Previously, all the yards were laid out for building large lake steamers; one berth of the old type could be utilized for two berths of the size now required, but even so, the number of berths was far from adequate. Some of the new berths are still uncompleted, but they will be ready for work well before winter. Three new yards were put in service, Saginaw, Globe and McDougall. Even deducting these, however, the district has nearly doubled its capacity, and practically all of this increase is the work of the past year, done while shipbuilding was kept up at full speed.

At the beginning of November outstanding contracts for ships totaled 285 vessels. All these are expected to be completed before the close of navigation in 1919.

FIG. 3. SHIPBUILDING AND YARD GROWTH—IN FOREGROUND NEW PIER FOR FOUR ADDITIONAL BERTHS AT DULUTH YARD UNDER CONSTRUCTION

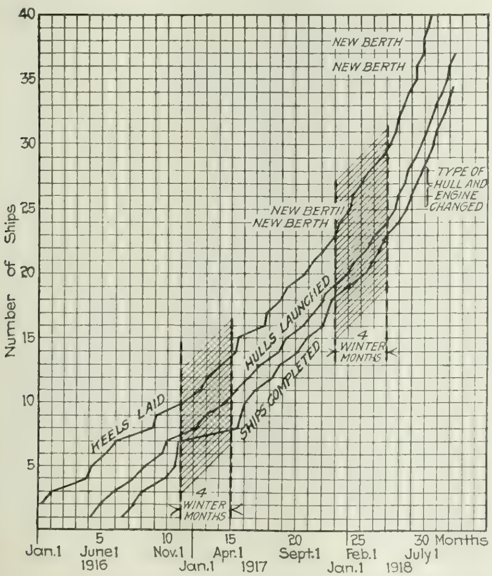


FIG. 2. REGULAR SHIP PRODUCTION AT WYANDOTTE

Tugs are being built at a number of small yards. These do not affect the main cargo-carrier work, but they increase the activity of the district and add to its problems of material and labor supply. Practically all of these are new enterprises. They have orders for 51 sea-going tugs 150 ft. long (38 steel and 13 wood), and 41 harbor tugs 100 ft. long (2 steel and 39 wood). In addition to these yards there is one at Buffalo, also a new enterprise, where barges are being built for the Railroad Administration, besides three concrete barge yards.

Except the last-named, all the work is for the Emergency Fleet Corporation, which has absorbed the entire shipbuilding capacity of the Lakes. The whole capacity is being applied to constructing ocean-going vessels. No additions are being made to the Great Lakes carrier fleet. On the contrary, its ships are being taken one by one, rebuilt and cut in two for passage through the canal, and sent to sea. Most of the shipyard dry docks are busy with this work.

Twenty-five or thirty large vessels were taken from the Great Lakes in this way during the past two years, and anxiety has been expressed by men familiar with conditions as to the depletion of the vitally important grain and ore fleet. But this depletion only makes greater the contribution of the Lakes to the solution of the ocean shipping problem.

The yards were planned for building large-capacity lake ships and for repair and docking. Building small ships at maximum speed proved to be a new task, which soon threw the various departments of the yard out of balance. Even the best-proportioned yards had to rearrange their facilities and enlarge first one department and then another.

For example, the Toledo Shipbuilding Co. found its punch shop unable to keep up with the rush work on its six berths, early in the emergency shipbuilding. It had been considered an unusually well-balanced yard. The punch shop, designed for an output of 30 tons per day, was adequate for normal times, but now its production had to be increased. Night and day shifts were

operated, and by concentration of work the output was raised from 24 lb. of steel per man-hour to 36. The shop then turned out 65 tons per day, making the yard production a little better than one ship per month. This is still far below the building capacity of the six berths, however, and enlargement of the punch shop by 35 to 40% is now being carried out; it is made possible by building a new machine shop in a distant corner of the yard, which will release the old shop, close by the punch shop, and permit its addition to the latter.

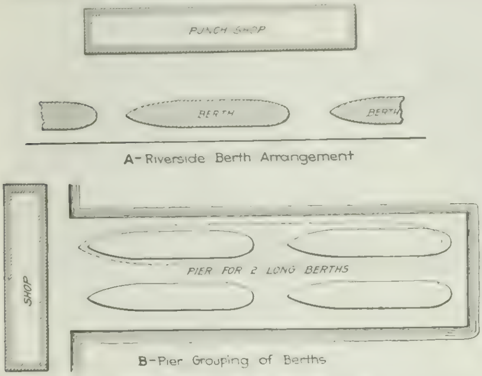


FIG. 4 TWO TYPES OF YARD ON THE LAKES

Inadequate provision for material storage, both raw and fabricated, shortage in compressor capacity and in crane service, and lack of pre-assembly facilities were among the items of deficiency that developed in nearly every yard, and, so far as the hull-building part of the yard is concerned, the rearrangement processes have been directed largely toward improvement in these services.

Characteristics of Great Lakes Shipbuilding

Two prominent features distinguish the Great Lakes work. First, side launching is used exclusively, and because of this fact the Lakes occupy a unique position among the world's shipyards. The yard layout and the shipbuilding equipment, being determined by the side-launching method, differ sharply from those found in seacoast yards. Second, the shipbuilding is being carried on by normal, everyday methods, though at high pressure for speed and quantity. No bridge-shop fabrication has been attempted by the Lakes yards.

This latter fact is specially interesting, because in nearly every yard conditions are similar to those previously sketched for Toledo: The hull production has been limited by the punch-shop capacity. At times scarcity of labor on the building berths made the hull erection lag behind the shop temporarily, but the record speed performances amply proved that with free supply of labor the erection work can be carried on at much faster rate than the punch-shops can meet.

Sharp contrast between the work of the Lakes yards and that of the big fabricated-ship yards of the Atlantic coast appears not only in the former's depending exclusively on yard-shop work, but also in their sticking to normal ship design. No simplification of outline or details has been attempted. The ship profile has pronounced sheer, the decks are heavily cambered, the sides have a distinct tumble-home, the bottom is shaped with 6-in. dead-rise from the keel, the tank top slopes down to the bilge, and its margins are turned down normal to the bilge strake. Because of the blunt proportions of the ship the parallel length is small. In fact, practically the whole of the ship is molded, which means that all elements of difficulty in shipbuilding are present.

Ships 261 ft. long and 43½ ft. wide in midship section are being built at all of the yards. These dimensions are the maximum for passage through the locks of the Welland Canal. When war-time shipbuilding began on the Lakes, through rush orders from Norwegian ship owners and the Cunard Line, in 1915, the main demand was for 3000-ton single-deck vessels 20 ft. 3 in. deep. A later design, calling for the molded depth of 24 ft. 2½ in., with an intermediate line of strongbeams (instead of a deck) in the hold to brace the frames, brought the carrying capacity up to 3500 dead-weight tons. Subsequently the Emergency Fleet orders called for vessels 28 ft. 2 in. deep, of 4200 tons capacity. Most of the yards are working to the same design drawings; in fact, only two designs of the 28-ft. ship are being built on the Lakes, as the result of the coöperation of the yards. All the ships are of the ordinary transverse-frame system of construction; their frame spacing is 24 inches.

Side launching can be done in water not much wider than the ship's breadth, so that the method is excellently suited to the narrow rivers flowing into the Lakes. But it is used also by yards located on wide rivers (Wyandotte and Ecorse on the Detroit, Toledo on the Maumee, McDougall on the St. Louis). Berth arrangements are of two types, the riverside (A, Fig. 4) and the slip-and-pier type (B, Fig. 4), the latter being most common. The greater berth capacity for a given river frontage of the slip-and-pier type is counterbalanced under the special conditions of the past year by the disadvantage of less easy expansion, on account of the dredging and pier construction required. In the expansion of the Wyandotte yard three riverside berths have been added to the seven slip berths.

GREAT LAKES SHIPYARDS BUILDING OCEAN-GOING SHIPS FOR EMERGENCY FLEET CORPORATION

Location	Owner	Number of Building Berths for 261-Ft. Vessels: Two years ago	Now
Buffalo, N. Y.	American Shipbuilding Co.	1	6
Ashtabula, O.	Great Lakes Engineering Works	2	4
Cleveland, O.	American Shipbuilding Co.	2	3
Lorain, O.	American Shipbuilding Co.	8	8
Toledo, O.	Toledo Shipbuilding Co.	6	6
Detroit and Wyandotte, Mich.	American Shipbuilding Co.	4	10
Ecorse, Mich.	Great Lakes Engineering Works	6	8
Saginaw, Mich.	Saginaw Shipbuilding Co.	—	6
South Chicago, Ill.	American Shipbuilding Co.	2	5
Manitowoc, Wis.	Manitowoc Shipbuilding Co.	2	6
Duluth, Minn.	McDougall-Duluth Co.	—	9
Superior, Wis.	American Shipbuilding Co.	2	5
	Globe Shipbuilding Co.	—	5
	Total	35	81

YARDS BUILDING TUGS

Cleveland, O., Lake & Ocean Shipbuilding Co.
Port Huron, Mich., Foundation Co.
Marine City, Mich., S. C. McLouth.
Benton Harbor, Mich., Daehl-Carter Co.
Sturgeon Bay, Wis., Leatham & Smith Co.
Universal Shipbuilding Co.
Green Bay, Wis., Northwest Engineering Works.
Superior, Wis., Whitney Bros. Co.

(To be continued)

Road Maintenance Methods and Devices Effect Saving of Material, Labor and Fuel

Bureau of Maintenance and Repair, New York State Highway Department, Working Through Nine Division Engineers, Endeavors to Keep the War-Traffic Roads Open and Still Conserve Material

CONSERVATION of state resources in both labor and material has been the aim during the past season of the administration of the bureau of maintenance and repair, New York State Highway Department, and is on the program for next year's work. To aid in this aim, many innovations in labor-saving machinery, new methods of design and new kinds of material have been utilized. The bureau, working through the nine division engineers, has striven to keep its roads in condition to carry the heavy traffic, and at the same time to use as little material and labor as possible, thus conserving these national resources for war purposes.

The roads of the state are divided into four classes: State highways, county highways, county roads and town roads. The first are built entirely at state expense, the second at state, county and town expense, the third entirely at county expense, while the last are built by the towns, with state aid. There are at present approximately 7000 miles of state and county highways which have been improved and accepted by the state for maintenance purposes. Of these some 5800 miles have low-grade concrete and macadam-and-gravel surfaces, while most of the remainder have brick, concrete and bituminous surfaces of the higher classes. There is also a scattering of various stone-block, asphalt-block and other pavements.

All state highway activities are carried on under the supervision of three deputy commissioners, who are appointed by and are under the orders of the commissioner of highways. The first deputy has charge of the design and construction of all state and county highways, the second has charge of the maintenance and repair of these highways, and the third supervises the repair, improvement and maintenance of town highways and bridges upon which state money is expended. The organizations of the first and second departments converge in the division engineers, through whom they work, and who have direct control of all construction, maintenance and repair in their divisions on the state and county highways. The third deputy commissioner works directly through nine district supervisors who report to him. The work of his department consists of supervising and auditing expenditures on town highway work.

While the practice varies in the different divisions, it is customary for each division engineer to have an engineer of maintenance, who is directly in charge of the accepted state and county highways. He has charge of all patrolmen and gang foremen, and these report to him and receive instructions from him. The further organization taking care of the county and town roads consists of the county or district superintendents, who are appointed by either the board of supervisors or the highway commissioner, and the town superintendents who are elected by the towns in which they reside.

State and county highways are maintained at state expense, with the exception that each town must pay $50 into the state treasury for each mile of state and county highway within its borders, and each incorporated village must pay 1½c. per square yard for those highways within its corporate limits.

Both patrol and gang systems are used for maintenance. The second deputy commissioner reports that "the patrol system of constant maintenance is more efficient and more economical than the intermittent gang system for the maintenance of water-bound macadam pavements and gravel surfaces, particularly

FIG. 1. DESTROYED BY HEAVY TRAFFIC AS THE FROST WENT OUT IN EARLY SPRING

where surface treatment is restricted." When the work to be done is greater in amount than the individual patrolman can do, he is furnished with one or more helpers. The efficiency of the patrol system is reported to have been greatly increased by the introduction of a cost system for all labor items connected with the work. As a part of this record, the patrolman is required to enter the work done each day in a book, and at the end of the month he must summarize it and distribute his wages among the jobs done. This acts as a constant spur to the patrolman to have as much work as possible to report, so that the unit labor cost may be as small as possible. Gangs are used where extraordinary repairs are required, such as broken spots in hard-surface pavements, surface treatment, etc. In fact, where repairs are only in spots widely separated, or where they are so extensive as to require special machinery and a greater number of men, the patrol system is not considered

economical. The bureau believes that pavements which deteriorate quickly in spots, so that immediate repairs are required to save them, should be handled by patrol methods, while the gang system works better on more permanent pavements, such as brick and first-class concrete, where occasional holes develop slowly.

Not only do minor repairs and surface treatments come under the Bureau of Maintenance, but also resurfacing of accepted state and county highways and often complete reconstruction. During last winter many roads were practically destroyed in stretches, as shown in Fig. 1, by the heavy motor-truck traffic, and it was necessary for the department practically to reconstruct the roads. Some of this reconstruction was described in *Engineering News-Record* of Oct. 31, p. 808, and, as explained there, it exemplifies the saving being effected in material by rebuilding only those portions which have broken down, thus using the least amount of material which will keep the road in condition to carry heavy traffic. By following this method, fully 50% of the material which would have been required to reconstruct the road entirely was conserved at this time of shortage. While this partial reconstruction is no doubt more expensive per mile covered than continuous reconstruction, still the second deputy commissioner feels that it is necessary to coöperate with the Government in conserving labor, essential materials and transportation, and he has suggested to the division engineers the advisability of continuing the procedure on roads which are broken through during the coming winter. It is further planned to coöperate with the Federal Government by preserving the surfaces of all roads, as far as possible, by patching and by light treatments with bituminous material.

By far the greater part of the bureau's maintenance work consists of constant patching of the incipient holes by the patrolmen. Thin repairs on bituminous surfaces are made by painting them with light asphaltic oils or refined tar products and covering with stone chips or sand. Heavy binders requiring heating have been used in the same manner. It is stated that where the thickness of a patch is ½ in. or more, the most satisfactory results have been obtained by the use of "cold-patch" materials. These are of two kinds, those which consist of emulsions of asphalt with soap and water, and which are thin enough to mix with materials when cold, and those which are kept in fluid condition by a cutback of volatile oils. Both preparations are convenient for the patrolman, as they obviate the necessity of transporting a heating kettle.

When a defective section of the surface has been cut out and cleaned, the patrolman takes the required amount of crushed stone and mixes it with the "cold-patch" material in about the proportion of one gallon of the material to 1 cu.ft. of stone. When this is tamped in place, the emulsion breaks down or the volatile oil evaporates, the patch becoming as solid as the remainder of the surface. The best results with asphalt cut-back have been obtained by using asphalt with a penetration of about 165, fluxed with 33% in weight of naphtha. When refined tar products are used, the best results have been obtained with a binder having a melting point of 70° C., fluxed with 40% in weight of tar oils of which at least 60% will distill up to 235° C. Emulsified "cold-patch" sets more quickly than the cutback preparations, but it is hard to use in cold weather, as freezing breaks down the emulsion.

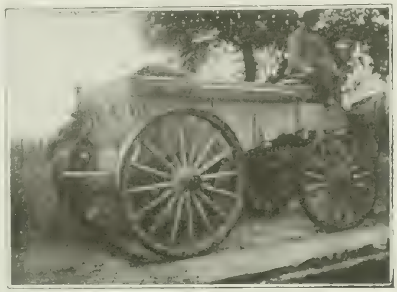


FIG. 2. STONE SPREADER GIVING LIGHT SURFACE TREATMENT—SIDE VIEW SHOWS LOCATION OF FEED AT THE END OF SLOPING BOTTOM OF WAGON

Next to the patrol work, light surface treatments are most extensively used, consisting of an application of cold bituminous material and a covering of stone chips. The bituminous material is generally spread with a motorized power distributor. It is the policy of the department to give as few surface treatments as possible, since they tend, if used too often, to pile up and become soft. It is thought better to allow them to wear down as thin as possible, although considerable patching is required during the later periods of wear.

A labor-saving device for spreading stone chips is shown in Fig. 2. It was made by reconstructing an old horse-drawn oil distributor in the blacksmith shops of the department. Fig. 3 shows a cross-section detail of the feed. These wagons follow the oil distributor closely, spreading a thin covering of stone chips over the surface of the tar. The feed may be regulated by means of the door, so as to spread anywhere from 10 to 35 lb. of stone per square yard of surface. The feed is operated by an 18-in. sprocket. The chain from this sprocket passes to a 4-

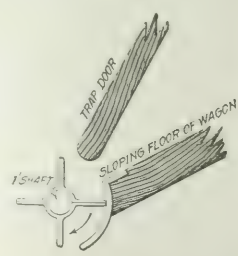


FIG. 3. FEED CAN BE REGULATED TO SPREAD FROM 10 TO 35 POUNDS OF STONE PER SQUARE YARD

in. sprocket on a cross shaft which is in turn geared to the feed. Sloping bottoms are placed in the wagons, so that with dry material there is no trouble in emptying. A gang of 10 men will oil and cover from two to three miles of 16-ft. road per day, giving an application of 2000 gal. to the mile and 15 to 20 lb. of stone to the square yard. By the old method of distributing the covering stone in small piles along the road and speading by hand, a gang of 30 men would be required to do the same amount of work. Thus a great labor saving is effected. In the division where the stone spreaders shown in the views are working, the contract prices for light-oil treatments have been cut 50% by the use of this device.

FIG. 4. OUTFIT PREPARES COVERING STONE FOR SURFACE TREATMENT

In many sections of the state transportation facilities are very poor, and an effort is being made to conserve them as much as possible by the preparation of materials along the highways. Fig. 4 shows an outfit preparing covering stone for surface treatment. Local stone is being used. This is crushed in a jaw crusher and then run through rollers which break it into the small sizes required for patching and covering. From the roller it passes by the elevator into a rotary screen which removes the dust and spalls. The power is supplied from the flywheel of a small tractor, which is also used to transport the apparatus to a new location when work on any section is completed. This outfit will produce 30 cu.yd. of covering stone in 10 hours.

Where the hand method of spreading screenings is used, the motor-truck equipment shown in Fig. 5 has been found very convenient. The chute can be attached to either side of the truck, and the amount of covering stone placed in each pile can be regulated by the sliding door and the lever. At railway sidings special unloading equipment is being used to fill the trucks, thus effecting a further labor saving.

Intermediate between patching and surface treatments and complete reconstruction come various forms of resurfacing. Resurfacing is done when it is no longer feasible to patch the old surface. During the season of 1917-18 very successful results have been obtained by resurfacing with "cold-patch" material. As the name would imply, this was not the use originally contemplated for this material; however, not only does it give a satisfactory surface, but it also effects a considerable saving in fuel which would have to be used if hot bituminous materials were employed.

Detailed costs of a job resurfaced by this method in 1917 are given in the accompanying table. In the laying, the crushed stone and "cold-patch" mixture, which in this case was of the emulsified type, were mixed together in a batch concrete mixer and spread to the required thickness upon the road. This was allowed to set for a short time, and was then rolled into shape with a heavy roller. The engineer in charge of the work says the costs were higher than they otherwise would have been, on account of rainy weather, which required the drying and cleaning of the stone before it could be used. Local crushed limestone was used, the thickness of surfacing being 2 in. in places. The road received a seal coat of Tarvia A, early in the season of 1918, and it is stated that it has a fine surface, with the appearance of a Topeka mix. The highway is a heavy-traffic line between Rochester and Buffalo; it is 16 ft. wide and 3900 ft. long, or 6933 sq.yd. Originally, the road was

COST OF RESURFACING OLD MACADAM WITH "COLD-PATCH" MATERIAL

Itemized Cost		
Materials:		
224 tons No. 2 stone purchased at $1.65 per ton	$369.60	
60 tons No. 2 stone from maintenance piles at $1.65 per ton	99.00	
331 tons No. 1 stone purchased at $1.90 per ton	628 90	
10,700 gal. bit. mat. C. P. A. E. at 0.1392 per gal.	1,489.44	
	$2,586 94	
Labor and equipment:		
Labor and teams	1,316.35	
Foreman	112.00	
Steam roller, 27½ days at $12 per day	330 00	
Water tank, rent	24.00	
5-ton motor truck	120.00	
1½-ton motor truck	168.00	
	$2,070.35	
Supplies:		
8.895 tons coal for steam roller	69.00	
4 gal. oil	2.00	
110 gal. gasoline for concrete mixer	29.70	
8 batteries for engine on mixer	2 80	
Oil, grease, waste wood for roller, etc.	9 04	
Repairs to engine on concrete mixer	5 00	
	$117 54	
Total cost of work		$4,774.83
Distribution of Cost		
Materials—total cost for work	$2,586.94	
Unloading and hauling bituminous material, 4-mile haul	157.50	
Hauling plant	20 00	
Loading and hauling stone from maintenance piles	60.00	
Repairing holes, material not included	125.30	
Manipulation of pavement, including screening the stone	1,770.09	
Making and scraping shoulders, cleaning up	55.00	
Total		$4,774.83
Unit Costs on 6,933 Square Yards		
Total cost, including shoulder work	$4,774.83–$0.688	per sq.yd.
Total cost, excluding shoulder work and including repairs to holes	$4,719.83–$0.68	per sq.yd.
Total cost, excluding shoulder work, labor and material in repairing holes	$4,524.68–$0.65	per sq.yd.
Cost of manipulation on pavement	$0.255	per sq.yd.

FIG. 5. COVERING STONE DISTRIBUTOR WITH CHUTE IN PLACE. OTHER OPENING BEHIND OPERATOR

of water-bound macadam, built in 1902, and it had been resurfaced with Rocmoc in 1910. At the time of resurfacing in 1917, it was worn in holes from 1 to 4 in. deep and was very rough. The holes were first repaired, and then the surface was laid and the shoulders were reshaped and cleaned.

Besides the equipment mentioned above the department has many other kinds of highway-building machinery, such as steam rollers, motor trucks and unloading apparatus, and is experimenting with tractors for hauling road scrapers in shaping shoulders and cleaning ditches. The tractors are reported to be working very satisfactorily, and are said to be able to go anywhere that a team can go, but as yet they have not been used long enough to provide reliable cost data as to their efficiency.

All work in the Bureau of Maintenance and Repair is under the supervision of F. W. Sarr, second deputy commissioner of highways, who holds this appointment under Edwin Duffey, state commissioner of highways.

Hard-Road Maintenance Costs in Illinois

Illinois has 270 miles of state concrete roads, and while these roads are scattered in short sections all over the state the maintenance cost in 1917 averaged \$30.25 per mile for the slab and \$51.20 for the shoulders. For 59 miles of brick roads maintenance of the surface cost \$5.36 and of the shoulders \$51.20. These figures were given out by Clifford Older, chief highway engineer of the State Highway Commission, and were used in the mass of propaganda put out during the recent Illinois campaign for the \$60,000,000 bond issue. This bond issue, which was voted upon favorably on Nov. 5, provides for the construction of 4800 miles of hard-surface roads.

Light-Traffic Railway vs. Highway and Motor Truck

Analyses of Operating Expenses, Fixed Charges and Amount and Kind of Traffic Should Be Made for Each Case

By Clement C. Williams
Professor of Railway Engineering, University of Kansas, Lawrence

MANY of the small railroads have been left out of the Federal Government's unified system of railways. This action of the Government calls attention again to the economic principles that underlie the operation of light-traffic railways, and, although the problems related to the war are of primary importance at the present time, yet matters pertaining to the existing as well as to the permanent economic and industrial organization must not be entirely overlooked. Even though the railroads after the war are returned to private ownership and private operation, they will doubtless be retained on a coöperative, unified basis rather than be restored to the quasi-competitive status that they occupied previous to their being leased by the Government. Careful consideration should be given, therefore, to the problem of devising for the nation the most economic, unified and comprehensive transportation system possible, including the waterways, railways (steam and electric) and the highways. The present discussion deals only with a certain phase of the last-named two modes of transportation; viz., the economic status of light-traffic railways and their relative advantages as compared with highways.

The advent and rapid development of motor trucks have rendered obsolete the data and conclusions which have governed the relationship between railways and highways predicated on transportation by horse-drawn vehicles on the latter. Studies should be made, therefore, into the economics of operation of motor vehicles in order that we may arrive at correct conclusions, for the conditions and results of their operation are not so well known as those pertaining to railways. The general adoption of standard types of trucks and trailers would greatly aid, in this connection.

Junking the Colorado Midland

The question as to the relative economy of a railway or a highway as an instrumentality of transportation is at once raised in the proposal to junk the Colorado Midland R.R., in accordance with a recent court order, and to build a highway on the existing roadbed. Obviously, the one will be more economical than the other if it will transport the total traffic to be carried at a less total cost than the other. Axiomatically, the total cost of transporting traffic consists of two elements; viz., fixed charges—that is, interest on the capital invested in roadway and equipment—and the operating costs. A railway will be the more economical, therefore, when $F_r + O_r < F_h + O_h$, where F_r is the yearly fixed charge and O_r the yearly operating cost on the railroad for carrying the entire traffic to be transported, and F_h and O_h are the corresponding quantities for the highway.

A railway is a highly specialized type of highway requiring special equipment, terminal facilities and so forth, and the fixed charges are relatively high, with a

corresponding reduction of operating expenses over the ordinary highway. If the total amount of traffic to be transported is not sufficient in amount to make the reduction in operating expense compensate for the increased fixed charge due to special roadway, equipment and terminal facilities, then the highway with its lower fixed charge will be the cheaper mode of transporting the relatively small amount of freight. Light-traffic railways generally serve chiefly as feeders, carrying traffic to connecting lines, and in this respect as well as in their local service they are comparable in function with highways similarly located.

Comparative Figures

From the 1915 report of the Interstate Commerce Commission the following statistics are obtained. From them crude estimates can be made which will illustrate the comparative economy of a light-traffic railway and a highway. Corresponding figures are also given for the Atchison, Topeka & Santa Fé Ry., with which the Colorado Midland connects, in order to indicate the distinction between a line carrying normal traffic and a light-traffic road. These latter do not require comment.

COMPARATIVE FIGURES FOR LIGHT-TRAFFIC AND TRUNK-LINE RAILWAY

	Colorado Midland	Santa Fe
Total stock and funded debt	$18,884,208	$707,400,991
Total traffic, ton-miles	88,970,000	6,347,563,000
Average tonnage per train	206.5	360.1
Average operating expense per train-mile	$1.91	$1.65
Average operating expense per ton-mile	$0.0093	$0.0046
Same, exclusive of maintenance of way and structures	$0.0074	$0.0031
Same, for maintenance of way and structures	$0.0019	$0.0015
Length of line owned, miles	261.1	7,155.5
Average length of haul, miles	134	288

Assume an investment in the highway of $10,000 per mile, or a total for the 261 miles of $2,610,000. If each truck to be used had a capacity of 200 ton-miles per day for 300 days per year, approximately 1500 trucks would be required. At $3500 each, the investment in trucks would be $5,250,000, making a total investment for the highway of $7,860,000. From various records, the average cost of hauling on motor trucks without trailers may be taken at 7c. per ton-mile for operating expenses, exclusive of maintenance of the highway. If trailers are used, the cost might be reduced to perhaps 4c. per ton-mile, and the investment in rolling stock to perhaps $2,200,000. The maintenance of a highway chargeable to trucks may be assumed as $200 per mile per year. On this basis, the cost of hauling the 88,970,000 ton-miles of traffic on the Midland and on the highway would be as follows:

	Colorado Midland	Highway: Without Trailers	Highway: With Trailers
Operating expense, exclusive of maintenance of way	$658,400	$6,827,900	$3,538,800
Maintenance of way and structures	170,000	52,200	52,200
Fixed charge (at 6%)	1,133,050	471,600	288,000
	$1,961,450	$7,351,700	$3,979,600

Had the traffic been only 2,000,000 ton-miles, under the above conditions the investment in trucks would have been about $115,500 and the cost of transportation over the highway would have been $1,400,000 + $163,500 + $52,200 = $1,615,700, which would have been cheaper than the cost by rail. However, if the traffic were appreciably less, the unit cost of operation on the railroad would be greater, so that the traffic would not have to be reduced as low as this figure before the highway would be the more economical. In the case of the Colorado Midland, diversion of a legitimate amount of the traffic to the Denver & Rio Grande R.R., and hauling by the most direct routes, might possibly reduce the traffic and average length of haul to such an extent that the highway would be the more economical means of transportation for the traffic handled at present. As the figures stand, however, the railroad appears to be the more economical, and the question of junking it resolves itself into the general economic situation—whether the transportation of this traffic by any means at the necessary cost is justified.

Other Data to Be Considered

Conclusions of this sort, in order to be reliable, must necessarily take into account specific data and the characteristics of the traffic and of the railroad. The average length of haul and the question whether the traffic is local or through to a connecting line affect the solution of the problem, as well as does the total ton-mileage. Short-haul local traffic may be more economically and more expeditiously transported by truck because of the expense and delay of additional handling in loading and unloading on the railroad, while, on the other hand freight that is to be carried farther on a connecting railroad must be loaded into cars ultimately and therefore can be conveniently placed in the cars at the beginning of the route. In general, truck hauling is feasible and economical only for the short hauls, and trucks should be operated to supplement the railways rather than to compete with them; also, the circumstances under which either mode of transportation may be the more economical can be determined with fair definiteness.

Of course, the entire question of junking the Colorado Midland, which has been operated at a loss since 1908, is not so simple and elementary as above outlined, involving, as the matter does, tourist passenger service and other factors, but it is believed that the above discussion suggests a rational method of determining the economic border line between the province of the railroad and that of the highway, where specific data are available instead of gross general averages.

Profitable War Gardens Made Possible By Water Company's Gift

From 37,000 war gardens in Denver, Colo., for which the Denver Union Water Co. furnished free water, the estimated yield is valued at $2,600,000. It is asserted that this direct war service derives its greatest value from the fact that the necessity for hauling in foodstuffs is reduced by the gardens. In 1917 the yield from 31,000 gardens was estimated at $2,000,000 by Prof. P. L. Clarke, in charge of the water company's garden department, after inspection of a large number of gardens. The 1918 estimate was made by telephoning to several hundred persons and inquiring as to the increase in yield over the previous year. From this information, plus the increase in number, the company estimated a total increase in value of 30%. The National War Garden Commission in Washington estimated the average yield of gardens all over the country as $100 per garden, which would make the value of the 37,000 gardens in Denver $1,100,000 more than the company estimated.

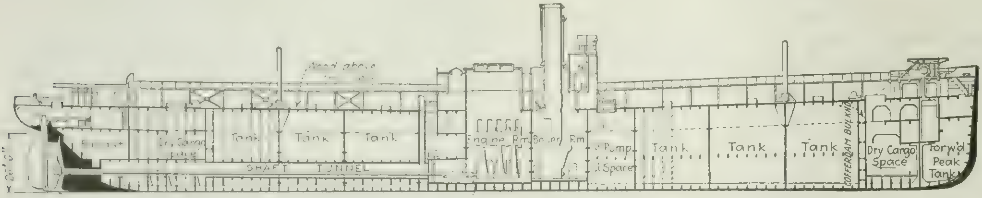
Different Types of Framing in Two New Government Reinforced-Concrete Ships

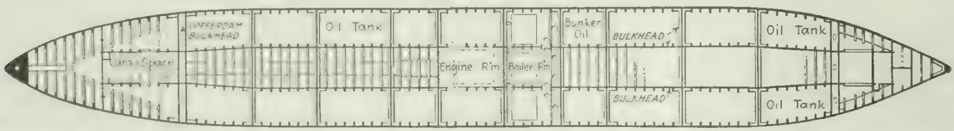
7500-Ton Oil Tanker Has Close-Spaced Frames With Vertical and Horizontal Reinforcing in Shell, While 2500-Ton Schooner Barge Has Long-Span Framing System With Diagonal Shell Reinforcement

TWO distinct systems of concrete-ship framing are represented in the latest types of design issued by the concrete ship department of the Emergency Fleet Corporation. In one of these, a 7500-ton oil tanker, the main transverse frames are closely spaced, following long-established practice in wood- and steel-ship design. In the other, a 2500-ton schooner barge which is to be used for carrying coal in the New England trade, the frames are spaced about 22½ ft. apart, and the hull is additionally stiffened by a thickening of the side shell, forming what is in effect a longitudinal stringer there. In the large boat no diagonal reinforcing is in the shell, except occasional spacer bars. In the schooner, however, heavy diagonal reinforcing is provided in the shell, in addition to vertical shear steel.

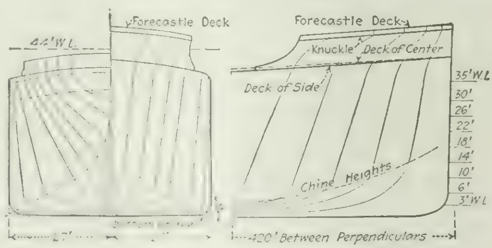
The 7500-ton oil tanker and its companion ship, the 7500-ton freight carrier, both of which have been designed by the concrete ship department, are the largest concrete ships ever attempted. Both ships are to be built in the five Government yards now under construction, but the tanker will be the first to be laid down. It is expected that the first hull will be launched in February, 1919. General details of the tanker design are given in accompanying drawings. The main dimensions are as follows: Length between perpendiculars, 420 ft.; length over all, 434 ft. 3 in.; molded depth at side, 36 ft.; beam, 54 ft.; designed loaded draft, 26 ft. The vessel will be driven by 2800-hp. reciprocating engines connected to a single screw. The boilers are oil-burning. Contrary to the usual practice with steel-tanker design, the engines and boilers are amidships. This more desirable location was selected because the oil-tightness of the shaft tunnel could be insured in a concrete structure, although in the steel tankers such tightness is not so certain.

Simplified ship lines are used in the design of the hull. As shown in the drawing of the lines, about 50% of the mid-length of the boat is practically rectangular in section, the only divergence from rectangularity being the 6-in. dead rise, the 10-in. deck camber, and the circular bilge curves. At the bow and stern the chine is a simplified form and the bilge curves have the same radius, so that the vertical rods in the frames, which are 6 x 24-in. girders spaced 4 ft. x 3 in. on centers, can be bent around the same curve, thus simplifying the steel fabrication exceedingly over the fabrication for a ship of faired lines, because of the possibility of using the same templet curve on the bending table for all frame steel.



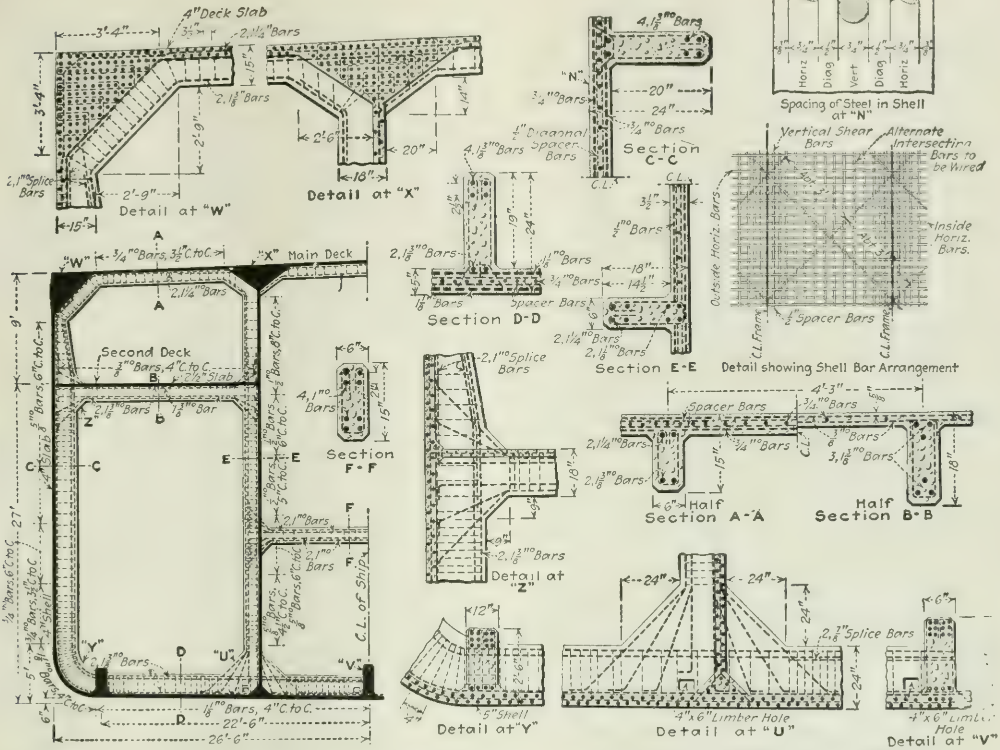


CONCRETE OIL TANKER OF 7500 TONS DEAD-WEIGHT CARRYING CAPACITY BEING BUILT BY UNITED STATES
Four hundred and twenty feet long between perpendiculars; 434 feet 3 inches long over all; 36 feet deep; 54-foot beam



LINES OF THE 7500-TON CONCRETE TANKER

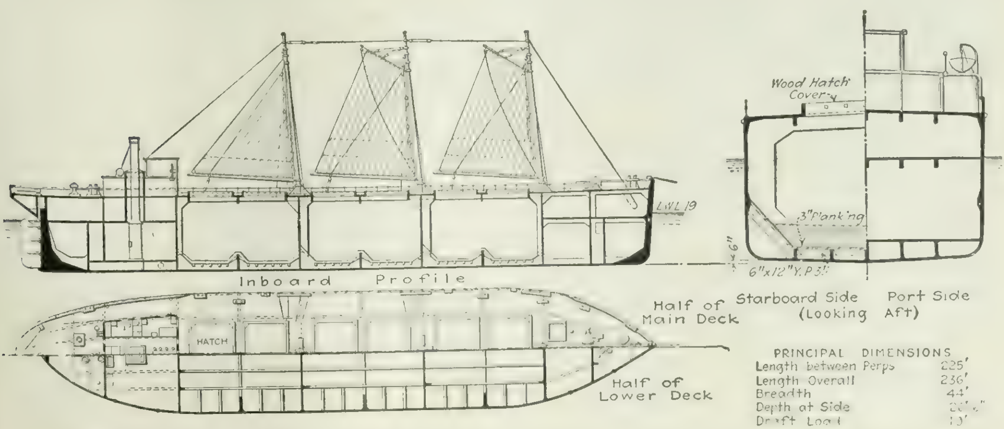
The hull is divided into a number of oil-tight tanks by two longitudinal and numerous transverse bulkheads. The longitudinal bulkheads consist of 3½-in. continuous reinforced-concrete plates backing against vertically placed reinforced-concrete beams which are braced at the lower third of the center tank by cross struts and in the upper third of the outside tank by a reinforced-concrete slab-and-girder floor. The latter



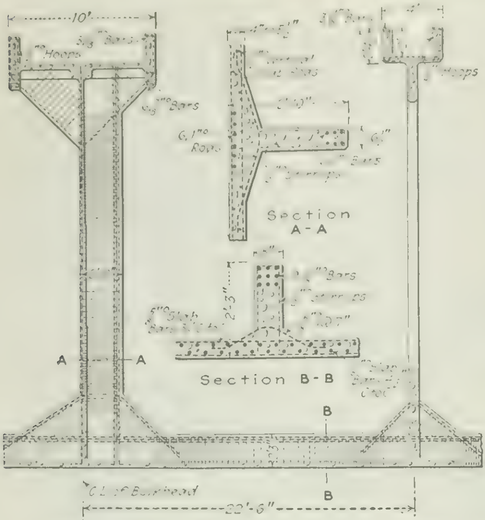
STRUCTURAL DETAILS OF THE GOVERNMENT 7500-TON REINFORCED-CONCRETE OIL TANKER

separates the lower tank from an upper or summer tank, to be used in warm weather when the oil is light. There are a center and two side keelsons, which are heavy reinforced-concrete girders. The main deck is a 4-in. slab on 6 x 15-in. stringers in line and continuous with the side frames.

The transverse bulkheads are of slab and horizontal beam construction. Near the stern and bow, at the extreme ends of the oil tanks, the bulkheads are of the cofferdam type common to oil tankers. This bulkhead is two vertical transverse walls crossbraced with beams in horizontal planes and with the two longitudinal bulkheads. The two bulkhead walls are in the line with adjoining frames of the ship.



CONCRETE SCHOONER BARGE OF 2500-TON CAPACITY, DESIGNED BY EMERGENCY FLEET CORPORATION, HAS WIDELY SPACED FRAMES



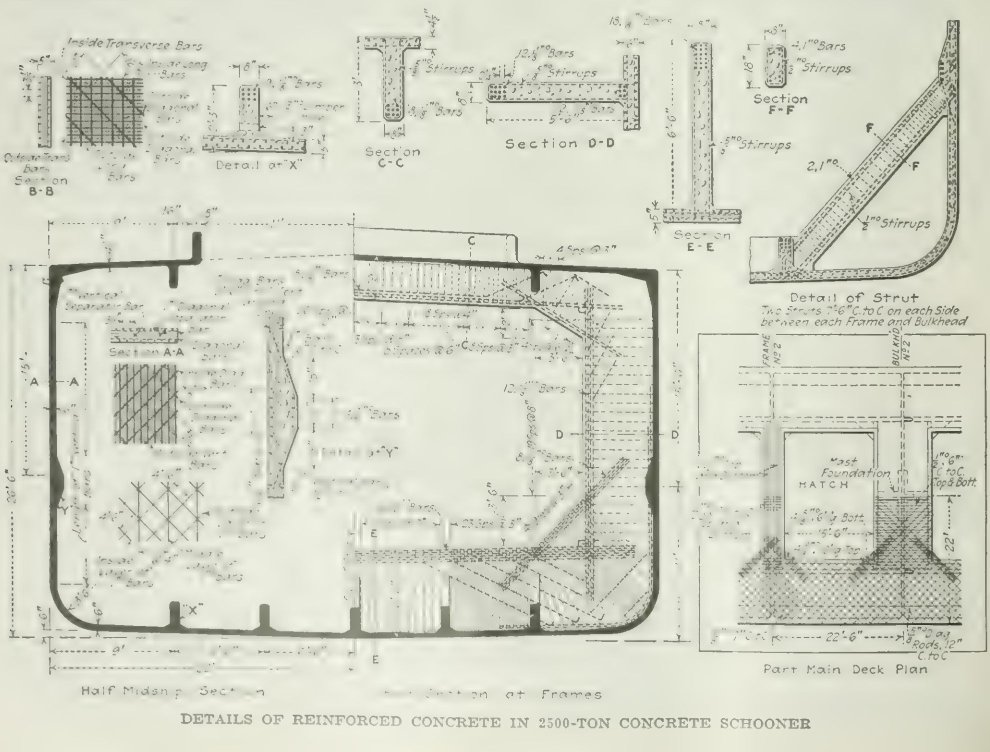
LONGITUDINAL SECTION OF 2500-TON CONCRETE SCHOONER, SHOWING DETAILS OF MAIN AND INTERMEDIATE FRAMES

In common with the 3500-ton ship of the concrete ship department, the stern frame of the 7500-ton tanker is an iron casting tied into the concrete of the stern frame with cross-bolts seated against an outside steel shell which makes the concrete form there.

The reinforcement for the 7500-ton tanker is detailed in all its elements in the main office of the Emergency Fleet Corporation. Exact following of these details as to sizes is not required of the individual yards, but all changes as to sizes and arrangement of details must be approved by the house office and must furthermore give an equal amount of metal as the official design and have equal stability of details.

As shown in the illustration of the midship section of the hull, the main reinforcement for the frame consists of 1⅜-in. bars, two of them at the shell end and four at the inner end. These bars are bent only in a radial curve at the bilge, with a slight curve at the connection of the deck and sides. Shear is taken care of in the frames by U-stirrups. Intermediate floor stringers, cross-brace stringers and bulkhead stringers are all tied into the main frame by rods with one bend only and with a hooked end, as shown in the drawing, thus simplifying steel fabrication and assembly at the joint. A great amount of steel is required at the heavy girder made up in the triangular corner between the deck and the sides of the hull. This steel is detailed as 1⅛-in. round bars, tied together with intertwined stirrups.

The shell, which is 5 in. thick on the bottom and 4 in. thick on the sides, is reinforced with an outer and an inner layer of horizontal rods varying from ¾ in. at the bottom to ⅝ in. near the top of the sides and spaced 4 in. on centers, the outer and inner rows staggering. These are to take care of the local longitudinal stresses due to bending. Shear is cared for by ¾-in. vertical rods, 4 in. on centers between frames and 2½ in. on



DETAILS OF REINFORCED CONCRETE IN 2500-TON CONCRETE SCHOONER

centers at the frames. As spacers to keep these rods in position and a distance of ⅜ in. from the outside and inside surface, ½-in. rods are spaced diagonally on 3-ft. centers on the shell. These rods are run between the horizontal and vertical rods, as shown in the diagrammatic view on one of the drawings of this hull section. Alternate horizontal bars are to be wired to the alternate vertical bars.

2500-Ton Schooner on Novel Lines

The 2500-ton coal barge is a novel type in the concrete vessel. It is 236 ft. long over all, 44 ft. wide, and 26½ ft. deep at the sides. The carrying capacity is 2500 tons. The vessel is schooner rigged, as shown in the drawing. Bids for the construction of a number of these ships were asked for early in October, but decision on contracts has never been made.

The vessel's framing, partly governed by the necessity for so many hatch openings in the decks, is distinctly novel. It consists of deep transverse frames spaced on 22½-ft. centers, carrying a heavy shell for the most part of 6-in. thickness, which is additionally braced at the third points between frames by diagonal concrete struts at the bilge angle. The ship is divided into compartments by a transverse bulkhead at every other frame and also by collision bulkheads at the bow and stern, in the stores and service sections of the boat. Longitudinal stiffness is obtained by six keelsons, which are heavy reinforced-concrete girders.

The transverse frames are 6½ ft. deep on the bottom, 5½ ft. deep at the side and 3 ft. deep under the deck. They are reinforced with bars, the maximum size being 1⅛ in., laid straight along the respective frames, the connection at the bilge and deck curves being made with additional diagonal rods, as shown in the drawing. (In fact, there are no curved bars in the reinforcement except for the hooked ends.) This is a device to save fabrication costs. Intermediate of the frames are the two diagonal struts which foot at the bottom into the outside of the outside keelsons and frame at the top into a thickened section of the shell, which is continuous along the shell and is reinforced longitudinally. The struts are 8 x 18-in. sections, reinforced with straight rods.

Shell reinforcement of this schooner consists of inside and outside rows of vertical bars, and inside and outside rows of diagonal bars, the vertical bars being spaced 3½ in. c. to c., the diagonal bars 6 in. c. to c. Details are shown on one of the drawings. Here the vertical bars take the shear, and the diagonal bars the bending stresses. It will be noted that there are no heavy longitudinal girders at the intersection of the sides and the deck, as are common to the other large concrete ships. The bottom of the shell has the usual longitudinal and transverse bars, with diagonal spacer bars on 12-in. centers. The deck is reinforced with diagonal rods with extra longitudinal rods between hatches.

The bottom of the coal bunkers will be covered with wood flooring backed to wooden joists which are hung from special hangers attached to the concrete members of the hull bottom. The schooner has provision for a small crew, and has also a donkey engine at the stern for handling operations.

In both of these designs the concrete ship department has used the following unit stresses:

CONCRETE:

(1) Maximum unit compressive stress in the extreme fiber in flexure 1500 lb. per square inch

(2) Maximum unit compressive stress in the extreme fiber in flexure, adjacent to support of a continuous or fixed-ended beam.............1700 lb. per square inch

(3) Maximum unit compressive stress in stanchions ... 1000 lb. per square inch

(4) Maximum unit shearing stress $\frac{V}{(bjd)}$ in T beams
and in shell or other slabs................. 500 lb. per square inch
In isolated beams.......................... 300 lb. per square inch

(5) When the maximum unit shearing stress is less than 50 lb. per square inch, the concrete may be considered to carry all the shear.

(6) When the unit shearing stress is greater than 50 lb per square inch, reinforcement should be provided as follows: (a) In the design of thin slabs, used as the webs of beams, with the shearing action perpendicular to any local shearing stress such as the shell, provide shear reinforcement according to a formula for combining shear and local stresses, (b) In all other cases provide shear reinforcement to carry the full amount of the shear.

(7) Maximum unit bond stress not over......... 160 lb. per square inch for steel stresses of 16,000 lb., and proportionately for other steel stresses.

(8) $\frac{Es}{Ec} = 10$

STEEL:

(1) Maximum unit tensile stress in all reinforcement, except as stated below, not to exceed... 16,000 lb. per square inch

(a) In all bulkheads except collision bulkheads.. 20,000 lb. per square inch

(b) In shell reinforcement exposed to water.. ..12,000 lb. per square inch

(c) Maximum unit tensile stress in top steel of keelsons due to combined local and hogging or sagging stresses............not to exceed 20,000 lb. per square inch

San Francisco Plans Separate Garbage Collection and Utilization

Municipal authorities in San Francisco have been giving much attention of late to the garbage disposal question, and it is probable that in the very near future an ordinance will be passed requiring the segregation of food waste from rubbish and other refuse that would not be useful for hog feed. At present garbage collections are made at intervals ranging from every day to twice a week. After the segregation plan goes into effect the smaller cans containing the perishable garbage will be emptied as frequently as conditions demand, while the larger, or rubbish, cans from the average household will require to be emptied only once or twice a month. The amount of garbage collected in San Francisco has been decreasing rapidly, which is believed to be an evidence of "Hooverizing." Although the population of the city has been increasing steadily and rapidly, the amount of garbage in tons per month for the past two years has varied as follows:

Month	1916	1917	1918
January	14,830	13,696	11,537
February	13,524	11,313	10,211
March	13,898	12,092	10,811
April	12,492	10,715	10,605
May	12,438	10,803	10,299
June	11,760	10,211	9,329
July	12,078	10,318	
August	13,780	11,846	
September	13,541	11,121	
October	13,482	11,861	
November	12,173	10,926	......
December	13,347	11,414	

It is likely that the new plan will not require hotels and restaurants to turn over their garbage to collectors designated by the city because they have contracts for disposal, some of which extend for two years and the abrogation of which would probably be fought as a confiscatory measure. The new plan will deal, rather, with the garbage from household sources. Some of the hotels are getting $5 per ton for garbage, but it is understood that this quality is superior as hog feed to that which would be obtained from households.

Capacity of Macadam Roads for War Business Increased

Three-Foot Concrete Shoulders Added at Each Side Without Closing Highways to Traffic — War Labor Conserved by Using Convicts for the Construction

CONSTRUCTION of 3-ft. concrete shoulders on each side of macadam roads in the State of Maryland was designed to increase their capacity for war business, while at the same time present traffic would not be interfered with. Besides increasing the capacity of the roads, the shoulders were intended to support the edges of the highways and were expected to distribute the traffic more generally over their entire surfaces. Every effort has been made in the construction to conserve labor by the use of machinery and by the use of convicts for the ordinary work.

The State of Maryland has many miles of surface-treated water-bound macadam roads which were built before modern concentrations of traffic were contemplated, and until recently they had given satisfaction. During the past winter, however, these roads suffered considerably from the increased traffic due to the war,

FIG. 1. CONCRETE SHOULDERS PROTECT EDGES OF MACADAM, INCREASE CAPACITY OF ROAD AND DISTRIBUTE TRAFFIC

and it became increasingly evident that something must be done to preserve them. Inspection showed that the greater part of the wear occurred at the edges, while the central part of the macadam remained in good condition. Large holes formed at the edges, extending one or two feet in, and ruts formed along the sides, causing a gradual spreading of the road crust away from the center line. To remedy this condition, it was thought that concrete supporting shoulders covering the parts most affected would not only be effective, but would increase the capacity and save the investment in the central portion of the surfacing, where very little wear had occurred.

With this idea in view, the Roads Commission decided to try out the design on the Baltimore and Washington Boulevard. It was proposed to construct one shoulder at a time, thus leaving the other side of the road open for the heavy war traffic, which it was realized could not be interfered with.

As originally constructed, the road was 16 ft. wide and 8 in. thick. In the spring of 1918 the condition of its surface varied greatly. In some places the surface was too badly destroyed to warrant anything but reconstruction; in others the only parts affected were the edges, which had broken down and rutted, the surface having been pushed out at the side and shoved up in large hummocks—in places 18 in. high. This had decreased its width from 16 to 13 or 14 ft., and 14 ft. was taken as standard width of macadam surface to be retained, while the addition of two 3-ft. shoulders would make a total width of 20 ft. In sections where the road was too badly injured to warrant saving, a 20-ft. concrete road was built. On these 20-ft. sections the design called for building 10 ft. at a time, thus keeping the road open to traffic, and this method was followed except in some places where good detours could be obtained. It is proposed to use the central macadam strip, where the concrete shoulders are being constructed, until such time as it requires reconstruction, when it will be removed and the entire center replaced with concrete, thus making the road conform to the 20-ft. sections now being built.

General dimensions and arrangement of the cross-section are shown in Fig. 1. The old 8-in. macadam had a crown of 4 to 5 in. and a parabolic cross-section. It was deemed unwise to continue this in the concrete shoulders, as they would be too steep, and a slope of ½ in. to the foot was adopted.

In construction, the plan followed is to dig trenches along each side to 8 in. below finished grade, remove the present surfacing where it is injured and grade the forms so that the top surface of the shoulder will be slightly above the old surface of the macadam. The shoulders are being built one at a time, and after the concrete has been placed long enough to bear traffic new bituminous macadam is constructed between its inner edge and the old surfacing. The top of the old surface is roughened sufficiently to make a good joint with the material used to bring it up even with the tops of the shoulders. After this joint is completed, that side of the road is opened up to traffic, and construction on the other side proceeds. When the work is finished it is proposed to give the central strip a surface treatment

FIG. 2. LABOR SAVED BY USE OF MACHINERY

of approximately ½ gal. of bituminous material per square yard, and cover it with stone chips at the rate of 100 tons to the mile. The drawing shows an automobile in the proper position for the distribution of traffic, leaving plenty of room for the passing of traffic coming up behind.

The entire contract consists of 53,000 ft., divided as follows: Macadam center with concrete shoulders, Stas. 0 to 71, 166 to 288, 308 to 332, 382 to 530, and 20-ft. concrete roadway on the intermediate sections, as the old surface was not considered worth saving.

Convict labor from the House of Correction is used for the common work, and is paid at the rate of $2.50 per nine-hour day. Each gang is accompanied by a guard supplied by the superintendent of the penitentiary, and conveyances are furnished to carry the men to and from the work.

Labor-saving machinery is used for the rough grading. Fig. 2 shows a traction engine hauling a road machine for grading on the sections to be paved with concrete full width. It is necessary first to break the surface with a scarifier. The fine grading is done by hand, and the subgrade is rolled with a 10-ton roller. On the excavation for the concrete shoulder work the contractor tried to use a small short-blade grading machine, but found that it did not work satisfactorily. He found it necessary to plow and dig the side trenches by hand labor. On this narrow work hand tamping is used to compact the subgrade.

All materials for the work are furnished by the state, being delivered at the nearest railroad siding, from which point the contractor loads and transports them to the job. The equipment for hauling materials consists of one 2-ton and two 5-ton motor trucks, with which the necessary stone, sand and cement are transported. In the case of the shoulder work, the sand and stone are dumped in uniformly spaced piles along the opposite side of the road from the construction, while they are dumped upon the subgrade in the 20-ft. and 10-ft. strips.

Concrete stone of the No. 2 size is used. It is limestone bought by the state in the open market, but coming from quarries within the state. In the delivery of these materials upon the subgrade, the sand and stone are placed in alternate piles, from which they can be conveniently wheeled to the mixer. The concrete for both the 20-ft. section and the shoulder work is mixed in the proportions of 1 : 2 : 4.

FIG. 3. CONCRETE MIXER BUILDS ONE SIDE AT A TIME

On the shoulder construction, a ½-yd. concrete mixer is being used. This is operated upon the surface of the old road, and the concrete is poured directly into the steel forms. Fig. 3 shows this mixer in operation. When the forms are filled with a concrete of proper consistency, it is struck off with a short board float which consists of a 2 x 6-in. plank 4 ft. long laid flat upon the forms, with handles for operation. The concrete roller shown in the illustration is used only where excess water makes it advisable to compact the concrete. The small float which can be seen lying on the form gives a surface similar to that on a cement sidewalk. Fig. 4 shows a completed section of shoulder with the concrete mixer standing in the distance. The forms are of steel, 650 ft. being used to build this narrow section.

FIG. 4. COMPLETED SECTION OF SHOULDER BEFORE THE BITUMINOUS CONNECTION WITH ROAD IS LAID

A force of 18 men is used for the shoulder work. Of these, 14 are convicts. The gang is made up as follows: Two stone wheelers, one sand wheeler, five shovelers, one cement wheeler, one cement feeder, three finishers, two form setters, one water boy, one mixer engineer and one foreman. This gang could build about 500 ft. of shoulders in a nine-hour day.

Fig. 5 shows a completed section at the crown of a hill covered with earthy material for curing; note the fine condition of the old treated-macadam surface, which had been worn away at the edges.

The itemized cost of building 2367 sq.yd. of shoulder is shown in Table I, the total cost per square yard being $3.24. Common labor was $3.60 and convict labor $2.50 per nine-hour day.

Wherever possible, the 20-ft. pavement is built in one section, but as detours are impracticable in most places, a large portion of it is being built in the 10-ft. sections, which are called for in the original contract. These sections are 8 in. thick at the center of the road and 6 in. at the edge, making an average thickness of 7 in., and are tied together with ⅜-in. rods 3 ft. long. The

TABLE I—COST OF BUILDING 2367 SQUARE YARDS OF THREE-FOOT CONCRETE SHOULDERS FOR MACADAM ROAD

Labor

Item	Cost Total	Cost Per Sq. Yd.
Excavation	$800 00	$0 338
Unloading and hauling materials	900 00	0 380
Mixing, placing forms, curing and protection	2000 00	0 845
Total manipulation	$3700 00	$1 563
Materials		
Sand, 360 tons at $1 30 (Cost of material 60c. and freight 70c.)	$468 00	
Stone, 570 tons at $2 10 (Cost of material $1 30 and freight 80c.)	1197 00	
Cement, 780 bbl. at $2 84	2215 20	
Demurrage, rentals, etc.	100 00	
Total, materials	$3980 20	1 681
Total cost	$7680 20	$3 244

rods are expected to control the joint along the center of the road, and while it may not be possible to prevent hair-cracking, it is thought that the rods will prevent vertical displacement of the two sections of slab with respect to each other.

The equipment for concreting the wide section con-

FIG. 5. SHOULDER PROTECTED BY EARTH COVERING

sists of a ¾-yd. mixer and about 600 ft. of steel forms. An ordinary strike-board is used for the concrete, and the finishing is done by the roller-and-belt method. The gang employed for this work is 28 men, of whom 21 are convicts. It is made up as follows: Six wheelers, ten shovelers, three men handling cement, two cement finishers, three form men, one engineer, two mixer men and one foreman. This gang has averaged about 400 ft. of 10-ft. pavement per nine-hour day. Practically the same force is used when the 20-ft. single slab is built, and the gang averages about 250 ft. per day, or equal to 500 ft. of 10-ft. slab.

Separate costs for 10-ft. and 20-ft. widths are not available, but Table II shows the cost on 20,800 sq.yd., of which about one-half was built in 10-ft. sections. As the amounts of each type of construction were equal, and as the amount of yardage laid per day varies as 500 to 400, an approximate relative cost can be obtained by proportion. About 25% more yardage of 20-ft. slab was laid per day than of 10-ft., using the same gang. The average unit cost of mixing, placing and curing, which, it will be assumed, was the only part of the total unit cost affected by the difference in width, was $0.433, as seen from Table II. Let x and y equal this part of the unit cost for the 10-ft. and 20-ft. strips, respectively.

Then $\frac{x + y}{2} = 0.433$, and as $x = 1.25\,y$, $x = 0.481$ and $y = 0.385$. If these are substituted for 0.433 in Table II, the cost of the 10-ft. strip was $2.703 per square yard, and the cost of the 20-ft. strip was $2.607 per square yard.

It will be noticed that the cost of the narrow shoulder strip is more per unit than for the 10-ft. section of the 20-ft. strip, while at the same time the 10-ft. sections

TABLE II—COST OF 20,800 SQUARE YARDS OF CONCRETE ROAD, ONE-HALF BUILT IN 10-FOOT SECTIONS

Labor

Item	Cost Total	Cost Per Sq. Yd.
Excavation	$5000 00	$0 240
Unloading, hauling and rehandling materials	7050 00	0.339
Mixing and placing concrete	9000 00	0.433
Total manipulation	$21,050.00	$1.012
Materials		
Sand, 3000 tons at $1 30 (Material 60c. and freight 70c.)	$3900 00	
Stone, 5500 tons at $2 10 (Material $1 30 and freight 80c.)	11,550 00	
Cement, 6100 bbl. at $2 84	17,324 00	
Demurrage, steel, rentals, etc.	1400 00	
Total materials	$34,174 00	1.643
Total cost	$55,224 00	$2 655

cost more than the single 20-ft. strip. This is as would be expected when the extra moving of equipment is considered.

The contract is a Federal-aid project, being done under the supervision of the Maryland State Roads Commission, of which Frank H. Zouck is chairman, and J. N. Mackall is chief engineer. E. H. Wroe is the engineer directly in charge. Thomas, Bennett & Hunter, of Westminster, Md., are the contractors. It is hoped that this road will be completed in time to carry the heavy motor-truck traffic that is expected in the coming winter.

Youngstown Sanitary District Proposed

Owing to the pollution of the Mahoning River all the way from Warren, Ohio, to the Pennsylvania state line, and various peculiar conditions involved which cannot be dealt with by the various communities singly, the Ohio State Department of Health has advised the formation of a sanitary district. The department expects to draft a bill for introduction in the legislature and to submit the draft to a conference of representatives of the municipalities concerned. The Mahoning River is grossly polluted by sewage and industrial waste, and at times receives so much water used for cooling purposes as to make the temperature of the water extreme abnormally high. All this, the department states, makes the river unsatisfactory as a source of water-supply for either municipal or industrial use. During low water, it adds, a decided nuisance arises. Dr. Allen W. Freeman is commissioner of health of Ohio; James E. Bauman, deputy commissioner; and W. A. Dittoe, chief engineer.

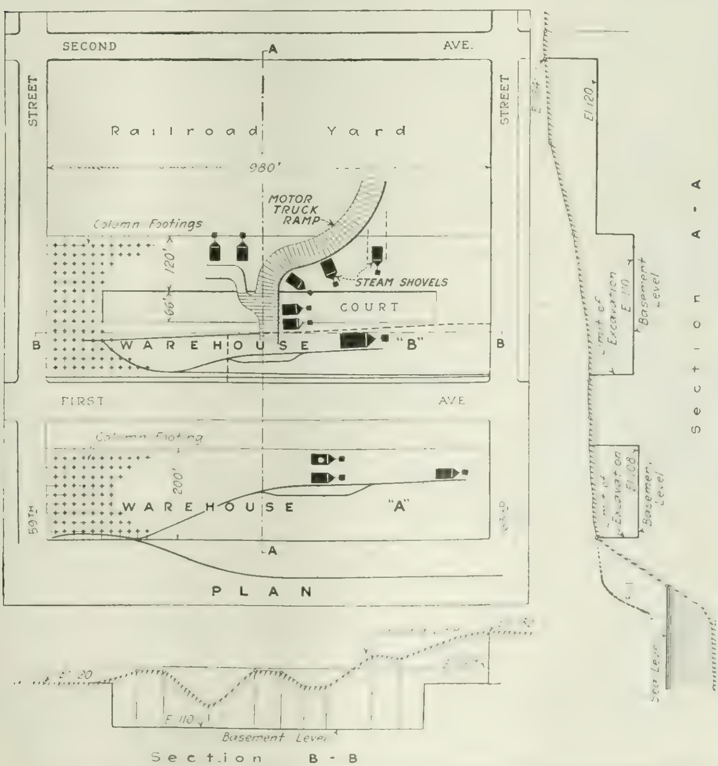
Comparison of Excavation Haulage by Motor Trucks, Industrial Railways and Teams

Detailed Cost Accounts on the Construction of the Brooklyn Army Supply Base Show That Trucks Are More Economical Than Teams and Less Economical But More Flexible Than Railways

OPPORTUNITY for comparing various methods of hauling excavated material to the dump is offered by the construction nearing completion at the Army supply base, South Brooklyn, N. Y. The three common methods of conveyance—teams, trucks, and industrial railways—are being used, and the amount of material handled is believed to supply sufficient data from which to form conclusions. The cost tables for this job show that trucks are much cheaper per ton-mile than teams, even for short hauls, but are somewhat more expensive than industrial railways for the long hauls. For short hauls the trucks are cheaper than the railways. Motor trucks are said to have the added advantage that they are more flexible and can go to any desired dump, while conditions such as traveling over city streets and up heavy grades make the industrial railway in some cases impracticable.

The South Brooklyn Army supply base is one of the large Government-owned shipping points built to facilitate the forwarding of supplies to the troops abroad. It is situated on the waterfront between 58th and 63rd Sts., extending two blocks back from the waterfront to Second Ave. The buildings, an excavation plan for which is shown in the illustration, consist of the usual docking facilities and two large warehouses. Warehouse A, west of First Ave., will be 200 ft. wide by 980 ft. long. Warehouse B, east of the avenue, will be 306 ft. wide by 980 ft. long, with a court 740 x 66 ft. through the center. The former has eight stories and a basement; the latter has nine stories above the dock-floor level.

As originally planned, Warehouse B was to have had twice the plan area of that built, but after the excavation was well started a basement was added and the size of the building was decreased. When the two warehouses are completed the floor space will be about 4,400,000 sq.ft. The total cost of the base is estimated at a little more than $30,000,000, a cut of about $14,000,000 from the original estimate.



EXCAVATION PLAN OF ARMY SUPPLY BASE GIVES TYPICAL STEAM-SHOVEL LAYOUT, SHOWING RAILWAY TRACKS AND MOTOR-TRUCK RAMPS

Excavation started May 15 under the cantonment type of contract for emergency work, and construction has continued night and day with few interruptions. The estimated amount of excavation is 650,000 cu.yd., of which 494,558 had been moved up to Sept. 18. The general contractor let the excavation by subcontract—the subcontractor to furnish all labor, equipment and supervision, and to be paid a rental for his plant and a commission not to exceed a fixed sum on the payroll and supplies. Although the cutting is heavy, the work could not be carried on to advantage as in a large excavation contract. The urgency of the construction required that all work should go on at the same time. Form building, piledriving and concreting had to follow closely behind the excavation, and arrangements had to be made which would accommodate all operations. Another feature tending to add to the difficulty of excavation was the change of plan soon after work started. Warehouse B, the dimensions of which were altered, originally required 10,000 piles, according to the

plans. When the basement was added it was supposed that the extra depth would give a sufficiently compacted soil, so that the bearing power of the column footings would be sufficient without the piles. However, soon after work began, it was found that an old ravine which had been filled had soft material at the bottom, and that sufficient bearing power could not be obtained without going below the water level in the bay. In part of Warehouse A, a large concrete mat was used instead of the piles, to expedite the work.

Much of the excavated material was old fill, which extended to varying depths over the entire site. The character of the material was quite general, containing all manner of débris, such as tin, wire, old barrel hoops and cans, all interwoven and having a tendency to clog the teeth of the steam shovels. The natural earth encountered was loam and plain sand. Reference to the plan and cross-section shows that the depth of cut varied considerably, the average being about 18 ft. Although the difficulties of excavation were greatly increased by the changes in plans and addition of basements, this portion of the construction, as all others, was completed ahead of the schedule originally proposed.

Eleven steam shovels were used on the work. A description of them and their performance from the start to July 3 is shown in Table I. The diagram shows the direction in which the various shovels worked in Warehouses A and B; the large 2½-yd. shovel cleaned out the southwest corner of Warehouse B, while the others were distributed in various positions over the work. Most of the material from Warehouse B was removed with motor trucks, which drove out from the hole over planked ramps having a grade of about 6%. When grades of more than 6% were used, the efficiency of the trucks fell off sharply. Four-inch plank were used for the ramps, which were built as near to an even surface as possible, since it was found that undulations in the grade had a marked effect on the operation of the trucks.

TABLE I. EARTH EXCAVATION PERFORMANCE, SOUTH BROOKLYN ARMY BASE, FOR THREE WEEKS ENDING JULY 3, 1918

Description				Excavation		
Shovels	Make	Size of Bucket, Cu. Yd.	Type	Amount Cu.Yd.	Cost	Cost per Cu. Yd., Cents
1	Marion	1½	41	22,354	$2,660.22	12
2	Thew	¾	A1 Revolving	13,904	2,071.09	15
3	Osgood	⅝	18 Revolving	12,670	1,764.23	14
4	Bucyrus	¾	18B Revolving	11,570	2,150.98	19
5	Thew	¾	A1 Revolving	14,240	2,220.92	16
6	Marion	1½	40	16,410	2,765.07	17
7	Marion	1¾	40	17,555	3,351.53	19
8	Marion	2½	60	34,308	2,836.85	8
9	Thew	¾	A1 Revolving	12,000	1,934.95	16
10	Marion	1	31 Revolving	12,670	2,057.76	16
11	Bucyrus	⅝	14B Revolving	16,930	2,154.42	13
Total				184,611	$25,968 02	Ave. 14

An industrial railway, with eighty 4-yd. dump cars and eight 10-ton locomotives, was used to carry the earth away from the large shovel. Because it was necessary to enter the basement excavation on an inclined track, it was impossible to use a storage track of more than 10 cars capacity without interfering with the concreting of the footings. Transportation of material from Warehouse A was by teams and industrial railway, both of which delivered the material at the waterfront adjacent to the building. The average haul at the site was about ¼ mile. No planking was provided where teams were used, and as the soil was sandy the load which could be hauled was cut down to an average of three-quarters of a cubic yard.

Three dumps were utilized for the disposal of excavated material, and, while much material was used for filling and backfilling at the site, the greater part had to be hauled quite a distance. Most of that hauled by motor trucks was transported to a dump at Dyker Park, where the city is filling up a low, mosquito-infested marsh for a park along the waterfront. This dump is located 3.2 miles from the construction, making the round trip 6.4 miles. The route passes over paved streets for the entire distance, and the only places where planking was necessary was at the shovels and on the dump.

Planking a Large Item

Planking is one of the large items in the expense of truck-excavation transportation, and it was particularly so at this dump on account of the marshy conditions involved. At times the drive along the edge of the dump would settle as much as 4 ft., requiring a complete readjustment of the plank. These settlements were the result of the forcing out of the underlying soil by the overburden of earth; a mud wave that was sometimes 4 ft. in height stretched along in front of the fill.

The dump used by the industrial railway for such material as was not disposed of at the site was near Fort Hamilton. But for the speed required in disposal, it would have been possible to haul all the material away in 4-yd. dump cars on narrow-gage track, but the single-track equipment could not handle the output of the 11 steam shovels required to complete the excavation on schedule. The Fort Hamilton dump is three miles distant from the construction. The material was used to fill in low ground between the harbor line and the shore. The usual difficulties in keeping track in shape when dumping into water were experienced on this fill.

Distribution of the excavation, transportation and disposal costs by the three different methods and to the various dumps, from the start on May 15 to Sept. 18, when about 75% of the entire excavation was completed, is shown in Table II. The distribution covers pay roll, plant rental, supplies and a commission of 6%; no commission, however, was computed on plant rental. In obtaining the total unit cost, the transportation, excavation, disposal and overhead are kept separately. Thus, to obtain the total unit cost for excavation, transportation and disposal of material by teams at the site, it is necessary to take the team cost of 32.4 plus the level cost of 27.2 plus the dump cost of 20.6 plus the overhead charge of 11.9, giving a total of 92.1c. In like manner, the total unit costs for trucks and railways disposing at the site are 106.6 and 96.5c., respectively. In the case of the long-distance hauling to Dyker Park and Fort Hamilton, the dump cost is included in the total unit cost in the last column; this makes it necessary to add only the excavation and overhead charge, which gives total unit costs for these items of 175.6 and 133.5c., respectively. Inasmuch as the average haul for these items varies, the only just method of comparison is on the ton-mile basis, which is shown in Table III. In the last mentioned table, all that is considered is the actual transportation—the excavation, dump cost and overhead being omitted.

Besides the cost of haulage per cubic yard and per

TABLE II. DISTRIBUTION OF EXCAVATION, TRANSPORTATION AND DISPOSAL COSTS FOR EARTH, SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START, MAY 15, TO SEPT. 18, 1918

Item	Quantity Cu.Yd.	Pay Roll Amount	Pay Roll Unit Cost, Cents	Plant Rental Amount	Plant Rental Unit Cost, Cents	Supplies Amount	Supplies Unit Cost, Cents	Commission at **6%	Totals Plus Commission	Total Unit Cost Cents
Excavation										
*Shovel gangs	494,558	$72,702.59	14.7	18,981.50	3.8	36,561.93	7.4	6,555.87	134,801.89	27.2
Transportation and Disposal:										
To site by teams	80,230	24,517.00	30.5	0.00	0.0	0.00	0.0	1,471.02	25,988.02	32.4
To site by trucks	24,490	10,833.00	44.2	0.00	0.0	0.00	0.0	649.98	11,482.98	46.9
To site by industrial railway cars	37,258	7,578.00	20.4	2,079.00	5.5	3,400.00	9.1	658.68	13,715.68	36.8
*Site dump costs	141,978	27,659.00	19.5	0.00	0.0	0.00	0.0	1,659.54	29,318.54	20.6
To Dyker Park	185,352									
Transportation labor		17,176.44	9.3	0.00	0.0	16,139.00	8.7			
Trucks		175,620.00	94.7	0.00	0.0	0.00	0.0			
* Dump cost		29,795.60	16.0	0.00	0.0	0.00	0.0			
Total		222,592.04	120.0	0.00	0.0	16,139.00	8.7	14,323.86	253,054.90	136.5
To Fort Hamilton by Industrial Railway	167,228									
Train operation		41,526.97	24.8	19,415.57	11.6	29,731.29	17.7			
Track gang		18,654.63	11.1	915.94	0.6	3,223.10	2.0			
* Dump cost		36,549.41	21.9	0.00	0.0	0.00	0.0			
Total		96,731.01	57.8	20,331.51	12.2	32,954.39	19.7	7,781.12	157,798.03	94.4
Overhead:										
* Field Office	494,558	13,027.82	2.6	1,149.99	0.2	1,344.65	0.3			
*Field supervision		17,354.37	3.5	0.00	0.0	0.00	0.0			
*Moving plant		19,891.91	4.0	2,111.92	0.4	958.00	0.2			
Total		50,274.10	10.2	3,261.91	0.6	2,302.65	0.5	3,154.61	58,993.27	11.9
Grand total		512,886.74	103.7	44,653.92	9.0	91,357.97	18.5	36,254.68	685,153.31	138.5

* Not included in transportation costs as shown in Table III.
** Commission was not allowed upon plant rental.

ton-mile, Table III shows the excavation transportation performance of the various types of hauling conveyances. The total number of 10-hour shifts, the number of trips per 10-hour shift, the distance to the dump, the mileage traversed per 10-hour shift, the average load, the average amount carried per unit per shift, and the total amount moved by each type of conveyance, are shown. As the yardages given are place measurements, and as a great amount of the material was sand and very damp, the weight per cubic yard taken for figuring the cost per ton-mile was 1½ tons. Considering the cost of haulage by teams disposing at the site, the total tonnage hauled would be 80,230 × 1½ = 120,345, and this multiplied by 0.25 mile equals 30,086 ton-miles. Dividing this into $24,517, the total cost of haulage by teams, gives a cost per ton-mile of 81.4c. By the same course of reasoning the other ton-mile costs were found.

Further consideration of Table III shows that even for short hauls, down to ½ mile, the motor truck was more economical than either teams or the industrial railway. If teams had been used to transport the material to Dyker Park, it is seen from the table that the difference in favor of the trucks would have been still more marked. Assuming that on account of planking a load of 1½ cu.yd. could be carried, and assuming that a team would make three trips per day, or a distance of 19.2 miles, a team would transport 3 × 1½ × 1½ × 3.2 = 21.6 ton-miles per 10-hour day. This divided into $9, the prevailing rate per day, would give a ton-mile cost of 41c., which does not include the cost of planking as assumed above. Therefore, the cost of hauling by teams would probably be more than double that by trucks, which was 23.5 cents.

For the long hauls the data show that the industrial railway was 8c. cheaper per ton-mile than trucks on this particular job, but when the only other variable, the dump cost, is considered, the difference is not so great. It will be seen from Table II that the dump cost for the cars was about 4c. per ton higher than for the trucks. The advantage in using the trucks lay in their adaptability and the speed with which they could handle the material. The only limit to the amount of material which could be handled in a given time was the number of trucks that could be passed under the steam shovels and loaded. In the case of the industrial railway with single track and passing track, the limit was determined by the number of trains that could be switched and passed. The work has been carried on in two 10-hour shifts, but careful records have shown no difference in the amount of work accomplished, with the same equipment, as between day and night work.

The work is being done by the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. J. W. Cerny,

TABLE III—EXCAVATION, TRANSPORTATION PERFORMANCE AND COST, SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START, MAY 15, TO SEPT. 18, 1918

Equipment and Destination	Unit 10-Hr Shifts Worked	Average No. Trips per Unit per 10-Hr. Shift	Average Distance Traversed per Round Trip, Miles	Average Miles per Unit per 10-Hr. Shift	Average Load per Unit Cu.Yd.	Average Amt. per Shift per Unit, Cu.Yd.	Total Amount Moved, Cu.Yd.	Cost of Haulage per Cu.Yd.	Cost of Haulage per Ton Mile	*Total Cost of Haulage
Teams, disposing at site	2,751.0	39.5	0.5	19.75	0.74	29.2	80,230	$0.305	$0.814	$24,517.00
Auto trucks, disposing at site	383.7	20.3	1.0	20.3	3.14	63.8	24,490	0.442	0.590	10,833.00
Industrial railways, disposing at site	1,064.5	10.0	0.6	6.0	3.5	35.0	37,258	0.350	0.779	13,057.00
Auto trucks to Dyker Park	5,774.1	9.0	6.4	57.6	3.57	32.1	185,352	1.127	0.235	208,935.44
Industrial railway cars to Fort Hamilton	11,308.5	4.0	6.0	24.0	3.7	14.8	167,228	0.678	0.151	113,467.50
Totals							494,558	......	......	$370,809.94

* Figures do not include excavation or dump costs or overhead charges.

Quartermaster Corps, Natonal Army, is directly in charge of the part of the work described. The general contractor is the Turner Construction Co., New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the excavation is Rodgers & Haggerty, of New York City.

City Plat Disapproved Because Not Suited to Topography

RECENTLY the plat of a new real-estate development was submitted for approval to the plat commission of Ramsey County, Minnesota, in which the city of St. Paul is situated. The commission refused to approve the plat, on the ground that the layout was not suited to the topography. In consequence, the question has been referred by the city council to the new city planning board.

All subdivisions in the city of St. Paul must be approved by the commission named, which consists of four members, one of whom is commissioner of public works and serves ex officio.

In the past the board has confined its jurisdiction largely to seeing that streets matched with territory already platted and that mortgage liens had been released in so far as they related to the dedication of streets and alleys, and to making sure that proper maps and records were prepared and filed. The present action is an important extension of the work of the board into a new field.

A subdivision of 27 acres fronting on the Mississippi River Boulevard was submitted for approval. There were already several developments and proposed developments in that neighborhood, in the nature of homesteads of from one to twenty acres. The proposed plat consisted of lots 40 or 50 ft. in width, with streets cut through as extensions of present streets. On account of the topography, the new streets would require heavy grading and considerable cutting of property. The commission declined to accept the plat, asserting that it was an improper development of the district and that the streets were not properly laid out as regards the topography.

Under the ordinance passed last March creating the city planning board, it has jurisdiction over "all matters concerning or relating to the platting of new areas." The case of the disapproved plat was referred to the board's committee on plats and street plans. This committee not only upheld the objections of the plat commission, but went further and submitted a definite plan and location of the streets. The report of this subcommittee has not yet been acted upon by the city planning board as a whole. In the meantime the owners are selling lots by metes and bounds in defiance of the city authorities.

Ford Car Cleans Water-Works Reservoir at Trenton, N. J.

BY W. COMPTON WILLS
Assistant Engineer of Distribution, Water Department, Wilmington, Del.

THE successful use of a Ford motor car in cleaning a 35,000,000-gal. reservoir at Wilmington, Del., has once again opened a new line of work for this machine.

The removal of sediment to an average depth of 8 in. from the reservoir was necessary, as concrete baffle walls are to be constructed to lengthen the period of retention of the raw water stored in the reservoir. Water for moving the sediment by hose-flushing was not available.

A Ford service car was lowered into the reservoir and attached by ropes to a plank drag 8 ft. long with side extensions 2 ft. high, and provided with four handles.

The automobile pulled the load slowly over the drain inlet, after having been loaded by two laborers directing the drag through the mud. Then three laborers stationed at the drain inlet guided the drag and kept the space about the inlet clean. It was possible to keep the car continually on the move, circling back and forth between the loading point and the drain. As the men worked away from the drain inlet the mud was dragged to water in the reservoir bottom, and carried in suspension by the water to the sewer.

Allowing $13 per day for running cost, depreciation of car and wages of the driver, also labor cost of $22.50 per day, both items totaling $35.50 per day, and a removal of 300 yd. of sediment per day, we have a rate of about 11⅚c. per yard near the sewer. As we cleaned away from the sewer and dragged to the stream of water, four extra men were used to puddle the material so the stream could carry it away. This increased the unit cost to 19⅓c. per yard. About 4000 cu.yd. were carried out in some 14 working days. Overhead charges for placing and removing the car, hauling men back and forth to the site, furnishing brooms and drags, and handling valves, etc., have not been included in the figures given herewith.

FORD CAR USED TO CLEAN RESERVOIR AT TRENTON

Salesmen of Engineering Equipment for Export Must Be Engineers

Must Introduce Not Only American Machinery but American Methods—Showing Economics of Use Most Important Factor

By S. T. Henry

Vice President, Allied Construction Machinery Corporation

(An address before the Technical Publicity Association, New York, Nov. 15, 1918)

LARGE and permanent export markets for standard American engineering machinery can be built up abroad by the introduction of American methods of using such machinery.

The introduction abroad of American industrial methods was a slow and tedious process, until recently. Several large American manufacturers had, however, conducted such introductory work with marked success. They had sent into various countries of the world sales engineers who were well grounded in the use of their machinery. While these engineers went as salesmen, their work was to educate the engineers and the industrial men of other countries regarding American methods. They had to show these prospective customers why our way was the cheaper way. They had to prove that the use of our standard machines would produce results more quickly and economically than special machinery. These men worked under great handicaps. But they made good. They demonstrated that it was then highly practicable to sell standard American machinery, instead of merely taking orders that were offered for special machines.

Governing Conditions Greatly Changed

In the past two or three years conditions have changed completely. The world has learned more in that time about American engineering machinery and American engineering methods than could have been forced upon it in a generation through the most strenuous commercial efforts. Engineers from everywhere know the wonderful results our forces have achieved in building, equipping and operating port works, railways, highways and machine shops in France. The world is ready now to adopt American industrial methods and wants to be educated in our way of doing engineering work.

If the opportunity is handled rightly, no limitations of the trade possibilities thus presented need be considered. The thing is to put the work in the hands of men who are thoroughly schooled in American methods of using American machinery. It goes without saying that these men must have commercial sense. They must know how to deal with other business men. But, above all, they must have the "know how" of what they are trying to introduce. They must be able to sell ideas, not merely to take machinery orders.

A few examples may illustrate how engineer-salesmen of such qualifications work. These examples also will indicate the type of men required to introduce American engineering methods and to sell the standard American machinery used in following such methods.

Take the largest American manufacturer of mining machinery; *this* concern and its predecessors consistently have followed for a generation a policy of using engineer-salesmen abroad. The company has branch offices or agencies in all of the countries in the world where mining and quarrying are done on any considerable scale. In each of these branches or agencies there is located one or more engineers who have had considerable experience in American methods of mining and quarrying.

These men are actually selling drill holes in the rock and tons of ore in the car, instead of rock drills and compressors. When a new proposition comes up they help to study the conditions to be met and advise what equipment is best suited to these conditions. In the case of existing works they must go right in and prove how American machinery and American methods will save money, as compared with what is being used. When up against cheap peon labor in Mexico, for example, it is not easy to get a native mine owner to substitute an expensive mechanical plant for plentiful hand labor. He must be shown that the cost per ton of ore brought to the surface is less with such a plant.

Work of this kind is too deep water for a commercial salesman who can readily switch from shoes to millinery. It requires men who know from experience what the customer wants to know. Men of these qualifications become practically a part of their customers' organization.

Here is another case. American saw-mill machinery is used quite extensively in a far eastern country, as a result of the work of a single American engineer-salesman. This man knew thoroughly American methods of cutting timber, handling logs and running sawmills. When he went to this country a few years ago he was totally unfamiliar with the language. He went out and lived among the timber operators, and learned their language, their customs and their conditions. He did not meet the peculiar demands of the local lumbermen for machinery. Instead, he showed them how American methods could cut more and better lumber for them at less cost. These American methods required standard American machinery.

Engineer-Salesmen Essential to Success

Whenever you find an American sales engineer, trained for work in foreign fields, you will find him introducing American methods, as illustrated by these examples. At home you will find that the executives who have had experience with men of this caliber are convinced what overseas policy they must follow to get results. The ordinary commercial salesman simply will not do. The engineer-salesman, of proper qualifications, is almost assured of success in realizing on the opportunities that are presented in foreign markets to American engineering machinery manufacturers.

Scarcity of the right kind of men is the one big problem in adopting a sales engineering policy in export marketing. So many qualifications are desirable that an enumeration of them would appear to reduce the candidates to a very few. Just as in domestic work, however, it rarely is possible to find a man who matches up completely to the requirements of the job.

It is comparatively easy to find men who are thoroughly grounded in American methods of using any line of engineering machinery. When these men are sorted on the basis of ability to deal with business men, the percentage of rejections is large. Those who do pass

this test are nearly all eliminated when considered as to their commercial sense. This does not necessarily apply to their commercial experience, but rather to their ability to sense a commercial situation.

The few candidates who are left when these few simple tests have been applied would nearly all be discarded on account of a lack of knowledge of any foreign languages. Frequently it is necessary, therefore, to overlook this very essential qualification and to send out to a foreign country a man who must learn the language after he arrives. Any man who goes out thus handicapped is bound to have to work under very great difficulty. Experience gained by a number of American engineering machinery manufacturers has demonstrated, however, that such a handicap is far less serious than a lack of knowledge of American methods of using the machinery to be marketed.

This conclusion is heresy in the minds of most people experienced in regular commercial export trade. Right here it is well to draw a very definite line between the marketing abroad of commodities and articles of ordinary commerce and the sale of engineering machinery. In the one case it is unquestionably necessary to adapt the commodity or article to the needs of the country. For example, it is impracticable to attempt to substitute an American hatchet for a Cuban machete. It is likewise necessary for a salesman of shoes to know the whims of the average man and woman of the country in which he is trying to do business. But antiquated industrial and engineering methods are much the same the world over. When the operations affected are sufficiently large to justify the use of machinery, instead of hand labor, the work is nearly always in charge of men who can understand engineering arguments. These arguments are the same everywhere. It certainly is a handicap not to be able to present them in the language of the men to whom an engineer-salesman must talk. It is a far greater handicap, however, not to know what the arguments are.

Engineers Lack Business Qualifications

The lack of business qualifications in most American engineers is a sad reflection on the work of our engineering schools. It is a fact, however, that the courses in these schools tend to give most of the young men who take them an entirely wrong viewpoint of the commercial side of engineering. Our technical societies also have overstressed the ethical side to such an extent that an engineer who has anything to do with business loses more or less of his professional standing. This seems strange in light of the fact that engineering is, after all, a matter of dollars and cents. Such an attitude on the part of engineers toward business is probably a relic of the old days of pure-science education. Whatever the cause may be, the time has arrived when our engineering schools and our engineering societies will either have to get a new viewpoint regarding commercial affairs, or fail to produce the engineer-salesmen whom American industry needs so greatly.

Many suggestions have been made as to what courses our technical schools should give. One suggestion in regard to the foreign-language work required of engineer students may not be amiss here. It would seem that these courses could be given in a practical way. Young engineers should study a language as it is studied by men who must have it for commercial use abroad. Most important of all, the student should be thoroughly convinced in advance of the value of the language to him. With some practical plan in place of the kind of language study now given, one of the chief handicaps of engineer-salesmen abroad would soon be eliminated.

Returning from these things as they might be to things as they are, the average American manufacturer may want to know how he can adopt the plan of using American engineer-salesmen to sell his products abroad. This has been done in a good many ways, in each of which there have been some successes and some failures.

For the large manufacturer, the problem is comparatively simple. He can afford to establish his own branch offices in the more important centers of the world. He can also afford to supply his own trained men to coöperate with agencies in other centers of less importance. In the still more limited centers he can have his trained engineers on call to help local connections, scattered over a considerable area, to develop leads for business.

Three Methods of Procedure Open

The manufacturer having a more limited output has three principal opportunities open to him, under present conditions: He can turn his export sales over to one or more general export commission houses with branch offices in the countries in which he desires to operate. He can join with a group of noncompeting manufacturers in similar lines, coöperating in order to reach the foreign markets in which these manufacturers are interested. He can bring together a group of his competitors under the Webb-Pomerene law to form an organization that will go after export business for all of them. The best plan to be adopted by any manufacturer can be determined only after very careful study of what he wants to accomplish, the markets to be reached, and his own limitations.

Some general export commission merchants have been quite successful in introducing and marketing American engineering machinery abroad. These concerns are of sufficient size to justify them in maintaining engineering-sales departments. These departments, to all intents and purposes, are separate machinery houses which utilize the experience and the facilities of the organizations of which they are a part.

Unfortunately, the number of general export commission houses so organized is very limited. Those general export concerns which attempt to market engineering machinery as they do ordinary commodities make some sales. They cannot, in the nature of things, build any business.

Coöperative export engineering-sales organizations developed by a group of noncompeting manufacturers in allied lines are a comparatively new idea. Such coöperative concerns, properly conceived, organized and financed, apparently offer to the average engineering machinery manufacturer one of his best opportunities.

In the first place, such an organization insures each manufacturer of the benefit of thinking of all of the manufacturers in the group. This collective thinking eliminates many of the difficulties which individual manufacturers would encounter. This plan permits the

group to maintain properly trained engineer-salesmen on salary in practically all of the centers of the world where there are opportunities for the use of the particular general line of machinery involved. This means that each member of the group has good representation in many places where the member could not afford to have a salesman call even occasionally. Many of the other advantages of the plan can be appreciated only by actual experience in its working.

Just how combinations of competitors under the Webb-Pomerene law will work in the engineering machinery field remains to be seen. Thus far no such combination has been undertaken. In certain lines of commodities and of quite standard products there are undoubtedly advantages to be gained through operation under this law. The difficulties apparently are such, however, that no group of competing manufacturers of engineering machinery has seen its way clear to attempt to get together for a combined effort to market their product outside of the United States.

Whatever plan is adopted by the American engineering machinery manufacturer in his export sales work, he can build a large and permanent market only by introducing American methods of using his machinery. Such introduction can be made properly only by experienced American engineer-salesmen.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Conservation Applied to Municipal Engineering Problems

Sir—The need for the conservation of both time and material is one of the many problems which the war has brought home to the American people. Confining myself to the municipal field, I wish to call particular attention to the time and money required because of the inaccuracy and in many cases the utter lack of records of municipal engineering projects in the offices of many city engineers, and to suggest a way of preventing or lessening this lack in the future.

It seems to be a reflection upon the engineering profession, to reply to a taxpayer inquiring about a sewer or a water line built only a few years ago in front of his property, that it will be necessary to send a gang of men and dig it up before he can get information which should be forthcoming in a couple of minutes. A similar lack of records often causes more serious trouble, attended with possible loss of property and life and with certain expense. For instance, the writer once had to shut off about 5000 persons from the use of water, including fire protection, for a period of several days, because no record had been provided by a predecessor for use in locating valves which had to be shut before it was possible to replace a broken main. In another case which has come under the writer's observation, improvements and extensions to existing sewer and water mains are costing from one-third to one-half more than they would cost were proper records available regarding the location of sewer Y's, water valves, etc. The main reason for such conditions is the employment of incompetent men as engineers.

Most city authorities are not in a position to audit their engineers' records, nor does there now exist an agency to which cities can apply for such aid. Most cities hire a man whom they consider a good engineer, as they employ a competent clerk or treasurer, but they place the latter under heavy bonds and have their accounts audited by certified public accountants periodically, in order to assure the safety of their funds. Meanwhile, the city engineer expends thousands, or perhaps hundreds of thousands, of dollars without check.

To remedy this deplorable condition, the writer would suggest the creation of a state board of municipal engineers whose sole duty would be to visit the office of each city engineer in the state, either at regular intervals or upon proper summons, for the purpose of investigating and reporting to the city authorities the exact state of affairs.

CLARENCE E. RIDLEY,
City Engineer.
Port Arthur, Tex.

Nation-Wide Legislation to Establish Bridge Loadings Needed

Sir—I have read your editorial on p. 878, issue of Nov. 14, with much interest, and suggest a matter which should be discussed at the Chicago convention—a matter which involves many millions of dollars; the loading for which highway bridges should be designed.

At present some states fix this loading by statute and some leave it to their engineers. This is good, but statutes are easily amended, and engineers die or resign and are succeeded by others with different ideas. The subject is a nation-wide one, and the loading should be established by uniform legislation throughout the country because many heavy trucks in the future will cross state lines. It is easy to specify an extravagant loading, but it is not so easy to pay for the bridges and other structures that will be necessary to carry it.

Economy will be the watchword, but it is not economy to restrict unduly the weights of transportation over the public roads. It should, of course, be borne in mind that whatever limits may be imposed by law on the weights to be transported on public roads, any concern, whether manufacturer, truck owner, street-railway company, quarry owner or other party, has a right to have public bridges built to carry any traffic he wishes to take over it, providing he will bear the additional expense it involves; the purpose of the proposed statute being to fix public liability, rather than to limit public transportation.

WILLIS WHITED,
Bridge Engineer, Pennsylvania Highway Department.
Harrisburg, Penn.

Number of Engineering Graduates

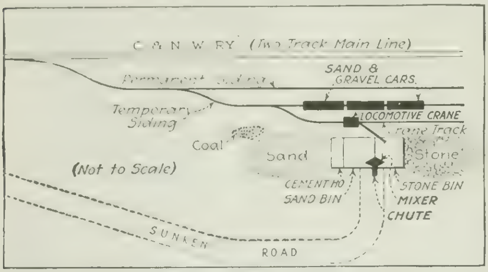
Civil engineering graduates from 1895 to 1916, inclusive, numbered 11,621; electricals, 6357; mechanicals, 11,291; miners, 3195; chemicals, 1172; general engineering 1897; metallurgical, 150; marine, 15; textile, 48; agricultural, 31; total, 35,777. These figures are from the United States Bureau of Education Circular No. 4, Aug. 30, 1917. The total number of graduates in engineering in 1895 was 752 and in 1916 4306. Students in 1916 numbered 33,106.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Motor Trucks Deliver Mixed Concrete Three-Fourths of a Mile

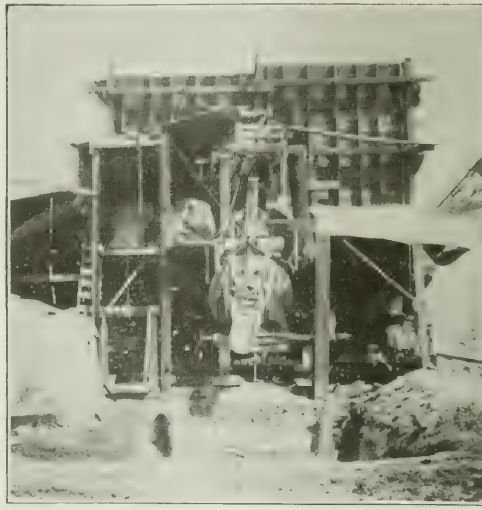
HAULING from a central mixing plant, four motor trucks have delivered 13,400 cu.yd. of concrete for pavement base at Edison Park, Ill. Base was laid on 5.7 miles of street. It was 24 ft. wide and 6 in. thick, of 1:3:6 gravel concrete. To cut down haulage and economize on labor, it was decided to install a mixing



MANUAL LABOR LAYING PAVEMENT BASE REDUCED BY CENTRAL UNLOADING AND MIXING PLANT

plant close to the point of delivery by railway of materials, and to haul the mixed concrete. This plan also kept the streets clear of material piles and mixing plants.

Temporary switches, as shown by the sketch, were led off the station siding, and a mixing plant was built alongside. This plant consisted of two elevated bins side by side, each holding 50 cu.yd. At one end of the bin structure was a ground-level cement house. The mixer sat under the bins on the side away from the tracks. An ordinary paving mixer was installed by blocking the wheels, jacking up the frame and replacing the elevating skip with a high-level charging hopper into which the bin chutes led. Cement bags were hoisted to the charging platform in an elevator



MOTOR TRUCKS BACK UNDER MIXER CHUTE TO RECEIVE FOUR BATCH LOADS

cage operated by the mixer engine, as described in *Engineering News-Record* of Nov. 21, p. 956. The bins were charged by locomotive cranes from cars on the stockpiles, as indicated by the sketch plan.

The average output of concrete per day was 305 cu.yd., the maximum day's run was 380 cu.yd. Operating the mixing plant was a crew of 13 men, distributed as follows: One mixer operator, one crane operator, two firemen, two car men, one dumper, five cement men and one handy man. The mixer discharged directly into trucks backed into the depressed roadway under the chute. Each truck received four batches, making a 2-cu.yd. load. It then ran to the work and dumped the concrete onto the subgrade. The average haul was ¾ mile and the maximum haul was one mile; the average time of haul was 14 min., and the maximum time of haul was 20 minutes.

LOCOMOTIVE CRANE HANDLES SAND AND GRAVEL

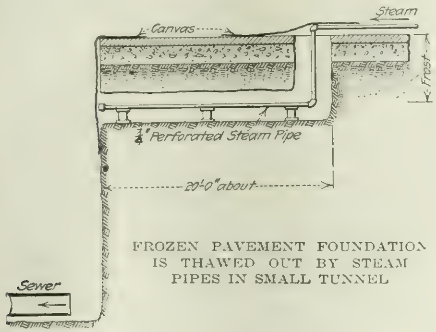
On the street the concrete was handled by a gang consisting of four shovelers, three broomers, two dumpmen, two graders and one stakeman.

The concrete was delivered without material leakage, and presented a good appearance both when it was spread and after hardening. The contractors for doing the Edison Park work were B. F. Conway & Co., Chicago, Ill.

Steam Pipes in Tunnel Under Frozen Pavement Aid Excavation

By C. H. Cotten
Lieutenant, Corps of Civil Engineers, United States Navy

IN BUILDING a large intercepting sewer through a paved street in very cold weather, considerable difficulty was encountered in breaking up the concrete base of the brick pavement, on account of 18 in. of frost



FROZEN PAVEMENT FOUNDATION IS THAWED OUT BY STEAM PIPES IN SMALL TUNNEL

underneath. This trouble was greatly reduced by digging a hole 3 ft. in diameter on the line of the trench about 20 ft. ahead of the section already excavated, and then tunneling between this hole and the excavated section.

Perforated steam pipes were placed in the tunnel, as shown in sketch, and hooked to the boiler of the excavating machine. Old canvas was used to cover the holes to retain heat in the tunnel. Steam turned into the tunnel for a few hours caused all the frozen earth to loosen up and fall from the under side of the concrete. The base could then be broken up with very little trouble.

Long-Handled Steam Shovel Digs and Fills Trench in 50-Foot Sections

TRENCH for a 7000-ft. sewer in Cleveland, Ohio, is being excavated and backfilled, at the rate of 50 ft. a day, by a single steam shovel. The shovel digs a short length of trench, the pipe is laid in the cut, and then the shovel, loading from a spoil bank, backfills the cut. Continuous repetition of this operation constructs the sewer, and only one piece of major equipment is required for the work. A trench 3 ft. wide and 15 ft. deep is being dug in hard clay overlying shale which has to be blasted. The shovel has a 30-ft. dipper handle; working five hours a day it is taking out 83 cu.yd., or 50 ft., of trench, and after

SHOVEL WITH 30-FOOT DIPPER HANDLES ALTERNATELY TRENCHES AND BACKFILLS

the two lines of pipe are laid it is backfilling the cut. The contractors, Randall & Cooper, Lorain, Ohio, estimate that the shovel replaces 30 laborers.

Construction Photographs Should Give Definite Information

By Rudolph T. Roesch
Thompson & Binger, Inc., Engineers and Contractors, Syracuse. N. Y.

CONSTRUCTION photographs, if they are presented in good form, are the records which interest clients most. A photograph which does not tell its own story is of little value. This may be how the site looks before work is begun, how work is progressing, how good the workmanship is, why progress is delayed, extra work that had to be done, special features of structure or construction plant—or, perhaps, faulty work—but there should always be a story.

Progress photographs are of most importance. Two vantage or observation points should be carefully chosen before work begins. Always take the photographs from these points, as progress is thereby emphasized. Different days, not less than two a week, should be designated, and on these days, weather permitting, one photograph should be taken from each vantage point.

Detail photographs will depend upon the subjects which present themselves for record. Suggested subjects are: Placing and handling material; exceptional and unusual formwork or concrete work; unusual structural features; finished work of various kinds, night work, special equipment, and ornamental details.

In addition to progress and detail photographs it is advisable to record extra work, conditions which hinder progress, faulty or defective work, and accidents. All photographs should be titled and dated. When the work is completed, those photographs which mean something, which show progress or excellent work, should be mounted in a small album. *Then use the album.*

NEWS OF THE WEEK

New York, November 28, 1918

American Reconstruction Conference Discusses Federal and Municipal Problems

National Planning, Housing, Garden Cities and Public Employment Among Topics at Rochester Meeting

Called before the armistice was signed to urge the need of Federal studies of reconstruction, the conference held by the National Municipal League at Rochester, N. Y., Nov. 20-22 was finally devoted chiefly to consideration of the lessons to be learned from unified national control in war time.

Besides the platform, several resolutions were adopted. One of these directed the president of the league to appoint a committee to promote local or community reconstruction activities, this committee to be provided with a full-time secretary. Other resolutions advocated the extension of municipal home rule, and provided for a committee to study public ownership and for a committee to coöperate with the United States Bureau of Standards in its "investigation into numerous technical problems of direct interest to municipalities, especially in the field of public utilities."

Relations of Government to Industry

In opening a discussion on the new relations of the Federal Government to industry and to state and local governments, Prof. H. L. McBain, Columbia University, said he thought the courts would hold legal a Peace Industries Board. He thought that Congress could legally authorize Federal acquisition of railroads, telegraphs and telephones under the post office and post roads portion of the constitution and that the Government could also legally acquire sources of industry—if it has the power to acquire forest lands, as it has already been doing. Government regulation of capital and labor seems almost inevitable, the speaker said, but as regards industries, control will be directed chiefly against evils rather than the industries themselves. One principle which labor would indorse and capital oppose is collective bargaining. Nothing strikingly new was expected by the speaker as regards the relation of the Federal to state and local government, except more coöperation.

A session devoted to "Replanning the United States in Regard to Transportation, Housing and Public Works" was opened by F. L. Ackerman of the Emergency Fleet Corporation. The taking over of the railroads by the United States, said the speaker, has shown that they were planned and built for no common or national purpose, but for speculation and for the development of territory. Terminal problems were neglected and at the opening of the war inland water transportation was almost dead. In not a single community where shipbuilding was taken up by the Government was there found a satisfactory forward-looking program to help in meeting the housing problems of shipbuilders.

Today the needs of ports and terminals and of agricultural areas to supply them can be forecast, Mr. Ackerman said. Why not plan accordingly? he asked, and said that if a plan be designed for the United States, then there should be one for the states, and if for the states, then for the cities. In the speaker's opinion such planning must be designed to satisfy the higher needs of industrial workers. There is nothing in their present surroundings to breed aught but discontent. In any industrial city which has developed rapidly the accumulated capital is not reflected in the environment of the workmen. Instead, we see ugly industrial buildings and ill planned cities or districts. "Garden cities" should be the ideal.

National planning must include regional planning and rural development, Mr. Ackerman contended. This requires the extension of the administrative work of the Government and the liberalizing of judicial decisions.

Street Railway Situation

The street railway situation was discussed at length by Delos F. Wilcox. Opening his remarks with the statement that his views were personal, he said that the present crisis was precipitated by the war, but that its origin lies far back in the "five-cent fare as a basis for speculation." The present problem is to get rid of over-capitalization. It is no longer possible to continue to pay dividends on ancient investments in mules and cable railways—which investments should have been written off long ago. In the larger cities, particularly where heavy investments have been made for subways and like facilities, municipal subsidies may be necessary if low fares are to be continued. The public is more interested in good service than in low fares. It

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All Restrictions on Non-War Building Removed

War Industries Board Announces That No Licenses of Any Sort Will Now Be Required

Since Nov. 21 no licenses of any sort have been required for new construction. This removes the last restriction on building, of those started early in the war. For ten days after the signing of the armistice prospective builders were required to get permits for non-war construction from state Councils of Defense. B. M. Baruch, of the War Industries Board, gave out the following statement regarding the latest ruling:

"The action taken permits all building operations of whatever character, held up in the interest of the war program, to proceed. No further permits will be required from the War Industries Board or the state councils, through whom control over the situation in each state was maintained.

"Immediately following the signing of the armistice on Nov. 11, the non-war construction section took steps to loosen the restraints on the industry, and in a formal order issued that day removed a great many of the barriers. Since then, and with a view to assisting the industry back to a complete peace basis as quickly as possible, a careful canvass has been made to determine whether the conditions obtaining in each state with respect to building materials, transportation, and the supply of fuel and labor would warrant a removal of the remaining restrictions. In this investigation the nonwar construction section sought the views of the industry itself and of the state Councils of Defense. The replies received, coming from practically all the states, showed a unanimous opinion in favor of such action."

Power Bills Probably All Dead

All of the emergency power bills and both of the water-power bills before the present Congress will in all probability be discarded, according to advices from Washington. The power bills were the so-called "war emergency power" acts, the first for $200,000,000 and the substitute for $50,000,000, which money was to have been utilized in the construction of new power plants and additions to old plants, mostly steam-driven, in the war-industry districts. The water-power bills, one of which had passed the House and the other the Senate, were in conference. They provided means for developing water-power on the public lands of the United States.

Hold Seven-Day Conference On Motor Transportation

Truck Owners Expect Boom for Industry—Practically Every Phase of Problem Discussed

A seven-day conference which started Nov. 16 under the auspices of the Colt-Stratton Co., New York, had for its object the dissemination of knowledge of vital interest to truck operators. Subjects of both local and national interest were discussed, and the speakers were unanimous in prophesying great developments in highway transportation.

Adaptations of the motor vehicle to the uses of modern warfare, rural express, store-door delivery, and intercity freight haulage, were described by prominent speakers. Economic problems, comprised under "Methods and Devices for Increasing Motor Haulage Efficiency," "Highway and Street Improvements" and "The Traffic Problem" were also discussed. A feature of the program was the showing of a film depicting the manufacture and exploits of tanks in France.

Advance in Motor Use During War

At the opening meeting, J. R. Eustis, of the Colt-Stratton Co. explained the purposes of the meeting and reviewed the great advance made in motor transport during the war. He stated that the United States has invested in motorized equipment for the Army to the amount of $500,000,000, and now has upward of 70,000 motor trucks in France and 30,000 more either on the way or contracted for. The motor truck has shown its adaption to every form of Army transportation, and motorized ice-machines, machine shops, water distillers, hospitals and airplane transports are now in use. In one operation the American Army transported a division of 38,000 men 116 miles in 16 hours to close the St. Mihiel salient, according to the speaker. Maj. George E. Greene, of the British Army Tank Service, made the statement that in 18 months of service he had not seen a single instance of the motor truck being out of commission from mechanical difficulties.

Monday evening was given over to the consideration of rural express and rural mail, the speakers being T. W. Fenn, executive secretary of the National Automobile Chamber of Commerce, and James I. Blakeslee, fourth assistant postmaster general. On Wednesday evening store-door delivery was the subject. It was discussed by Joseph Husson, editor of the *Commercial Vehicle*, and Arthur A. McKeever of the Ajax Trucking Co. Intercity freight delivery was the subject on Thursday evening, and the speakers were E. F. Foejambe, of the *Commercial Car Journal*, the Hon. Cyrus C. Miller, director of transportation of the Federal Food Administration, and others. All the speakers emphasized

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General Contractors Complete Organization

Over 165 Firms and 25 Associations Represented at First Annual Convention

Coördinated organization was the keynote of the convention last week at which final steps were taken to create the Associated General Contractors of America. Organization was urged, to the end that the contractors of America, like the other great business interests of the country, may present a united front in dealing with the problems which construction and reconstruction present to engineering.

Prominent speakers at the convention, including John F. O'Rourke, engineer and contractor; Brig. Gen. R. C. Marshall, Jr., chief of the construction division, United States War Department; Col. W. A. Starrett, chairman of the committee on emergency construction of the War Industries Board, and Harry A. Wheeler, president of the Chamber of Commerce of the United States, made the dual thought of organization and coördination the theme of their remarks. Three principal tasks, in the view of these speakers, confronted the association. First is the adjustment of the contractor's relations with labor, based on a broad recognition of labor's right to a voice in determining the principles and processes of industrial development; second is the adopting of a construction contract which shall fairly divide responsibilities and risks and assure a fair compensation for work honestly and efficiently done. General Marshall indorsed this thought when he said: "Time has passed when between the four corners of a sheet of paper may be written the words which will consign a contractor to bankruptcy." The third great task of the association is to coördinate the owner, the engineer and the contractor into a trinity having as its single purpose economic construction and the common good.

Experiences in Various Cities Told

The convention opened with an experience meeting. Secretaries of local contractors' associations of Chicago, Detroit, Memphis and New York told what organization had accomplished in their respective communities. The cost of conducting business has been lowered; the morale of the industry has been bettered; a finer *esprit de corps* has been created; recognition of contracting as one of the units of the business life of the community has been enforced, and more sound relations with owners and workmen have been established.

The constitution finally adopted was quite different from the committee's draft published in *Engineering News-Record* of Oct. 3, p. 620. The articles of most immediate interest to contractors are those relating to membership and to dues. The qualifications for membership follow:

"Sec. 1. Only general contractors, either individuals, firms or corporations, who have been engaged for at least two years in general contracting prior to applying for membership in this association, or who have established a reputation for skill, honesty and responsibility, shall be eligible for membership. They must also undertake work in its entirety, partly at least with their own constructing forces.

"Sec. 2. Members of the association must be associated organizations of general contractors, individuals, firms or corporations engaged in general contracting. Only such members of associated organizations as fulfill the above requirements shall have voting representation in this association."

Fixing of Dues

As presented by the committee the article on dues read: "Dues of the association shall be, for each individual, firm or corporation $50 annually. Dues for associated organizations shall be $10 annually for each voting member of such organization, with a minimum for each associated organization of $100 per year." Discussion on this article was active and assumed two sides. The argument of a part of the members was that extended membership was the first need, and dues should be small enough to accelerate increase in membership. On the other side the contention was made that money was needed, and needed at once, to prosecute the work of the association, and only by high dues could this money be obtained. As finally passed, the article read: "Dues of the association shall be, for each individual, firm or corporation, $100 annually."

The election of officers resulted as follows: President, D. A. Garber, New York; first vice-president, W. A. Rogers, Chicago; second vice-president, T. T. Flagler, Atlanta, Ga.; third vice-president, John W. Cowper, Buffalo; treasurer, C. F. Mullen, Cleveland. The constitution provides that the secretary shall be named by the executive board.

Delegation of American Engineers To Visit France

At the invitation of the Société des Ingénieurs Civils and a committee of the French Engineers' Congress, and with the official approval of the French Government, a delegation of American engineers has been appointed to study with French engineers certain problems involved in the rehabilitation of France after the war. This delegation was invited to come to Paris to examine in joint conference questions of the utilization of commercial ports the development of navigable waterways, the development of water power, and the improvement of road systems. Although these were the only subjects mentioned specifically, the congress will probably take up many other ques-

tions of development in which all engineers are directly interested. The invitation was sent to the American Society of Civil Engineers and was accepted at once by cable, the acceptance stating that such a delegation would be organized in coöperation with the other American national societies.

The following delegates have been appointed:

By the American Society of Civil Engineers — J. F. Case, chairman; George W. Tillson, George W. Fuller, A. M. Hunt, Nelson P. Lewis, and George F. Swain.

By the American Society of Mechanical Engineers—Charles T. Main, president.

By the American Institute of Electrical Engineers—Lewis B. Stillwell.

By the American Institute of Mining Engineers—E. Gybbon Spilsbury.

The date of sailing was originally set for Dec. 2, but it may be postponed a few days. The trip as planned will take about six weeks.

Motor Transport Conference

(Concluded from page 1003)

the great advantage to the public of utilizing these three new means of transportation and regulation.

Store-door delivery would decrease the cost of foodstuffs in New York City greatly, according to Mr. Husson. He brought out the fact that a bushel of potatoes can be delivered in New York for 70c., but the delivery charges at this end raise the cost to the consumer to $2.10. Mr. McKeever stated that freight congestion had extended as far as St. Louis, and that freight had to be returned to Chicago from New York for warehousing on account of the congested condition in New York.

The development of intercity haulage to 300 miles for less than carload lots was stated to be the field of the motor truck by Mr. Foejambe. Trucks with two drivers, having a sleeping compartment back of the seat for the use of one while the other drives, are now in service. One great advantage in this development of the motor truck is the elimination of terminal congestion by going from store door to store door.

Highways and their relation to motor-truck transportation were discussed by Prof. Arthur H. Blanchard, of Columbia University. Of the 2,500,000 miles of rural roads in the United States 0.25% are suitable for motor trucks, according to Professor Blanchard, who gave a general review of the highway situation. H. G. Sherley, of the Highway Industries Association, treated the highway problem from a national point of view, urging the desirability of national regulatory laws and increased national aid in highway construction.

These who desire a résumé of the proceedings of the conference can obtain one from the promoters, the Colt-Stratton Co., 1847 Broadway, New York City, who announce that similar conferences will be held semi-annually.

New Firm Organized by Dwight P. Robinson

Engineering and Construction Company with Headquarters in New York to Cover Wide Field

Dwight P. Robinson, a former partner of Stone & Webster, in charge of their construction and engineering business, has opened offices in New York under the name of Dwight P. Robinson & Co., Inc., constructing and consulting engineers. Associated with him will be R. M. Henderson, in charge of construction; C. W. E. Clarke, mechanical engineer; R. A. Philip and D. L. Galusha, electrical engineers, and M. E. Thomas, structural engineer, together with the nucleus of a strong purchasing, accounting and field construction organization. All of these men, for many years, have been engaged in large undertakings under Mr. Robinson's direction.

In the past they have specialized in the economical and rapid execution of difficult projects, and in the new work are prepared to construct, either from their own designs or from the designs of others, hydro-electric developments, steam-power plants, transmission systems, industrial plants, housing developments, steel and reinforced-concrete structures, the electrification of steam-railway systems, and similar work in this general field. They will also carry on a general practice as consulting engineers, including the making of engineering and financial reports and appraisals.

In these fields the members of the organization have had extensive experience, both individually and collectively. Mr. Robinson's work runs back for a period of 25 years, during which he has been associated with Stone & Webster, first in the management of some of their electric railway and lighting properties, later, for 15 years, as president of the construction and engineering branch of the organization. Since 1912 he has been a member of the firm.

While he acted in this capacity all of Stone & Webster's construction and engineering activities came under his personal supervision. Some of the more generally known projects were the extensive water-power developments serving the Puget Sound cities, the steam and water-power plants supplying Minneapolis, the electrical and transmission features of the Keokuk development on the Mississippi, the Big Creek development serving Los Angeles, and others in various parts of the East and South; large steam-power stations for Buffalo, Boston, Minneapolis, New Bedford, Youngstown and other smaller plants, aggregating over 500,000 kilowatts capacity; a wide range of industrial buildings, from simple warehouses and factories to monumental structures such as the new home of the Massachusetts Institute of Technology; housing developments, including complete towns with paving, sidewalks and all utilities. Mr. Robinson is a graduate of Harvard University and the Massachusetts Institute of Technology.

Mr. Henderson will, for the present, have charge of construction. He was with the Stone & Webster organization 12 years, seven as assistant construction manager at Boston, and three as district manager at Chicago. His earlier experience as industrial engineer on the staff of the Arnold Co., Chicago, and as electrical engineer of the Mexican Central Ry., was in both the design and the construction of railway locomotive and car shop plants and other industrial plants, including such projects as the principal shops of the Mexican Central Ry. at Aguascalientes, the Big Four Ry. shops at Beech Grove, Ind., and those of the Missouri Pacific Ry. at Sedalia, Mo. He was chiefly instrumental in the internal development of the construction department of Stone & Webster, and later had direct charge of a wide range of steam, hydraulic, industrial and building construction, including reinforced-concrete structures of many types. He is 39 years old and a graduate of the Armour Institute of Technology.

Mr. Clarke, for seven years with Stone & Webster, five as mechanical engineer and head of the division, has had a long and varied experience in the design of central power stations, and mechanical engineering in industrial plants.

Mr. Galusha has been working under Mr. Robinson's direction for 12 years, the past five as head of the electrical division. His experience also covers a long list of power stations and industrial plants in all sections of the country. Some of his best known work was done as electrical engineer in charge of the Mississippi River power development at Keokuk, and the Minneapolis General Electric Co.'s large steam station, replacing one destroyed by fire.

Mr. Thomas, who will have charge of structural design, has been engaged in a similar capacity with Stone & Webster for nine years. His work has covered the layout and design of industrial factories and plants, including the buildings and the structural features of steam and hydro-electric plants. His specialty has been in reinforced-concrete design, and, with C. E. Nichols, he is a co-author of "Reinforced-Concrete Design Tables." Some of the noteworthy concrete structures which have come under his direction are the monumental superstructure of the power station surmounting the dam on the Mississippi River at Keokuk, the concrete structural work of the new buildings of the Massachusetts Institute of Technology, the concrete buildings of the field and siege gun carriage plant at the Rock Island arsenal, and the less pretentious but larger brick and steel group at the Watertown arsenal. The numerous steel unit warehouse buildings and shop build-

ings which were fabricated in America and shipped to France for the American ordnance base depot back of the fighting line, as described in *Engineering News-Record* of Jan. 3, 1918, p. 23, were designed by Mr. Thomas. He is 35 years old and a graduate of the University of Illinois.

Mr. Philip's association with Mr. Robinson began 18 years ago, when he was electrical engineer of the Seattle Electric Co., which was then under the management of Mr. Robinson.

War work at various arsenals, cantonments, ordnance bases, and on other direct and indirect war plants in this country and France, has occupied these men from the beginning of the war until the need of such work has passed. They form the nucleus of an extensive staff whose development will keep pace with the activity of the reconstruction period. Adequate financial resources and connections assure the company's ability to handle operations of any magnitude.

American Reconstruction Meeting

(Concluded from page 1002)

is easier to insure good service, the speaker said, by municipal ownership and operation than through municipal or state control.

The broad subject of "Public Employment," including employees of both the Government and the public utilities, was presented by Charles A. Beard of the New York Bureau of Municipal Research. With the present Federal control of railway, telegraph and telephone facilities there are now some 4,000,000 Federal employees. The public must be educated to the necessity for trained and expert public servants, railway administrators, engineers, chemists, bacteriologists and others. Civil service commissions must be transformed into public employment agencies, charged not with turning rascals out but with getting and keeping efficient men into public service. The right of public employees to organize for other than social or beneficial purposes, and also the right to deal directly with the Government through committees and to strike, is, in the opinion of the speaker, sure to come with the increase in the number of public employees.

Federal housing was the subject of addresses by Ernest Cawcroft of the Emergency Fleet Corporation and of Richard S. Childs, New York City. These men and other speakers were enthusiastic over the achievements of Federal housing at some of the permanent cities or villages which have been developed along the "garden city" line. Mr. Childs expressed the hope that these examples of good housing and of good town planning would react upon not only the industrial workers who live in these houses, but also upon the country at large. The satisfactory appearance of some of these groups of houses is due not so much to the architect as to the town planner. A single one of these very simple houses looks bare, but a village of them properly grouped is charming. Particular reference was made to Buckman Village, near Chester, Penn., and to Perry Village, Md. Mr. Childs urged that the bureau of industrial housing in the Department of Labor should be continued, and suggested that a revolving fund might be provided for housing purposes, similar to the revolving fund of the United States Reclamation Service.

Concrete Freighter "Faith" Completes 12,000-Mile Voyage

On Nov. 21 the reinforced-concrete ship "Faith," which was launched in San Francisco last March, reached New York after a voyage in which stops were made at Vancouver, Lima, New Orleans and Havana, and totaled about 12,000 miles. On Nov. 25 she was put in dry dock at the Erie Basin in Brooklyn. So far as could be seen in an examination of the outside of the shell and bottom by a member of the staff of *Engineering News-Record* immediately after the docking, there are no cracks in the hull, nor is there any sign of rusting from lightly embedded steel. There was some slight marine growth, but in general the hull was remarkably clean. Examination of the inside of the shell is not readily made, because the wooden sheathing is fastened to the frames, but the holds were quite dry, and the shell, where it could be observed, showed no cracking. The ship encountered very heavy weather throughout the voyage, but handled well.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

The Western Society of Engineers has made the following nominations for office for 1919, through the nominating committee: President, A. S. Baldwin; vice-presidents, Kempster B. Miller, William M. Kinney, J. L. Hecht, treasurer, C. R. Dart. This is the first set of nominations made under the revised constitution of the society; the names are selected by a nominating committee appointed by the board of directors. Other nominations may be made, up to Dec. 20, by petition of 20 members.

The Municipal Engineers' Society of the City of New York held a meeting Nov. 25 at which Harry M. Devoe, deputy superintendent of school buildings, New York City, delivered a paper on "Repairs and Maintenance of Public School Buildings and Equipment in the City of New York." The date of the December meeting has been changed to Dec. 23.

The Albany Society of Civil Engineers was addressed at a meeting Nov. 26 by George F. Thompson, Lockport, N. Y., who spoke on "Hydro-electric Power." A nominating committee was chosen to select candidates for officers for the coming year.

The Engineers' Club of Trenton elected the following officers at the meeting held Nov. 14: President, Charles R. Fairchild; first vice-president, Alfred P. S. Bellis, and secretary, Joseph E. English.

The National Drainage Congress will hold its seventh annual meeting at Chicago Dec. 13. Edmund T. Perkins, Chicago, is chairman of the central co-operative committee in charge of the arrangements for the meeting.

The Engineers' Club of Philadelphia will be addressed by Dr. Lightner Witmer, Department of Psychology, University of Pennsylvania, at the weekly luncheon to be held Dec. 3.

Personal Notes

G. C. THAYER, formerly of the Cramp shipyard, Philadelphia, has been appointed general manager, Merchant Shipbuilding Corporation, Bristol, Penn., succeeding W. T. Smith.

C. W. STARK has resigned as associate editor of *Engineering News-Record* to go with the New York-New Jersey Port and Harbor Commission. His work will be to assemble in report form the data collected by the engineering forces of the commission. Mr. Stark was graduated from Harvard University in 1903, and entered railroad work in the maintenance-of-way department of the Baltimore & Ohio R.R. at Chicago. A year and a half later he entered the engineering department of the New York Central R.R., where he remained for five years, serving as draftsman, assistant engineer, and assistant to the engineer of grade crossings. His last year with the New York Central was spent in the general designing department. For

a year previous to his joining the staff of *Engineering Record*, five years ago, he was with the engineering department of the Central Railroad of New Jersey. His work on the staff of this journal has been largely in the railroad field, specializing in track elevation, terminals and valuation.

J. T. WILSON, district engineer, Baltimore & Ohio R.R., with headquarters at Baltimore, has been appointed consulting engineer, Baltimore & Ohio Lines East, Wheeling Terminal R.R., Western Maryland Ry., Cumberland Valley Ry. and Cumberland & Pennsylvania Railroad.

R. W. MCKINSTRY, who recently completed two years' service in France and Belgium, has been elected county engineer of Skagit County, Washington. He was a member of the 72nd Seaforth Highlanders and is a veteran of Vimy Ridge. Mr. McKinstry served three terms as engineer of Goodhue County, Minnesota.

ALBERT J. CHANDLER has been appointed chief engineer, Nevada Northern Ry. on account of the extension of leave of absence granted to P. R. Boese, formerly chief engineer, now serving with the Canadian engineering forces.

RICHARD MATHER, district engineer, Baltimore & Ohio R.R., with headquarters at Huntington, W. Va., has been appointed district engineer with headquarters at Baltimore, succeeding J. T. Wilson, who has become consulting engineer of the Baltimore & Ohio Lines East, as noted eleswhere.

MAX DIETENBECK has resigned as assistant engineer, Kansas City, Mexico & Orient R.R., and has become assistant engineer in the valuation department, Chicago, Burlington & Quincy R.R., with headquarters at Chicago.

CAPT. SAMUEL W. FLEMING, JR., of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., is now a major.

C. S. HERITAGE, bridge engineer, Kansas City Southern Ry., with office at Kansas City, Mo., has been appointed also bridge engineer of the Missouri & North Arkansas Railroad.

A. C. CLARKE has been appointed district engineer, Baltimore & Ohio R.R., with headquarters at Huntington, W. Va., succeeding Richard Mather, appointed district engineer with headquarters at Baltimore, as noted elsewhere.

A. S. ZINN resigned recently as designing engineer, Air Nitrates Corporation, New York City, to enter the office of the chief engineer, Missouri Pacific R.R., at St. Louis. Mr. Zinn was resident engineer, central division, Panama Canal, from 1906 to 1914, afterward serving as consulting engineer for the Republic of Panama.

V. V. KIRKPATRICK, assistant division engineer, Kansas City Southern Ry., has become valuation engineer, Missouri & North Arkansas R.R., with office at Kansas City, Mo.

LIEUT. J. H. H. MUIRHEAD, British Royal Engineers, is now on duty in this country as a lecturer with the British Bureau of Information.

H. J. ARMSTRONG, engineer maintenance of way, Missouri & North Arkansas R.R., has been appointed division engineer, with headquarters at Harrison, Ark.

I. A. COTTINGHAM, chief engineer, Southern Pacific Terminal Co. and Galveston Wharf Co., was recently appointed chief engineer of all Galveston railroad terminals.

R. E. VAN ATTA, principal assistant engineer, Kansas City Southern Ry., with headquarters at Kansas City, Mo., has been appointed also principal assistant engineer of the Missouri & North Arkansas Railroad.

OBITUARY

CAPT. HUGH MITCHELL PRICE, United States Engineers, died Nov. 4 in the embarkation hospital at Newport News, Va. He was born at Bloomington, Ill., and was graduated in civil engineering from the University of Illinois in 1903. After some professional experience in Oklahoma and Texas he went to Chicago, where he was, at one time, with W. S. Shields, sanitary engineer. Later he entered practice as a civil and sanitary engineer. When the war broke out he offered himself for military duty, and also volunteered for service as a civilian engineer. After being in Washington for some time in the latter capacity, he was sent to the Pig Point Ordnance Depot, near Hampton, Va., where he was construction engineer and afterwards chief engineer. In September, 1917, he received his commission as captain, but continued in charge of the work he had begun as a civilian. In August, 1918, he met with a motor-car accident, which was not considered serious at the time, but his injuries developed an illness which caused his death.

LIEUT. HAMILTON R. CLARK, United States Engineers, died of pneumonia in France, Oct. 1, at the age of 24. His home was in Stapleton, Staten Island, New York. Lieut. Clark had served in the 71st Regiment of New York, and on his arrival in France was transferred from the New York Division to the 305th Engineers.

DR. CHARLES R. VAN HISE, president of the University of Wisconsin, died in Milwaukee Nov. 19. He was born in Fulton, Wis., in 1857 and was graduated from the University of Wisconsin in 1879 with the degree of B. S., and in 1880 received the degree of M. S. In 1882 he was made a doctor of philosophy. From 1878 to 1883 he was instructor in metallurgy at the University of Wisconsin, and from 1883 to 1886 he was assistant professor of metallurgy, later becoming professor of mineralogy and professor of geology. He became president of the university in 1903. In 1909 he served as chairman of the Wisconsin State Conservation Commission. From 1908 to 1915 he was chairman of the board of arbitration in the controversy between the Eastern railroads and the Brotherhood of Locomotive Engineers. Among his works are "The Conservation of the Natural Resources of the United States" and "Concentration and Control—A Solution of the Trust Problem in the United States." He was also joint author of works on the iron-bearing regions of Michigan and Lake Superior.

PHILIP W. BRADY, who served in the San Francisco city engineering department continuously from 1864 to 1906, died in that city, Nov. 15, at the age of 76. After the fire of 1906 Mr. Brady's knowledge of the surveys of the city made his services invaluable in the restoration of the true positions and alignment of corners and street lines.

LOUIS BLACKSTONE, division engineer of the Philadelphia & Reading Ry. for 29 years, died recently. He was born in Connellsville, Penn., in 1849, and was graduated from Bethany College in 1870. He entered the employ of the Allegheny Valley R.R. as a member of the engineer corps. In 1878 he was made supervisor of the Pennsylvania R.R., and in 1889 he was appointed to the post he occupied when he died.

F. C. DE GUERRE, previously of the city engineer's office, North Vancouver, B. C., and later with the engineering staff of the Granby Consolidated Power Co., died recently in Vancouver.

CHARLES ERHARDT, acting chief engineer, Citizens' Water Supply Co., Newtown, L. I., died in Long Island City, Nov. 23, at the age of 38.

W. A. COWAN, superintendent of the western lines of the Canadian Government railways, died at Cochrane, Ont., Nov. 19, at the age of 40. He was also chief engineer of the district, and had three divisions in his charge.

NEWS OF ENGINEERING INDUSTRIES

Priority Ratings May Still Be Obtained

Certificates Will Be Granted Only When Need Is Urgent and in the Public Interest

Although existing priority ratings, with few exceptions, have all been revoked, it is yet possible to obtain rulings on urgent public business. Orders included in circular No. 58 of the priorities division, War Industries Board, dated Nov. 20, 1918, supersede all previous orders, revoke former rulings and explain exceptions.

After Nov. 22, 1918, all rules and regulations heretofore promulgated by the Priorities Division providing for automatic priority ratings are revoked and cancelled but applications for the issuance of priority certificates may still be made. The circular states, however, that such applications should be made only where the need is urgent and where it is clearly in the public interest. Under such circumstances priorities will be granted.

Among the activities classed as those in the public interest, orders from the Navy, Emergency Fleet Corporation, railroads, telegraph and telephone companies and the War Department rank first. The manufacture of farm implements, tools and machinery, the production of natural gas and petroleum with the necessary machinery for distribution, the expansion of coal mines, coking plants and ore-reduction machinery, smelters and furnaces are also included. The Priorities Division requests the industries of the country to speed up production and filling of orders for these purposes, to insure delivery when required without the necessity for priority assistance.

The circular concludes with the statement that the Priorities Division will from time to time promulgate such rulings and make such suggestions and requests in connection with priorities in the production and supply of fuel, electrical energy, labor and transportation as the changing conditions may require.

Building Industries Will Hold Atlantic City Meeting

A meeting of the National Federation of Building Industries will be held in Atlantic City, Friday and Saturday, Dec. 6 and 7. These meetings will follow the reconstruction conference and will be held in the Hotel Traymore.

The notice states that any association of architects, contractors, engineers or manufacturers and distributors of building materials who have failed to receive formal notice are invited to send delegates to act for their respective organizations.

Foreign-Trade Statistics To Be Revised and Extended

A revision and extension of the monthly, quarterly and annual foreign-trade statistics published by the bureau of foreign and domestic commerce, Department of Commerce, are announced to take effect in the near future, probably Jan. 1. More than 1500 new items will be added to the export classification, and the number of import items shown will be materially increased.

The plans now nearly completed provide for an enlarged classification for both imports and exports, instead of the two classifications at present used, and instead of the present alphabetical arrangement of items by commodities there will be a more general assembling of items under larger groups. Adaptability to mechanical tabulation also has been kept in mind in making the changes.

A bill is now in Congress providing for the publication of annual trade statistics by calendar instead of fiscal years.

Ship-Engine Contract to Kansas City Manufacturer

The United States Government has let a contract for five marine engines, each to cost $25,000, to an inland plant, owned by the Smith & Sons Co. of Kansas City, Mo., which formerly manufactured road-making machinery and is converting its plant to make these engines. The engines will be made in their entirety at the plant, and the contract must be completed by Jan. 1.

The contract was accepted under the condition that the plant could be made adaptable for production at once, it being necessary for the company to rearrange its entire plant and build a new machine shop 60 by 300 ft. in size. The shortage of steel made it necessary to construct this addition or extension entirely of wood, with only about ½ to 1 per cent. of indispensable steel.

Economic Aid to Russia Through a Government Corporation

The execution of plans to render economic aid to Russia has been intrusted by the President to the War Trade Board. To carry out or administer such details of this economic program, in regions and lines of trade where it is not possible to accomplish the desired end through the ordinary channels of trade, a corporation has been established which will be known as the War Trade Board of the United States, Russian Bureau (Inc.) The capital of the corporation, which is to be operated in the interests of the Russian people, is placed at $5,000,000

Good Roads in Central Spain Increase Auto Traffic

Improved Financial Conditions Make Extension of Highways and Wider Use of Motors Probable

The excellent system of boulevards and roads in Madrid and the surrounding provinces of Spain invite an ever larger public to take up motoring, according to a recent commerce report. This, and the improved financial position now occupied by the nation, with its resulting increase in spending ability, make a market of increasing potential importance.

Until 1914 France was the pioneer in this territory for high-grade motor cars. Her place as Spain's nearest industrial neighbor, her ability to make deliveries of automobiles and spare parts quickly, and the quality of her production, gave her the dominant position. Another factor was the belief that the services of French mechanics were essential to the proper operation of their cars, and another was the tendency of Spanish chauffeurs and mechanics to consider a technical education incomplete without a period of practical training in the automobile factories of France. For these reasons there was only one make of American automobile in operation in central Spain up to the outbreak of the war.

Obstacles Overcome

The report states that although the extensive present sale of American machines is attributable to the war's interruption of trade currents, the success of the vehicles of medium and better grades has resulted from the efforts of several local agents in introducing the product. This result, it is pointed out, was attained in spite of certain serious obstacles arising in the United States. American manufacturers demanded payment f.o.b. factory or New York, and in other ways displayed a lack of interest in the trade, and the opportunity for building up the business in the capital and in the central region of Spain was apparently a matter of unconcern. If this passive attitude on the part of American automobile exporters persists when the return of normal conditions again permits of European competition, it is stated that a rapid loss of present trade will result.

The shortage of gasoline and the long delays in receiving cars from the United States have already produced a falling off in the business for 1918, and at the close of the war a determined effort will be made by French, English and Italian automobile manufacturers to regain the lost market. The commerce report states that a concerted

and vigorous campaign of publicity concerning the excellence of American design and construction is necessary to acquaint the Spaniard with the latest progress in the motor-vehicle industry of the United States. Spanish requirements and taste, it is pointed out, must be considered in building cars for sale in that country. Right-hand drive, a low chassis, long head, obscure body color, and the indication of tire and wheel measurements in millimeters, are among the features deemed indispensable by Madrid purchasers of motor cars.

Barcelona Invites America to Use Her Free Port Facilities

Reports indicate that America has been the first to be invited to occupy and use the free port facilities of Barcelona, Spain. The city was made a free port by royal decree about two years ago, although actual construction has not yet been started. The work is planned, however, and will be commenced on an extensive scale in the near future.

During the construction of the free zone a portion of the ordinary port will be set aside as a free zone and will be ready for use about the middle of December.

The only charge in the free zone will be for storage. This, although not definitely fixed, is not expected to exceed ⅛ of 1% of the value of the merchandise. The usefulness of such a port in this locality lies in its position as a distributing center for Mediterranean and near east ports.

Empl yment Service Has Placed 2,500,000 Men

The United States Employment Service, under the Department of Labor, has found places for approximately 2,500,000 workers, from the time of its organization last January to Nov. 1. The employment service has announced that the number of its officers has been increased from 90 to over 900. It is expected that the service will be used very largely in the placing of discharged soldiers and sailors.

No Marked Change in Steel Situation Yet

No visible effect is yet apparent in the local steel situation from the cessation of hostilities, according to reports received from the steel industry. An easing of the tension is felt on account of the diversion of shell and other munition steel to other lines, but the uncertainty of the future makes the market almost as inactive as when the industry was on a 100 per cent. war basis.

Bonds for Concrete Street Work Issued in New Zealand

Bonds amounting to over $600,000 have been issued by the city of Auckland, New Zealand, for the building of several miles of concrete street. This improvement, it is stated in *Commerce Reports*, will give the city from 12 to 16 miles of up-to-date streets, and there is now under construction or already financed about 23,000 sq.yd. of concreting on two thoroughfares of the city. This class of pavement, it is stated, has been found very satisfactory.

The report states that the cement plants of the country are able to supply the necessary cement for this work, but that there is an opening for American concrete-handling and other machinery for use in these improvements.

Industrial Development of India Started by War

New Plants, Including Engineering Industries, Have Created Demand for American Products

The demands of war have started a wide industrial development in India. The older activities, such as tanning, the manufacture of jute, and cotton weaving, have been enlarged and electrical appliances and machinery have been introduced. The industrial field has been widened by hydro-electric plants, iron- and steel-working and engineering industries generally, in all of which a large amount of American machinery has been used.

Shells, rivets, bolts and nuts have been produced on an extensive scale. Machines such as were never produced before in India have been made. A company has been started to manufacture brass and gun-metal work. One large firm has manufactured articles formerly imported, to a large extent, such as jute-mill machinery, lathes, steam hammers, winches and baling presses.

As an indication of this industrial activity it may be noted that a large iron and steel company, whose plant is located at a town near Calcutta, has become so extensive as to give the town the pseudonym of the "Pittsburgh of India." This development alone is due to the necessity of meeting the constantly increasing home and foreign demands. The company is engaged almost entirely on Government orders, particularly rails, but the plate- and structural-steel demand is rapidly developing in connection with the rapid growth of India's shipbuilding program. The company has a contract with the Government alone for supplying 10,000 tons of plates per annum for 10 years, and is constructing a mill capable of rolling plates of any desired length and up to 90 in. wide. The plant will contain two sets of three-high rolls with the necessary straightening rolls. It will have a capacity of about 100,000 tons per annum. In addition to this, the company is building a large structural shop, in which it will be possible to roll beams of 3 to 24 in., and a new steel-casting plant, in which steel castings up to 35 tons in weight will be poured.

Other industries have extended their operations since the war began and are preparing to expand still further after the war. These will serve to show the possibilities of the situation, and how it has appealed to India.

Industrial development has long been regarded by many in India as the necessary accompaniment of political progress, and it is now regarded as likely that a Department of Industry will be established to supervise this expansion.

BUSINESS NOTES

The Missouri Valley Bridge & Iron Co., Leavenworth, Kan., has been appointed supervising engineers for the new engineers' cantonment to be constructed at Fort Leavenworth, and also for the additional coast defense cantonment at Galveston, Tex.

The John A. Stewart Electric Co., John A. Stewart, president, formerly of Cincinnati, Ohio, has opened offices in Chicago in Room 1034, 208 South La Salle St. The c mpany will handle second-hand machinery, both electrical and steam.

At a recent special meeting of the board of directors of the Independent Pneumatic Tool Co. held in Chicago, Roger C. Sullivan was appointed a director, elected chairman of the board and member of the executive committee, to succeed John P. Hopkins, deceased.

The P. J. McHugh Paving & Construction Co., Seattle, has filed a petition for the termination of the arti les of incorporation of the concern. Members of the firm are P. J., Frank and A. McHugh, and H. M. Hood.

TRADE PUBLICATIONS

The Moore Trench Machine Co., Rockaway, N. J., has published a 26-p. catalog, 6 x 9 in., describing the variety of uses to which its trench-working machinery can be put. It is illustrated with half tones and line cuts.

"Air and Light in Foundries and Forge Shops" is the title of a 27-p. booklet, 6 x 9 in., issued by David Lupton's Sons Co., Philadelphia. It describes and illustrates with half tones and line cuts the construction of sash types and roof formation manufactured by the company.

Two booklets have been received from the Great Western Cutting & Welding Co., San Francisco, Cal. One is entitled "Catalog No. 11," and describes and illustrates the Victor oxyacetylene cutting and welding apparatus; the other is an instruction book on oxyacetylene cutting and welding, using the Victor equipment.

Engineering News-Record

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Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

In This Issue:

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, *President*

Engineering News-Record

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AND CONTRACTING

E. J. Mehren
Editor

Charles Whiting Baker
Consulting Editor

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The President and Public Ownership

PUBLIC ownership advocates, of the variety that sees the millenium in ownership of every public-service enterprise by the people, will find little consolation in the President's message to Congress last Monday. Far from indicating a leaning toward national ownership of the railroads, he stated that he should feel obliged to turn them back to private control before the statutory time has expired unless some policy far more convincing than any yet proposed is soon worked out. At the same time he deplored the alternative of a return in all fullness to pre-war conditions. Every right-thinking man will agree, we believe, in the hope that the President's threat of early return will result soon in the formulation of a policy which will allow the maximum benefit from coöperation, yet retain private ownership. The rapid formulation of such a policy should not, however, interfere with the return of the roads even before the statutory period has expired.

President Backs Land Reclamation Program

RECLAMATION of arid, swamp and cut-over timber lands as a prompt and effective way of providing work for those of our returning soldiers most in need of aid deservedly occupies a prominent place in President Wilson's message to Congress. His hearty indorsement of Secretary Lane's reclamation-reconstruction plans should meet with country-wide popular support, made effective by immediate Congressional legislation and appropriations and by similar state action where state and Federal coöperation is necessary. Engineers and engineering societies—local, state and national—can and should help in formulating plans and securing popular support for immediate land reclamation. Unless it be highway construction, nothing else promises such speedy and effective opportunity for the returning soldier, and it will at the same time be of far-reaching benefit to the country and to the world at large through increased agricultural production.

Teachings of Miles Acid Sewage Tests at New Haven

FRESH illustration of the limitations which hedge about every method of sewage treatment which has yet come to the front is afforded by the summary of the New Haven tests of the Miles acid process printed on p. 1034. Recovery of both grease and fertilizer is claimed for this process. As has happened so many times with other new processes, when this one was put to a commercial test serious difficulties arose. These pertain to the conversion of the grease to a utilizable form. Under New Haven conditions the advantages of the Miles acid process are held to offset the difficulties in grease treatment, but the implications are that in many other communities this would be far from the case. Other tests and further developments may broaden the chances for wide use of the process. Meanwhile, it may be regarded as worthy of further study but not as safe for adoption until after disinterested expert investigation, like that at New Haven, indicates that it will produce better results at lower costs than other methods adapted to given local conditions.

The Spruce Victory

A GREAT purpose and a great leader backed up by organized talent, team work and enthusiasm—that was the Spruce Production Division of the Army, with headquarters in Portland, Ore. Without actually seeing the results, it is hard to appreciate the importance to our war program of the work this organization was doing in the Pacific Northwest. Now, of course, like all other war agencies, it is being disbanded. Radically different methods of logging, and entirely new methods in the sawmill, were worked out by leaders unafraid to disregard precedent. Out of their fresh and broader view came enormous increases in total production of spruce and—what is still more important—an almost unbelievable improvement in the quality of the product. The thick spruce stands of the inaccessible regions have been tapped by railroads—thirteen of them—located, built and operating in less than a year, and a new goal of practically doubling the present output was recently announced. Popular attention during the year has been elsewhere, and the men in the Spruce Production Division have been too busy to tell of their work, if they would. Therefore, little is generally known of problems and successes that under other conditions would have had world-wide publicity. This would have been particularly true in engineering circles, because of the engineering pioneering involved. The policy of putting engineering problems in the hands of engineers has been followed by General Disque from the outset, and too much praise cannot be given him for his methods of management. His farsighted analysis of the spruce production problems and his ability in handling men have made him the greatest single factor in the success attained. Now, that the work is closing down it is a pleasure to record the achievements and to give to General Disque and his colleagues the credit they so richly deserve.

Effective Use of Our Merchant Marine

WE DO not believe that many thinking citizens of this country need to be convinced further that the retention in American hands of our new merchant marine, and its operation on terms that will permit of competition with foreign nations, are necessary for the future prosperity of our country. Nevertheless, the support of competent authority is always helpful in strengthening us in our beliefs. We find these words in an address by Stevenson Taylor, president of the Society of Naval Architects and Marine Engineers, before the twenty-fifth annual meeting of that body: "It is incredible that any administration of the United States Government shall sacrifice the great funds and efforts, individual and collective, that have been expended in the past two years to build up facilities, to educate men—and women, too,—in order that we may have and operate ships of our own; and if there are laws upon our statute books that prevent our reasonable operation of ships they must be amended; if our loading, unloading and other port facilities are not what they should be, they must be changed; if there is anything which interferes with our progress upon the seas, it must be removed and if there is anything yet lacking to advance this progress, even Government ownership, or private ownership aided by a judicious government, it must be developed not for the advantage of any section or coast, but for the needs and advantages of our whole nation."

Cabinet Attitude on a National Highway System

ENGINEERS and contractors, particularly those interested in highway work, will look upon Secretary Houston's statement of Nov. 27 as one of the most important that has ever been made concerning our highway problem. The secretary, after discussing state and Federal expenditures for road work, added: "Still, it seems to me that we should take a further step. . . . It would be in the public interest to make available larger appropriations from the Federal treasury to be used *separately* or in conjunction with state or local support." The important word in this statement is the word "separately," which we have taken the liberty to put in italics. Later in the interview the secretary stated that he had canvassed his various suggestions regarding highway work with the President, the Secretary of War, and the Postmaster General, and had found them in accord with regard to the appropriation of additional funds. He does not say in the latter connection that he specifically canvassed the matter of separate expenditure of funds by the Federal Government but it is presumed from the context that such was the case.

The statement does not commit the secretary to the policy of building a national highway system, but, by considering it as an alternative of Federal aid, he shows at least that he is not averse to such a proposal. The Government's attitude in the past has been strongly set against a national highway system, to be built and maintained by Federal funds. In thus taking a step forward, the President and his cabinet advisers are merely reading, and reading aright, not only the public demand but the new conditions which have made necessary the adoption of a policy of national highway construction. *Engineering News-Record* in the past has been opposed to a national system, but the new conditions introduced by motor trucking have so changed the situation as to leave no doubt of the necessity of completing the highway net of the country by adding to our county and state systems a national system tying in the various states just as efficiently as rail lines now do for the bulk of our transportation.

Secretary Houston's views lend added importance to the highway congress which will convene under the joint auspices of the American Association of State Highway Officials and the Highway Industries Association in Chicago next week. The subject will be among the other broad questions of policy discussed. The meeting, taking its cue from Secretary Houston, should do much to crystallize the nation's thinking on highway work, particularly as to the advisability of building a national highway system.

The New Industrial Consciousness

OUT of the chaos of building a great war machine there is emerging one highly desirable result, not evident so long as munitions of war engrossed the attention of most industrial leaders, but now becoming evident. This is the strengthening of our great industries by a closer relation of those engaged in them. Heretofore, with a few exceptions, fear of our laws prohibiting the partial coöperation within industries which other countries found most helpful, and ample markets developing steadily under the existing methods of business warfare, checked the development of business association within the industries. Then the wartime needs suddenly changed the entire relations of manufacturers among themselves. The administration found that many of the things Congress had prohibited were absolutely essential for the maximum service from the railroads, and those prohibitory laws fell on the scrap heap. In order to send munitions to Europe on General Pershing's schedule, the War Industries Board forgot the Sherman law and all other laws, called together the representatives of each essential industry, and told them to work together to increase their output. In other cases, the same procedure was followed to make non-essential industries curtail their output, in order that materials, fuel, labor and transportation might be saved for more essential purposes.

The administration has been knitting together the members of each great industrial group. They have learned to coöperate for the nation's benefit and to their own good. They are now facing the great strain of reconstruction, and of their own volition many of them are reaching the conclusion that what the administration found necessary in war the industries will find helpful in peace. The American Iron and Steel Institute and the Portland Cement Association long ago proved their industrial usefulness to those who came in contact with them. It required war conditions to show to the nation their value in swinging great industries as units into the service of the country.

Perhaps the most significant development of this idea recently has been in the oil industry. Fifteen years ago

there began a timorous groping toward some kind of recognition of the possibility that competing producers were not necessarily business pirates. Local associations arose from time to time, but it took the war to demonstrate clearly that a strong national oil-producers' association was necessary to coördinate the development of our petroleum resources on a sound basis. The National Petroleum War Service Committee will undoubtedly be succeeded by some organization adapted to normal conditions. Other industries, not so prominent but of great significance in the nation's life, have now the same opportunity and the same incentive to get together, in order that a united effort may be made for their welfare, and for the elimination of all the waste of time, energy and money due to independent, uncoördinated endeavor to accomplish reforms only successful when comprising an entire industry.

An Engineering Failure

WHEN the public is served as it was in the recent moving of several very heavy viaduct girders through the streets of New York, as reported in the news columns of Nov. 7 and discussed in this issue (p. 1041) by an eye-witness, the engineering profession has little cause to take pride in the performance. Needless to say, the damage need not have occurred, for the art of construction has ample means at its command to build a simple viaduct in more conservative manner. That it should not have been allowed to occur is no less obvious; certainly from the standpoint of the public the injury to property and the accompanying danger to public security should have been prevented at almost any cost.

Not only were asphalt pavements, manhole structures and tracks injured, and a large gas main ruptured, but the risk of much more serious damage was present during the trucking. These results must be charged either to a serious lack of prevision or to a faulty view of relative costs—weighing a saving in erection expense against the risk of damage and menace to safety incurred in trucking extraordinary loads through the streets.

It is clear that the public's interest was left unprotected. Blame for this rests solely upon the engineer; the contractor's part in the matter may be left out of consideration, since his work was in all respects under the direction of the engineer. Most remarkable, perhaps, is the fact that the engineering bureau which was in charge of the viaduct construction, and therefore responsible for the trucking, the city's Bureau of Highways, damaged public property which was intrusted to its own care. A more thorough failure of trusteeship to the community can hardly be conceived. But, even apart from this special relationship of trust, the engineer's disregard of the public interest is a matter of the most serious concern. No obligation is more urgent than that imposed by his duties to the community in which he lives.

Modern construction is able to meet most varied requirements as to strength, weight and space. No branch of the whole art is as highly developed in this regard as steel construction. Structures may be built of straight or of curved members, of large or of small units. Columns and girders may be constructed integrally or in sections built together at the place of erection, without sacrifice of service qualities. With such means at his command, the structural engineer is under obligations to use them not only to suit the technical requirements of his structure but also to serve the interests of public convenience and safety. He cannot plead the justification of necessity when he plans to erect in the heart of a city a structure of ponderous steel units that create danger and cause destruction while being moved to the site.

What advantage was gained by avoiding field splices in the girders is not apparent. The method pursued involved very great expense. Unquestionably it was more costly than its alternative, even apart from the matter of property damage. And in addition it entailed grave risk of causing interruptions of vital public services. Yet it will not produce a better finished structure.

Thus, the primary failure must be traced back to the design. Its source, no doubt, lay in lack of prevision; the work was studied more with regard to the structure than to the processes lying between the project and its final realization. Similar lack of prevision, however, must be charged against the engineering represented in supervision and execution, for in each stage the results should have been foreseen.

The most serious effect of the undertaking, we believe, is not the material damage done—to the public—but the harm done to the engineering profession itself. Citizens and taxpayers noting the facts of the case are bound to conceive a distrust of engineering skill. They may fairly conclude that the art of construction has progressed but little beyond that primitive stage when its works involved the expenditure of life as well as money. Such an operation as the present one, therefore, jeopardizes the asset of public confidence and good will which the engineering profession has built up through a long history of successful achievement.

The Port Problem of the Future

EVERY sign points to a tremendous future for the United States upon the ocean. The demands of a world starved of commodities for four years, the establishment of a shipbuilding industry that cannot be allowed to die, and the revived habit of the sea which our country lost with the passing of the clipper ship all call for a merchant marine capable of winning its share of the world's free markets. How to develop successfully that merchant marine is one of the many problems of today. The questions of seamen's laws, Government ownership or subsidy, efficiency of ship construction and operation, and the design and control of ports, all have to be studied and answered in the next few years. The problem of the port is, above all, one which calls for engineering thought and action.

In the restricted sense in which it has been attacked in the past, the port problem is merely the problem of the terminal. It resolves itself into reducing to the lowest terms the cost of getting goods off and on a ship. As in all other forms of transportation, this cost forms the major part of the total charge against the movement of freight. So haphazard has been the development of the ports of this country, so careless the general attitude

toward foreign trade, that so far as methods of handling are concerned there is not a major port in the country which could not be completely revamped with profit. Moreover, whether it be the result of railway domination of the water front, the vicissitudes of political control, or the inevitable congestion resulting from disordered development, port layout, too, is in need of general revision.

The various local port authorities realize the situation today; from nearly every city on the Atlantic, Gulf, and Pacific coasts come reports of bond issues, port-commission studies, and actual construction work, all looking toward the material improvement of the port facilities to meet the coming increase in foreign trade. It can be confidently expected that the new designs and construction which will surely come in the next few years will be far in advance of the existing facilities. As a result, we may look forward to a material reduction in the cost of transferring freight to and from ships.

Unfortunately, however, the best mechanical equipment or engineering design does not itself attract business, as several of our leading secondary ports can testify. In so far as it reduces the cost of transferring freight which does come to the port it is an advantage, and one on which the local authorities can hardly spend too much time and effort. But the port can no longer be considered merely as a mechanical terminal. It must be treated as a link in a grand transportation system stretching from every store and factory in this country to and from the landing quays and docks of every foreign port.

As such, its economical operation, with the consequent reduction in cost of foreign trade, passes beyond the control of local port authorities and becomes a national problem. Here, then, is the critical element in the future problem of the port. How are we to have the necessary independence of the port itself, that initiative of construction and operation which only local pride and business necessity can secure, and at the same time preserve some Federal control over the freight routes which will give a maximum two-way cargo for the ship and a minimum land carriage for the ocean-directed freight? With Government operation or even control of our merchant marine there is inevitably connected the problem of most efficient use, and that involves all the factors that are here considered.

So long as war conditions prevail, the Federal government through the Railroad Administration and the Shipping Board can exercise this control, and can parcel out the business to the various ports on the basis of what they consider national economy, regardless of local profits. As soon as the war-recovery period is over, however, the country will be face to face with the alternative of a possible political control which all Government direction invites, or local port administration which does not look beyond the benefits to its own immediate district.

Somewhere between the two must lie the solution. Ocean-carrying costs must be reduced to the lowest limit, if the United States is to meet competition. Local business initiative should not be limited. The day of railroad dominance of our ports is past, and the scientific routing of freight, based on a sure knowledge of the origins and destinations of various commodities, will supersede the artificial routing which has largely prevailed. The opportunities for the presentation of the essential facts on which the new order must be built lie with the combined engineering and business talent of the country.

Contractors Undertake Unification of Construction Industry

UNIFICATION of the construction industry is the reconstruction task undertaken by organized contracting. Two weeks ago, in Chicago, addressing the Associated General Contractors of America, Brig. Gen. R. C. Marshall, Jr., director of war construction contracts amounting to over a billion and a quarter dollars, enjoined these duties upon the new society: To affiliate employers and workmen in the construction industry; to bring equal responsibility into the relations between owner and contractor; to join the engineer and the contractor into a partnership of mutual confidence. Can organized contracting bring about these results? The spirit of the Chicago convention answered, Yes. And we, knowing the contractors of the country, heartily subscribe to the same belief.

By the mere fact that it sets itself high ideals an organization takes on strength. No higher ideals were ever accepted than these of unifying the construction industry of America. Schism has always characterized this industry. The engineer has set himself apart from the contractor, and the owner has held jealous guard against the rights of both. Against all stood labor. This is not because workmen or contractors or engineers or owners are naturally dishonest, but because they have let their relations with each other become perverted. Unification of the construction industry is primarily the problem of eliminating the evil from the relations between owner, engineer, contractor and workmen. Can organized contracting find the common denominator of the opposing factors?

In a typical speech John F. O'Rourke, veteran engineer and contractor, defined the contractor as "the man who draws together the materials and the artisanship which create the structures which the engineer draws." Incidentally, this thought was repeated by Col. W. A. Starrett, chairman of the Committee on Emergency Construction of the War Industries Board, when he defined the contractor as a collective expert. As collective experts, Mr. O'Rourke asserted, contractors have peculiar talents for accomplishing unification because, besides having in common with the engineer knowledge of length, breadth and thickness, they know also the fourth dimension of cost. Though uttered jocularly, this thought embraces profound truth.

Mutual recompense is the common denominator of the trinity of problems which General Marshall set organized contracting. Lack of vital concern for, if not actual indifference to, mutual compensation for labor expended is the cause of every serious difference between owner, engineer, contractor and workmen in the construction industry. Our war construction has taught this lesson thoroughly. No such construction task as has been performed for war in the past eighteen months could have been accomplished with so little friction between the traditional enemies in the construction in-

dustry, had not a contractual relationship which assured mutual recompense been established at the outset.

Organized contracting can unify the construction industry. Every delegate of the Associated General Contractors of America left the convention hall in Chicago convinced of this fact. Every delegate left with the knowledge that assured mutual recompense for labor expended was the common denominator of the factors of the problem. If contractors will rally to this standard, set high at the Chicago convention, we shall before long look back on that meeting as a milestone in the progress of the construction industry.

The Most Hopeful Experiment in the Settlement of Irrigated Lands

FOR years our arid states and the Federal Government have been grappling with the problem of failures on irrigation projects. In many cases unscrupulous or incompetent promoters were at fault. But even on the Government's own work, where there is no suspicion of improper methods, there have been lamentable failures. There has been much investigation, and the errors are now pretty well known. It has remained, however, for the State of California to put in hand the first experiment in this country which strikes at the roots of the evil. That experiment, the most hopeful thing agriculturally that has been done in the United States in many a year, is described in an article on p. 1014 of this issue. Aside from its bearing on problems that have long been with us, it is pertinent today for the possibilities it shows of land settlement in the reconstruction period.

Briefly, the chief evils in our past methods of irrigated-land settlement have been the admission of plainly unqualified settlers to the projects, and the failure to give them, on private projects, any disinterested or expert advice. In the admission of unqualified settlers the public projects have been quite as much at fault as those under private control. California's approach to the problem has been, first, to insist that plainly disqualified applicants be rejected, and second, to afford the settler, both before taking land and after entering upon it, every assistance that expert agencies of the state and Federal Governments are able to furnish.

In rejecting those evidently unfitted, the California Land Settlement Board has done what other Government agencies have declared to be impossible—discriminate among citizens in the apportionment of the Government's bounty. The fear has been that political pressure would be brought to bear, or that the disgruntled would disparage the management and wreck the enterprise. The California board has stood solidly on the ground that the admission of the disqualified was an injustice to them and, on account of the economic waste, to the state itself. Such is the confidence reposed in the board that there has been no criticism of its selective work. When we hark back to the selective principle at the base of our civil-service law, we wonder why this precedent was not sufficient to give courage, before this experiment, for the application of the principle to land settlement.

It must not be thought that any board can pick prospective successes in 100 per cent. of the cases. There will probably be some failures, no matter how careful the scrutiny. The percentage of these, however, will be very greatly reduced by the expert counsel placed at the disposal of the settlers.

The second great feature of the experiment is the utilization for the benefit of the settler of all the available and qualified expert agencies. The Reclamation Service has done much in the way of community organization, but its work has started only after the settler has come on the project, and even then is not as complete as in the Durham effort. California calls in its experts at the very start, when the land is subdivided and valued. The settler knows exactly what he is buying, and the values are fixed with all factors in mind. How well the valuation work has been done is shown by the applications for the second allotment at Durham. Every tract was first choice of at least one applicant. In other words, taking into consideration the kind of soil, the distance from the village, the lay of the land, price, etc., every tract appealed to someone as the most desirable. Such conduct of its work gives promise of a strong hold by the Land Settlement Board on the confidence of California's agricultural interests.

There are additional merits of the scheme—the elimination of exorbitant commissions, the loaning of money for improvements, etc.—all interesting and important, but comment need not be made on them here.

Two other aspects of the experiment, however, should not be overlooked. At the minute we are deeply concerned with the problem of giving our returned soldiers as large an opportunity as possible. Many are to be re-inducted into industry. Some will prefer the farm, and to these the nation, either alone or in coöperation with the states, should offer an opportunity for becoming independent. It still holds true that an agricultural community composed of strong, independent men is the backbone of any nation. The California development points the way for assisting these men. Something more will have to be added in the way of financing, but this could readily be supplied by paying the men for their work in developing the irrigated units and adding this cost to the lands the same men buy later.

The other aspect is that in this time of mental fluidity, when a sense of responsibility to the nation still rests in the hearts of all classes, we can, even in the Eastern states, by proper leadership, show what can be accomplished by agricultural coöperation and the assistance of expert agricultural agencies. There is not a state in the Union which cannot find undeveloped tracts of land and corresponding numbers among the returned soldiers who would be glad to take them up if a proper system of financing could be arranged. A boy from the Eastern states will not look with enthusiasm upon a transfer to the arid West. Some few venturesome ones may want the novelty of pioneering in a new country, but most of them will prefer to remain in familiar surroundings. The national interest would be served by Congressional appropriations which, in coöperation with the states, would start a new era of land settlement in the Eastern states.

In all of these directions the California experiment shows a hopeful way. Its interest transcends the boundary of that state; its lessons are a contribution to the solution of a national problem.

Developing Irrigated Land with Selected Settlers

In California Experiment, Real Estate Sharks Have Been Eliminated and Expert Agencies Called in To Help Sales Problems

IT HAS been recognized during the past five years that the greatest problems in the development of irrigated lands are not technical, but human. On recent private projects effort has been expended almost entirely on building the works and selling the lands to anyone who had the price, the developer trying to "get from under" as rapidly as possible. In many places the methods of selling were unscrupulous, the commissions absorbed a large part of the purchase price, and the settler was left with worthless land or inadequate works. On pubic projects the unscrupulous features were removed, but care was not exercised to exclude those who plainly lacked the qualities necessary for success.

California has taken the first step in the United States in the adoption of an intelligent settlement policy. Its work has progressed far enough to give an indication of results—and the results are excellent and encouraging. Briefly stated, the aim of the experiment is *to give deserving and qualified persons assistance in acquiring small, improved farms, and to demonstrate the value of adequate capital and organized direction in subdividing and preparing agricultural land for settlement.* The method of selecting the settlers, rejecting the obviously unfit, is the most interesting feature of the whole experiment.

Inception of Plan—The experiment was inaugurated because a study, made by direction of the California legislature, of the conditions of settlers in colonies inaugurated by private enterprise, showed the heavy loss which individuals had sustained through the methods in

ALFALFA SEEDED BY LAND BOARD BEFORE LAND WAS SOLD MAKES FARM PRODUCTIVE THE FIRST YEAR

vogue. It showed that the colonization companies had made no study of the kind of agriculture suited to a particular locality, and no effort to determine the capital the settler must have or the conditions essential to his success. In every case the time allowed for payment was too short; the settler that could make the initial payment was accepted, regardless of the condition in which it left him. This report made it apparent that private land settlement was a failure, that this failure was not due to lack of resources, and that it could have been prevented had the projects been under competent direction and if the settlers had received expert and disinterested advice.

Pursuant to the recommendations of the committee which made the study, composed of Dr. Elwood Mead, director of rural institutions in the University of California, chairman; Mortimer Fleishhacker, president of the Anglo-California Trust Co.; David H. Barrows, professor of political science in the University of California; Harris Weinstock, a merchant of Sacramento, and Chester A. Rowe, editor of the Fresno *Republican*, the legislature in 1917 passed the Land Settlement Act, providing funds for the purchase of lands and their development and disposal to settlers under the direction of a State Land Settlement Board, created by the act. The sum of $260,000 was placed at the disposal of the board as a loan, all of the moneys to be repaid to the state in 50 years, the board to pay the state treasury 4% interest on such of the funds as was used. The board appointed consisted of Dr. Mead, as chairman, ex-Senator Frank P. Flint, a lawyer; W. B. Langdon, a judge; Mortimer Fleishhacker, a banker, and P. F. Coggswell, a farmer.

The Durham Tract

Some 40 tracts of land were offered to the board, and after competent examination two tracts at Durham (near Chico), in the Sacramento Valley, were selected as the most satisfactory for initial development. The tracts totaled 6219 acres, were partly under cultivation, and had water rights on Butte Creek. Ditches, of a more or less satisfactory sort, had been dug to parts of the land. There were no farmsteads. The terms of purchase by the land board permit of payment for the property in 20 years. Under such conditions of purchase the board can acquire a considerable area of land with the available funds, and still have sufficient money for the building of the necessary irrigation structures, for loans to settlers, etc. The cost of the land to the board was $100 per acre.

Before purchasing the tracts, the board settled a water-right litigation of five years' standing on Butte Creek, by inducing all the holders of rights to agree as to their respective interests, and have this entered as a decree by the court. Once the land was purchased, the procedure of the board was to call to its aid every established agency that could render expert assistance. The sanitary experts of the university reported that the irrigation of the land might cause malarial troubles if the mosquito were not eliminated, and the county supervisors therefore created a mosquito-abatement district embracing not only these lands but a large surrounding area. The statistical expert of the Prudential Insurance Co., in a recent address in San Francisco, said

that the preliminary arrangements to insure the health of this settlement were the most enlightened and efficient of which he had any knowledge in this or in any other country. The soils experts of the Agricultural College of the University of California made a soil map which was used in the subdivision of the land and the determination of the sizes and value of farms. The professors of animal husbandry and agronomy helped work out the kind of agriculture best suited to the locality. The drainage and irrigation scheme was prepared by the engineers of the Office of Public Roads and Rural Engineering of the Federal Department of Agriculture, and the designs for houses and farm buildings were made in a large measure by the architectural bureau of the California State Engineer's office. In other words, agencies created by the state and paid by the state and Federal governments were given an opportunity to use their knowledge and experience in constructive planning, and as a result the farmers of the community have the benefit of this cumulative knowledge and experience.

In making the soil map, samples were taken at such intervals as was necessary to make an accurate map of the whole area. With this in hand the sizes of the farms were determined so as to give considerable choice to intending settlers, keeping each farm within such limits that one family with one farm-hand could take care of it. As a consequence, the farms with the richer land are the smaller, while the poorer lands were laid out in rather large units, running as high as 160 acres. In some cases a tract of this poorer land went with a small tract—say 15 or 20 acres—of the rich land, the two tracts sometimes not being contiguous. The units having rich land only ran from 30 to 50 acres.

Financial Features—The prices per acre were fixed with due consideration to all influencing factors, such as character of soil, roughness, accessibility, etc. The character of the soil caused the chief variation in price, the survey disclosing the fact that practically no two tracts were exactly alike. The prices in the first settlement varied from \$60 to \$235 per acre, and the total price of units from \$3600 to \$13,600. The average selling price was \$150 per acre, this increase over the purchase price being made to cover the overhead expenses, the irrigation improvements, etc. The terms of purchase were, 5% down and 5% each year on the principal until paid, with 5% interest on the unpaid balance. In other words, the settler pays out in 20 years. In order to remove the heavy burden of the higher interest amount in the earlier years, the payments are scaled down as to payment on principal, so that the semiannual payments are the same throughout the period.

Where there were improvements on the property, the settler had to pay 40% of the value, the balance to be paid in installments extending over 20 years. On both land and improvements settlers might make a larger initial payment, or might pay off more than one installment on any interest date after five years.

In the first tract to be opened there were 63 farms and 21 farm laborers' allotments, the latter consisting of home plots of either 1¾ or 2 acres each. All were taken up, and the applications outnumbered the units available. The farm workers' allotments sold for \$400 each. The object of these farm-laborers' plots is to furnish satisfactory living conditions for farm laborers and their families, and thus encourage them to stay in the country. Moreover, these men were selected because they were sober, clean-living men, good and skilled workers who would, with their families, form a congenial element in the community life as well as provide needed help in its agriculture.

Selection of Settlers

The method of selection of the settlers is the most interesting feature of the whole experiment. In the past, private enterprises were not concerned with the qualifications or condition of the settler other than his ability to pay for his purchase, while the managers of public enterprises feared the disrupting influence of charges of favoritism that might be made by disgruntled rejected applicants. The board, however, took the position that it was an injustice to the individual and to the state to admit to the project men whose records, character or conditions indicated likelihood of failure.

Therefore, the procedure was adopted of following the careful examination of the applicant's record with a personal interview. Those thought best qualified, all factors being considered, were selected, and those rejected were told plainly the reasons for the failure of the board to allot units to them. Such was the confidence in the board's fairness that *no complaints have been registered and no political pressure has been brought to bear.*

Besides taking into consideration the settler's practical knowledge, industry and character, to which great weight were given, the board required that the settler should have a minimum capital of \$1500 or the equivalent in implements and livestock. Twenty-five hundred to three thousand dollars was considered a better sum for an allotment of 40 acres or over. There was no maximum limit set on the money a settler might have, but the law required that he must not be the holder of agricultural lands elsewhere to the value of \$15,000, or that by this purchase his land holdings should not be made to exceed \$15,000 in value. As a matter of fact, the settlers on the first allotment at Durham had an average of \$3000 in cash and \$7000 in total assets.

The farm laborers' allotments could be taken up by men of experience, industry and character without capital qualification other than the amount of the initial payment, \$20. There were many applications for these allotments from city folk and other inexperienced persons, but in all cases the allotments were assigned to experienced, capable laborers. These, in the first settlement, included five carpenters, two market gardeners and a shoemaker.

A residence qualification is fixed for the settlers, as well as restrictions with reference to the sale or mortgaging of the lands. An applicant must enter upon actual residence within six months, and must continue *to reside on the farm for at least eight months in each calendar year for at least 10 years from the date of approval of his application, unless prevented by illness, or he presents some other reason satisfactory to the board.* Moreover, no allotment may be transferred, assigned, mortgaged or sublet in whole or in part within five years after the date of sale without the consent of the

board, given in writing. At the expiration of five years, if all the conditions of the contract have been complied with, the purchaser may, with the written consent of the board, dispose of or mortgage the property. In the event of the failure of the settler to comply with any of the terms of his contract, the board shall have the right to cancel the contract, and all the payments made thereon shall be deemed rental paid for the occupancy.

RESOURCES OF LAND BOARD ALLOW EQUIPMENT SUCH AS THIS TO BE USED FOR BENEFIT OF SETTLER ON ALLOTMENT

Assistance to Settlers—Owing to the amount of detail involved in organization, in selecting the land, taking title, etc., following upon the passage of the act, it was not possible to throw the first lands open to settlement until June of this year. In order not to lose a season therefore, the board leveled, plowed and seeded as much of the land as possible. Settlers might buy these crops or not, as they wished. Most of the new owners bought the crops, paying the land board the cost of preparation and seeding, and managed to clear from those crops from \$300 to \$1400 per unit. The land board, from crops not taken, netted \$2000.

Immediately upon taking title, each applicant had an opportunity to confer with a representative of the department of farmstead engineering, created by the board, as to the layout of his farm, the location of the farmstead and the design of the buildings. As a result, the department has made a farmstead and field layout for each unit. The barns are of uniform design but varying size, but the houses differ in accordance with the requirements and tastes of the owners. Under the law, the state may loan \$3000 to a settler, but not in excess of 60% of the value of the improvements or other security. Probably one-third of the settlers will apply for building loans, the others having sufficient capital to take care of their own building improvements. Even where they have sufficient capital without recourse to loans, the buildings are being erected for them under contract by the land board, which is buying all of the building material at wholesale, thus reducing the cost to the settlers. All loans carry 5% interest. The repayment of building loans may be spread over as many as 20 years, but loans on livestock and implements must be repaid in five years.

In contrast with the liberal terms allowed by the land board, it should be noted that throughout the West banks charge as high as 9% on crop and stock mortgages, and farmers frequently pay 12% for short-time loans, and often cannot borrow money on any terms.

Coöperative Efforts—A constitution and bylaws of a coöperative stock breeders' association, based on those of Denmark and Wisconsin, was prepared by the board, and all settlers who intended to become stock raisers were required to become members of this association and to conform to its requirements. One of these conditions was that nothing but pure-bred animals should be used in the settlement, and that the sires should be mainly owned by the association rather than by individuals. There was to be one breed of dairy cattle, one breed of beef cattle, one breed of hogs and two breeds of sheep. Holsteins have been adopted as the dairy breed, Shorthorns as the beef breed, Duroc Jerseys as the breed of hogs, and Rambouillet and Romney Marsh as the breeds of sheep. The settlers promptly organized and elected Prof. G. H. True, professor of animal husbandry in the university, as the head of their executive committee, and appointed a buying committee of three. That committee has secured one bull of unsurpassed breeding at one-half of the price that would have been paid if he had been bought under ordinary commercial conditions, and Fred Kiesel, a banker of Sacramento, has given the settlement the pick of the yearling bulls from his fine Holstein herd. Several of the settlers have bought cows from one of the noted herds in the state having unusually high milking records. They have bought as a community the breeding herd of a noted breeder of Duroc Jerseys, the herd being sold on the owner's death by the administrator.

Coöperation In Other Lines

Such has been the general confidence in the livestock association that it has already been turned into a general coöperative association, and has bought for the community seed potatoes for next spring, alfalfa seed, lime, fencing, and numerous other farm materials. The start that the settlement has already made gives assurance that it is soon to have a reputation for pure-bred animals, and can sell livestock on its pedigree value and greatly increase the farmer's income. Every animal that enters the settlement is tested for tuberculosis, and the hogs are protected from cholera by inoculation.

In order to get agreement on these matters, the old-style town meeting has been revived, and has created a fine community spirit in the settlement.

It is the ambition of the land board that there may be established at Durham or on the settlement lands a training school in agriculture. There will be between

400 and 500 children in the settlement, and the farms will furnish them with opportunity for observation and study, to supplement the work done on the school grounds. Twenty-two acres of a beautiful old grove have been set aside for community purposes. On this will soon be built a social hall that will be a center for recreation as well as more serious gatherings.

The Second Tract

Applications for lands in the second tract purchased were closed Nov. 20. In order to have these lands made ready for settlers the board purchased a 70-hp. caterpillar traction engine and two platform plows, and has hired another 7-hp. tractor to cultivate the land for the settlers. It was only in this way that the land could be made ready for seeding at the proper time, because of the dryness of last summer. The settlers could not have afforded the tractors, and horses or tractors of ordinary size were wholly inadequate. The ability to bring to community development ample financial assistance will give to this new community an income from the farms twelve months earlier than it could otherwise have been obtained, and will mean an addition to the grain crop of the state of the produce of not less than 1000 acres.

There are 31 farms and five farm laborers' allotments in the second unit. As in the first instance, all the farms were applied for, but in this second settlement something unusual occurred. Every farm in the settlement was the first choice of some applicant. This is a high testimonial to the judgment of those who valued the farms. The price of the land in the different units varied from $48 to $235 an acre, the endeavor being to make them all equally attractive, balancing all factors —and the effort has succeeded. The results here were better than in the first settlement, because in that some of the plots were neglected, while there were 10 to 14 applicants, in portions of the second, for each farm. In the second settlement there are certain farms that are attractive, from location or appearance, that were applied for by a large number, but every farm was the first choice of some individual.

The fact that these farms on a single area vary from $48 to five times that sum per acre shows how unscientific and unfair is the Government practice of making no discrimination in the conditions on which farms on the public domain are obtained. This shows especially in irrigated sections. One homestead on the public domain may be worth five times as much as another, because the one of uneven surface will cost five times as much to level as the one made ready by nature for the plow and irrigation ditch—yet the Government makes no distinction between them, thereby perpetrating great economic injustice. This example of Durham ought to lead to a reform in the Federal land settlement laws.

Financial Status of Project

It is interesting to examine the balance sheet of the State Land Settlement Board at the end of its first year of operation, June 30, 1918. Up to that time the board had drawn from the state treasury $196,000, and with the net value of the liens held by it on property disposed of to settlers—less, of course, its indebtedness for land purchases—showed a surplus of $176,000. It is further important to note that all of the administrative expenses involved in buying, valuing, laying out and disposing of the first lot of units was only $5918. Had the scheme been privately developed, the selling commissions alone would have approximated $75,000. In other words, the settlers are getting their land at cost, know in advance through careful soil surveys the exact character of the lands they are purchasing, and have the best advice available, all without paying tribute to the real-estate shark, who has in the past exacted high commissions and has not given them any assistance or any guarantee as to the character of the soil.

Some notion also of the impression the experiment has made in California is evidenced by the fact that a syndicate of bankers holding some 70,000 acres of land, which was offered to the board when the land settlement scheme was first proposed, have again come to the board with their property, offering not only to sell it to the state on 20-year terms, but in addition to loan the land board funds for aiding settlers to de-

FARM HOUSE ON ONE OF THE DURHAM ALLOTMENTS

velop the property. The land board, being favorably impressed with the tract, consented to reconsider it, but suggested that, instead of the haggling customary in land deals, the land board appoint a committee of three recognized experts—men who would command the confidence of the entire agricultural community of California—to value the lands. This the owners agreed to. The three men selected could not agree on a report, though each one, separately and individually, and for a set of reasons all his own, had arrived at the same figure as to the value of the property. It was stipulated, when the suggestion was made by the land board, that neither party bind itself to the figure that would be determined upon by the experts, but that their report would furnish a basis of confidence for the prospective settlers if the state should take the lands. The owners had held the land at a figure somewhat higher than that determined by the committee of experts, but upon receipt of the three individual reports modified their offer to the state and accepted the experts' figures. Though the deal has not been closed, there is good reason to expect that the proposition will be accepted and that the land board will proceed to develop this larger propery.

The California experiment, then, seems largely to have passed the experimental stage. It is true that the settlers have not paid out and that the scheme is only

in its first year. But the project is settled by experienced farmers and men of character who have sufficient financial resources to work through the development period. In addition, the scheme has been started on such intelligent lines that the land board has won the confidence of the settlers and of the people of California.

Problems Before the Civil Engineers' Society

Three Alternative Plans of Organization and Their Logical Results are Discussed—More Representative Form Inevitable

By Gardner S. Williams
Ann Arbor, Mich.

THE development committee of the American Society of Civil Engineers met at the rooms of the Western Society in Chicago, Nov. 14, and spent three days in deliberation, adjourning to assemble in New York during the week of the annual meeting of the society. Of a total membership of 29, twenty-six members were in attendance, representing 17 states and 23 localities. The membership, which covered territory from Boston to Los Angeles, and from Duluth to New Orleans, was unanimously in favor of an extension of the functions of the society, but when it came to the details of a plan —*confined to the American Society of Civil Engineers*— the ideas seemed hardly to have passed beyond the nebular stage.

The conception of some central engineering body around which or under whose leadership all the engineers of the country could be gathered was clearly uppermost in the mind, but just what was to be its relation to the American Society of Civil Engineers, or what the relation of that society to it was to be, no one seemed prepared to state. The sentiment was also very clear among the members selected by the local associations that those associations must be recognized by the governing body to a much greater extent in the future than has been the case in the past. A considerable inclination toward the combination of all societies in a particular locality under some coöperative organization, and an impression favorable to the development of some type of student membership, were also apparent. Comparatively little thought, seemingly, had been given to the development of the technical functions of the society, and if President Talbot, in an address to the committee, had not directed attention to this subject, it might easily have been overlooked.

The main idea of the committee, as evidenced by the discussions, was not distinguishable from that which has animated the two conferences on coöperation held in Chicago in 1917 and 1918.

Three Possible Lines of Action

While ideas are still in a nebulous, or as one member of the committee suggested, in an amorphous state, it may be well to indicate some possible lines of action, and, from the views expressed, there are suggested the following three. It should be borne in mind that this discussion proceeds from the point of view of the American Society of Civil Engineers, and not from that of the profession as a whole.

First, the merging of the four great national societies into a single organization, a truly national society of engineers, around which shall be gathered all the other national engineering and allied associations, and the state and local societies.

The swing of the pendulum, in this highly specialized age, away from specialization is not unexpected, and while, from the point of view of technology, there are natural distinctions between civil, mechanical, electrical and mining engineers, when it comes to the consideration of their civic duties, their responsibilities to their fellow citizens and to the public at large, these differences disappear. The obligations of citizenship rest alike on the section-hand and the railroad president.

The query is, Can it be done, and if so, is it desirable?

Second, the creation of a central organization charged particularly with the care of the interests of the profession at large, in which body not only the national but the state and local societies shall have representation, but in which each element will preserve its own identity. In other words, a republican institution. Whether in such an organization the representatives of national societies shall form a senate and those of state and local societies a house of representatives, to draw a parallel from our National Government, or whether all delegates shall stand on an equal footing, are details upon which no general opinion was expressed. The feasibility of such a program was generally accepted, but comment on the failure thus far of the Engineering Council to measure up to its opportunity was neither infrequent, nor altogether apologetic, and while the fact was recognized by all that engineers as individuals have done a wonderful work in the war, it was also felt very keenly that the profession as a body had very little in the way of collective achievement of which to be proud.

Third, assuming the creation of a central organization as above contemplated, it was suggested that such an organization naturally would have very little time or inclination to deal with technical matters. It might be wise for the American Society of Civil Engineers, it was suggested, to devote itself chiefly to the scientific problems before the engineering world, and assume that its members would, through other organizations—national, state and local—exert their desired influence upon the central organization. The remarkable development of the American Society for Testing Materials affords evidence of the demand for purely technical work, and the possibility of the less difficult and more popular exercise of public-service functions overshadowing and crowding out the scientific spirit is to be considered. On the other hand, it was maintained by some that local associations devoted wholly to the scientific cannot live.

Under some one or another of the foregoing three propositions is probably to be found that to which the American Society of Civil Engineers must turn, and the query now is, Which?

Logical Result of These Plans

Whichever one of these alternatives be adopted, or even if another and unthought-of organization be worked out, it must involve local associations; and the one immediate and definite step that can be taken is

to establish the relation that must exist between the local and the national body.

The parent society occupies a position not dissimilar from that of the British Parliament, for while it is endeavoring to be a national society and to deal with the problems of national import, it is also discharging the functions of a local association for New York City and its immediate environs, just as the British Parliament, while administering the affairs of the empire, devotes a large part of its time and energy to the local government of England, Scotland, Wales and Ireland.

Any comprehensive plan of representative government demands a change in this situation. The members within 20 miles of the postoffice of New York cannot be the national society, but must find their place in a New York or metropolitan local association on exactly the same terms as do the Philadelphia, San Francisco or St. Louis members. As a further step to a representative government based on local associations, it follows that every member of the national society must become a member of some local association. When this is accomplished the directors of the society can and should be elected by the associations in their districts, and the president and other officers at large. It will easily follow that candidates for admission to the society must first be accepted by the local association with which they are to become affiliated, before coming to the consideration of the national governing body. The next step in the program is to provide for the setting apart of a certain portion of the dues of every member, for the use of the local association. When these principles will have been adopted the American Society of Civil Engineers will have become truly national.

The remaining question to be considered is the relation of the local association to other local societies in its district. The experience of the St. Louis and Philadelphia associations, and some of the Western associations, affords a reliable guide at least for the initial program, and will not be discussed here.

To summarize, in the writer's present opinion four things are essential to the nationalizing of the society:

1. The establishment of local associations in New York and Boston, and the separation of national and local affairs in the society.

2. The assignment of every member to some local association.

3. The election of directors and the passing upon membership by the local associations.

4. The assignment to the local associations of a sufficient part of the receipts from dues to enable them to maintain themselves without a further tax upon their members.

Wave Pressure on Ships Does Not Follow Hydrostatic Laws

Preliminary Tests by Emergency Fleet Corporation Give Information of Value in Ship Stress Determination

(Passed by Publication Approval Committee, Emergency Fleet Corporation)

OBSERVATIONS taken in a special testing station at Atlantic City by F. R. McMillan of the concrete ship division of the Emergency Fleet Corporation have shown that within the limited range of possible observation it is not correct to assume that pressure on the side of a ship is equal to the hydrostatic head of the wave. There seems to be a dragging effect of the moving water which reduces pressure at the crest and increases it at the trough. If these observations are confirmed in further tests the knowledge gained should have considerable effect on the current analysis of hull stresses, in which the actual hydrostatic heads of an assumed trochoidal wave are used in moment calculation.

The testing station, located on one of the ocean piers, employed instruments which gave synchronous and continuous records of wave height and water pressure. These instruments were developed by Professor McMillan for concrete ship stress determination, and were first installed on the concrete freighter "Faith" for her initial voyage. They are being further developed in connection with continuous recording strain gages, for the investigation of stresses in the new Government concrete ships.

With these instruments it was possible to make continuous pressure and height records at 2, 6, 10 and 14 ft. depth below the average water surface, and on waves up to a length of 175 ft. and a depth of 4 ft. Most of the results were on wave lengths from 85 to 135 ft. The seas were what might be called choppy, and as such not considered indicative of general conditions at sea. The object of the experiments was to determine whether the pressure at any point below the surface of a wave is equal to the static head represented by the depth at that point, and, if it is not equal to the static head, to determine what relation exists between pressure and wave height. The conclusions over the limited extent of the tests is that at the crest of the wave the pressure is less than the static pressure, and at the trough it is greater. The variation of pressure under any given point during the passage of the wave is less than the static equivalent of the wave height, the actual ratio varying from 60 to 70 per cent.

Further studies on a more elaborate scale are being planned, but for the present it is assumed that the pressure reduction is due to the hydraulic action of the moving wave. That is, at the crest of the wave the water moving upward exerts an upward thrust which tends to reduce the downward pressure due to the height of the water. At the trough the downward-moving water increases the static head. The tendency is thus toward equalizing the extremes of pressure.

County Organizations for Forest Fire Control

Twenty-four counties in California have adopted a plan of organization for rural fire control. In these counties, covering 16,000 square miles, 412 rural fire-fighting companies have been organized and now include about 6500 men, according to a summary of the situation recently made by the University of California. By the aid of 532 automobile trailers, which have been purchased and equipped with fire extinguishers and fire-fighting tools at county expense, these companies have kept losses from fire at a remarkable low figure in the past season.

FIG. 1. PANORAMIC VIEW OF BETHLEHEM SHIPBUILDING CORPORATION 6-WAY YARD AT ALAMEDA, CAL.—

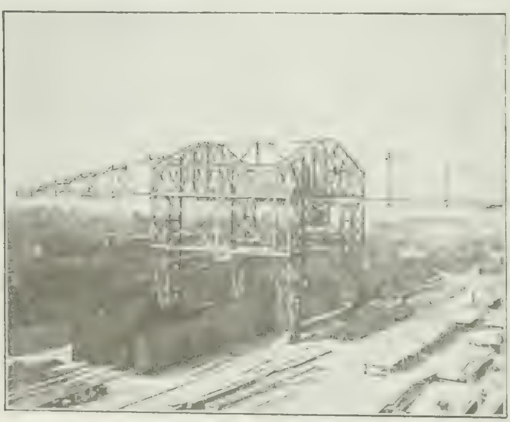
Handling Shipbuilding Material at Alameda Shipyard

Planned for Direct Routing—Three Craneways in Fabricating Shop—Shape Shop in the Open—Turret Cranes at Shipbuilding Berths—Assembly Yard

DIRECT routing of materials and speed in handling them are notable features of the Alameda, Cal., plant of the Bethlehem Shipbuilding Corporation. The company has contracts on a cost-plus basis for 12,000-ton steel vessels, and is working at capacity speed on six ways. The layout of the yard is notable in the general allotment of cranes and all material-handling devices. Ample space for present and future needs was provided, but it is significant that there is only very limited storage space for finished material. This is so because it was the intention to equip and man the plant so that material could go directly into the hull as fast as it was ready.

The plate and shape storage yard is served by four standard-gage tracks. Plates are taken from the cars and stored at the upper end of the yard (see plan, Fig. 6); the shape section is at the lower end. Two gantry cranes are used on a track paralleling the railroad tracks, one serving the plate storage and the other the shape section, although both can be used at either end of the yard if desired. These gantries have a span of 165 ft. from end to end of the arms. The outer arms extend over one of the railroad tracks, and thus can deliver material from the cars direct to the plate-marking area or to the racks, as desired. On the side of these large gantries, next to the structures in which are located the mold loft and templet storage, two one-leg gantries operate beneath the arms of the larger cranes. The small cranes serve plates to horses in the templet yard, where they are marked for punching and shearing. It is typical of the California yards that this space is not roofed over.

From the templet yard plates pass into the shop on small flat-cars. The shop is divided into two bays, each served by overhead cranes on three runways side by side. The bay nearer the templet yard contains the smaller and lighter machines, while the second bay is laid out for handling the larger plates and the heavier work. In each bay there is an electrically operated crane, on the central track, which delivers incoming plates to the machines. A number of hand-operated cranes on the two outer tracks are used for serving the plates at each machine or for transferring to adjacent machines.



FIGS. 2 AND 3. STORAGE AND SHAPE FABRICATION AT ALAMEDA—GANTRY CANTILEVERS SPAN CARS, RACKS, AND MARKING AREA; SHAPES WORKED IN THE OPEN UNDER "UMBRELLA" RIG

FOUR OLD WAYS IN THE CENTER, PLATE SHOP TO THE RIGHT, TWO NEW WAYS IN THE BACKGROUND

The machines are ranged along either side of the bay beneath the outer or hand-operated cranes. Thus, as a plate comes into the shop it can go down one side of the aisleway, being successively sheared and punched on one side only. It may then be returned from machine to machine on the opposite side of the bay for punching and shearing on the other side, or it may be brought back through the same machines in the reverse order, after being turned. Under this plan it is never necessary to turn a plate more than once, and it has been found that one man and helper are sufficient for each machine even with the heaviest plates and when the pay is on a piecework basis.

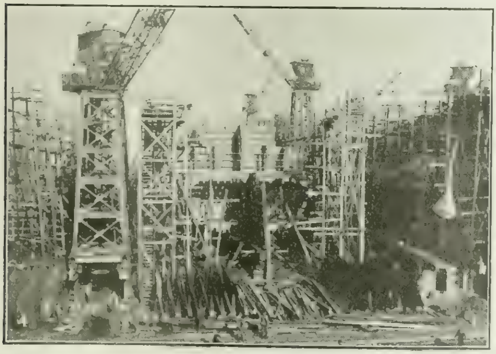
The extent to which the skill of the workmen affects plate-shop capacity is shown by the fact that early in July the shop was turning out about 1200 tons per week, while during the last week in September, with practically the same crew, it produced 1928 tons, the increase being attributable to the skill of the workmen developing with experience.

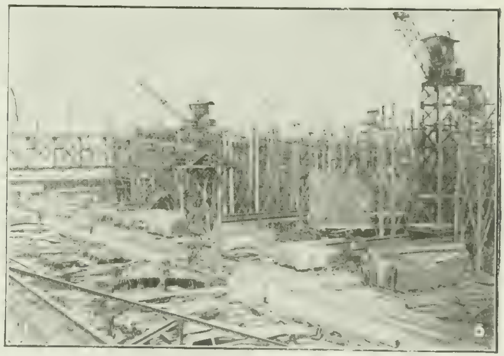
Shape fabrication differs from the plate work in being done outdoors. All shearing, punching and planing of shapes are done in the open and the only operations carried on indoors are hot and cold bending. For the latter purpose two 60-ft. oil furnaces are used, besides the usual cold rolls.

"Umbrella rigs" shelter the outdoor machines. Such a rig consists of a structural-steel column supporting a roof, without walls, which shelters the machine. Each corner of the column supports two radial jib cranes which swing through about 150°. The upper crane is considerably longer and heavier than the one below, so that for larger or more complicated pieces the lifting can be done by the large crane while the lower one adjusts the piece and holds it in position for the machine. This constitutes a very flexible and convenient arrangement well adapted to the climatic conditions of California.

The punching and shearing machines are so located that on either line of progress through the shape yard successive machines alternate in vertical and horizontal arrangement. That is, when a shape requires punching or shearing on both sides it is passed along from one machine to the next instead of being turned to afford access to the other side. The shape yard includes a 500-ton hydraulic joggling press for odd shaping work.

The yard has six ways, 400 to 500 ft. long, served by turret cranes. Originally there was only one crane on each track. This was found inadequate, and on the first four ways another crane was added to the tracks between the ways, leaving the outer tracks with only one way. When two more ways were added to the yard





FIGS. 4 AND 5. FABRICATED STORAGE AND ASSEMBLY AT ALAMEDA—LITTLE SPACE AVAILABLE FOR STORING FINISHED MATERIAL ALONG HEAD OF WAYS; ASSEMBLY YARD BETWEEN PLATE SHOP AND WAYS, WHERE TURRET CRANES CAN REACH FOR MATERIAL

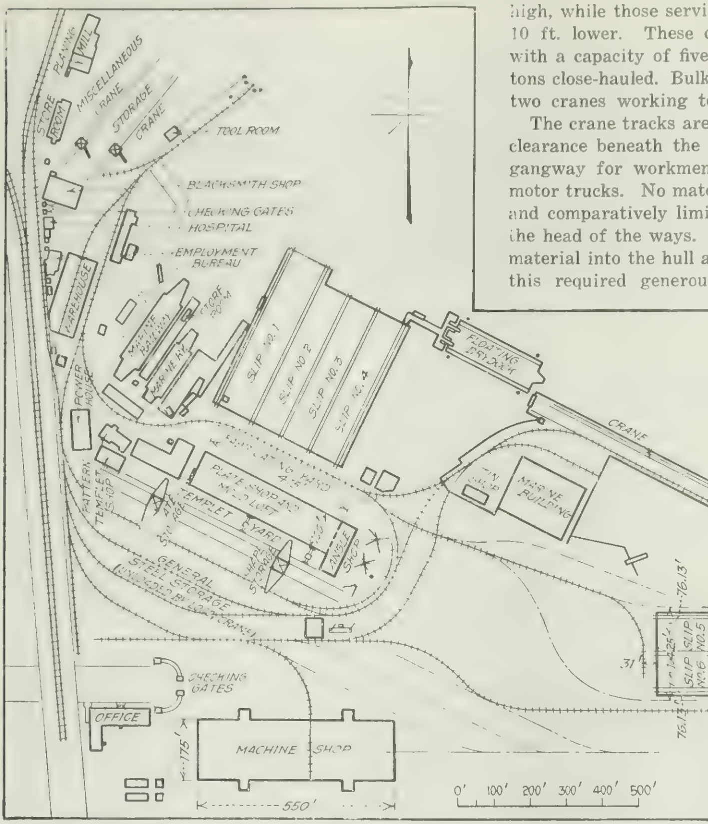


FIG. 6 TWO NEW SHIPBUILDING WAYS AT ALAMEDA FORM A SEPARATE GROUP FROM FOUR OLD ONES, AND HAVE MORE AMPLE ERECTION CRANE EQUIPMENT

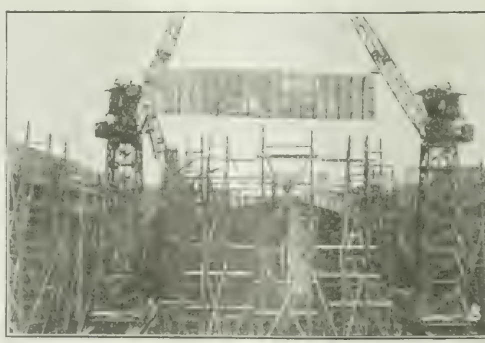
two cranes each were put on the inner and the outer tracks, giving six cranes for the two ways.

At the new ways the pile foundation for the cranes were cut off below low water and capped with concrete, the concrete being carried up above the high-water level. The cranes at the forward end of the ways are 60 ft. high, while those serving the after part of the boat are 10 ft. lower. These cranes have 50- to 55-ft. booms with a capacity of five tons at maximum radius, or 20 tons close-hauled. Bulkhead sections are often placed by two cranes working together.

The crane tracks are on steel trestles, so that an 8-ft. clearance beneath the lowest member is provided as a gangway for workmen, or for the operation of small motor trucks. No material is stored alongside the ways and comparatively limited storage space is available at the head of the ways. The plan, rather, is to move the material into the hull as soon as it is ready. Of course, this required generous allotments of equipment and labor, and both these conditions were met. The number of men employed at the yard is about 8000; deducting those not employed on work incidental to ship construction, the actual number of men per way is about eight hundred.

The assembly yard occupies a space 85 ft. wide, extending the full length of the plate shop, and directly in front of it. An 85-ft. gantry crane moves material from one part of this area to another, while finished material is removed by the shipbuilding cranes along the ways. Locomotive cranes can also take material to or from this yard, using the track along the head of the ways.

The ways are wholly of timber construction. Piles are 2 ft. on centers in bents 5 ft. apart under the keel, while the launching ways are supported on a double row of piling. At other points on the ways there is just sufficient piling to support the ordinary deck floor load. The yard is planked wherever the access of tractors might expedite the handling of materials.



FIGS. 7 AND 8 ROTATING [illegible] SERVE ALAMEDA BERTH—NEW WAYS HAVE THREE TURRET CRANES EACH. TWO [illegible] COMBINE ON BULKHEAD SECTIONS AND OTHER HEAVY PIECES

Filling the Allies' Rush Order for Airplane Spruce

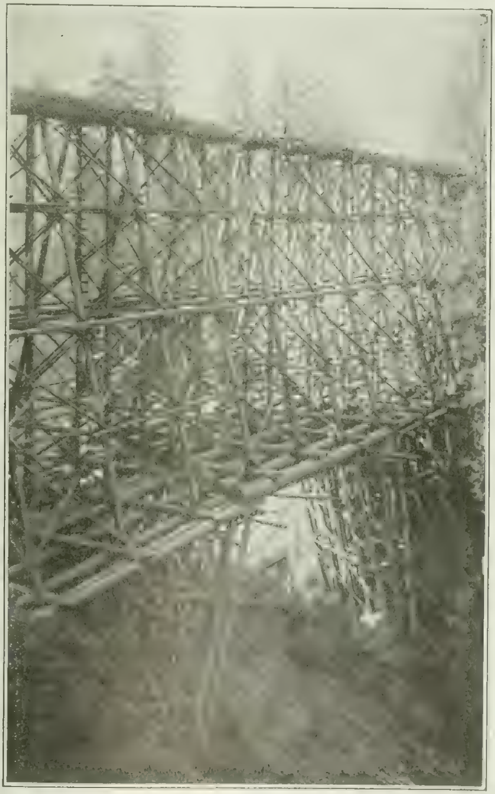
Best Talent of the Country Assembled to Develop Methods New to Logging and Sawmill Practice—Thirteen Railroads Built and 100,000 Workers Coördinated

By Nathan A. Bowers
Pacific Coast Editor, Engineering News-Record

This article was prepared early in November, before the conclusion of the armistice. It is published as written, however, because it is important that the remarkable development of the Government's Spruce Production Division should receive adequate record—Editor.

IN THE forests of the Northwest an army is working at high pressure, directed by the unique combination of a military organization operating on a modern business basis. The Spruce Production Division of the United States Army Bureau of Aircraft Production it is called. It was formed just a year ago, and since then has developed new methods and built up a completely equipped organization for producing daily 30 to 40 carloads of 98% perfect airplane spruce. This output means that the mill built this year at Vancouver, Wash., especially for this purpose has to cut 16,000,000 ft. of airplane stock per month. That is, this amount represents the present net result. The work is still being expanded, and a new goal of 30,000,000 ft. of airplane stock per month was recently announced. There is much of interest to the engineer in this phase of our war program, because new ways and means had to be developed in several fields. In most of these the engineer played an important rôle. The results desired could not have been attained simply by increasing the production of spruce by the old methods, and on a rush schedule the lumber industry, naturally, did not think they could be attained at all. But the work was not put in the hands of the lumbermen; it was turned over to Brig. Gen. Price P. Disque, then lieutenant colonel in the Signal Corps.

He had no experience with lumber, but had made a report on the prospects for getting spruce in large quantities from the Northwest and getting it quickly. He believed it could be done by new methods.


POLE BRIDGE, 196 FEET HIGH, OVER SKAGIT RIVER

So in October, 1917, General Disque began to assemble an organization with which to produce airplane spruce at a high rate. Woodsmen of the Northwest were in an ugly mood; I. W. W. organizers were active and strikes were frequent. But General Disque arbitrated the differences between employers and woodsmen, put the entire industry on an 8-hour day basis and organized the Loyal Legion of Loggers and Lumbermen to prevent the spread of seditious propaganda. The organization now has more than 110,000 members. Contractors working on a cost-plus basis are furnished with soldier labor, drawn from the national Army. Many came from the timber districts of Michigan and Wisconsin, and the force was strengthened continually, until it now includes some 30,000 enlisted men and 1200 officers. The officers get only their regulation pay but the men receive the prevailing civilian scale of wages. About 75,000 civilians are engaged in the spruce program. In each district where logging or construction work is under way there is, as commanding officer, a representative of the chief of staff. He assigns the soldiers, audits accounts and reports on progress. A district superintendent representing the Government—usually a civilian—actually lays out and directs the work. These two work out their local problems, referring important matters only to headquarters.

The problem of finding the spruce and getting out the logs came first. The heaviest stands were discovered on a strip of territory about 50 miles wide on the western

slope of the Coast Range in Oregon and Washington, the wildest and most inaccessible section of the West. There were practically no transportation facilities in the region, because the fir timber, heretofore the chief lumber product, grows on the eastern slope.

Cruisers' reports were collected, and supplemented where necessary, and locating engineers were sent out to make cost estimates of the railroads needed to tap the best timber. Where estimates showed a railroad cost of less than \$3 per 1000 ft. of spruce tapped, construction was approved. Thirteen separate railroads, as shown in the table below, were thus decided upon.

This railroad construction would take time. Meanwhile, spruce was urgently needed. General Disque therefore made contracts with lumbermen for the delivery of all the clear spruce they could get, and in addition sent his own crews to supplement the supply. Over the protests of lumbermen he inaugurated selective logging methods—the felling of only those trees which had been picked by experts as suitable for airplane stock. Where the stand was too sparse to warrant roadbuilding, or where the country was too rough to get out the logs in the round, they were "rived" where they fell—that is, the logs were split, the knotty heartwood was removed and the remainder was split up into "flitches" of convenient size.

Government Selective Plan Superior

How the commercial methods compared with the Government's selective logging plan appears from the fact that logs from commercial logging camps contain only about 25% of airplane stock, while the logs taken from trees selected under the Government's methods average about 80% airplane stock. At present the cut for Government use is about 16,000,000 ft., log scale, per month, of which 75% comes from commercial and 25% from Government camps. By next spring, when the new railroads are operating, these conditions are to be reversed, so that three-quarters will be Government cut and one-quarter commercial. By that time the monthly total will probably reach 30,000,000 ft. of airplane stock.

Selective logging was not the only new departure General Disque insisted upon. Logs could be sawed, he maintained, to get a much higher percentage of clear, straight lumber than the usual methods afforded. To prove this he produced his own expert and designed a Government mill to be built at Vancouver, Wash. Lumber men declared the mill could not be built in less than a year and then might not be a success. Again their arguments were disproved. Early this year the mill went up in 45 working days, and instead of the 25% of airplane stock produced by ordinary methods from clear "flitches," the mill is producing 65%. Three other mills are being constructed in logging centers from which sawed cants [wide, thick boards in the rough] will be sent to the Vancouver mill. Their capacities will total 1,300,000 ft. per day.

The Vancouver mill is designed for quality, not for quantity, despite the fact that it is the largest in the world. The most important departure from standard methods is at the head saws, where the logs get their first cut. Here each log is considered separately and is handled to get out the maximum amount of straight-grained stock, regardless of the number of cuts required. When being put on the head-saw carriage the logs are blocked out in alignment with the saw to get an equal cut from end to end running straight with the grain. The log is turned frequently during the sawing and cants about 2⅝ in. thick are cut from successive faces.

Logs less than 60 in. in diameter are sawed with the exact taper of the log, into 2⅝-in. cants, full width, until some defect appears; then the log is turned on the carriage and another face is begun. This is continued thus until all the clear material is in cants. Chains are used for turning the logs, in place of the usual "niggers," whose spurs would scar the faces in the frequent turning.

By this method broad, flat cants are secured with faces parallel to the grain. An inspector tests the grain with a blunt needle, and with a crayon indicates on each cant the direction of the grain. The mark is used to align the cant on the carriage so the saw will cut parallel to it, regardless of the angle which the cut makes with the edge of the cant. Thus, the pieces which come through the second cutting have both edge and flat grain parallel to the faces. This method has made it possible to use cants from logs that had a slight twist, and increases from 6 to 18% the airplane stock that can be made from a clear "flitch." A variation from straight grain of 1 in. in 20 is allowed by the airplane-stock specifications.

Use of Model Saves Many Beams

The mill proper now covers about 5 acres and has 12 head saws. Extension of plant and improvement of methods are being made continually. For example, roller feed and loading dogs for the carriages on one pair of head saws has increased the capacity there 38%. When this improvement can be made throughout, it is expected

RAILROADS BUILT TO REACH SPRUCE STANDS

No.	Name	Location	Main Line, Miles	Branch Lines, Miles	Total Spruce Available Feet
1	Lake Crescent Line	Joyce to Lake Pleasant, Clallam County, Washington	36	8	1,250,000,000
2	Merrill & Ring Line	Northwest from Pysh, Clallam County, Washington	5	1	39,000,000
3	Quinault Line	Quinault River Valley, Grays Harbor County, Washington	13	3	125,800,000
4	Elk River Line	Grays Harbor County, Washington	6	5	50,000,000
5	North Nemah Line	North Nemah River, Pacific County, Washington	10	5	60,000,000
6	South Nemah Line	Middle Nemah to South Nemah River	7	3	33,000,000
7	*Nasel Line	Near Nasel, Pacific County, Washinton	3	..	10,000,000
8	*Lewis and Clark Narrow Gage Line	Lewis and Clark River, Clatsop County, Washington	4	..	......
9	Lewis and Clark Line	Lewis and Clark River, Clatsop County, Washington	22	12	131,000,000
10	Toledo and Siletz Line	Near Toledo, Lincoln County, Oregon	3	3	17,000,000
11	Yaquina Northern	North from Yaquina Bay, Lincoln County, Oregon	27	14	160,000,000
12	Yaquina Southern	South from Yaquina Bay, Lincoln County, Oregon	24	12	300,000,000
13	Beaver Hill Line	Near Coos Bay, Coos Bay County, Oregon	7	7	170,000,000
	Totals		167	149	2,345,000,000

*Narrow-gage

These Views Show Operations Through Which Spruce Production Was Raised in One Year to 30,000,000 Feet Per Month

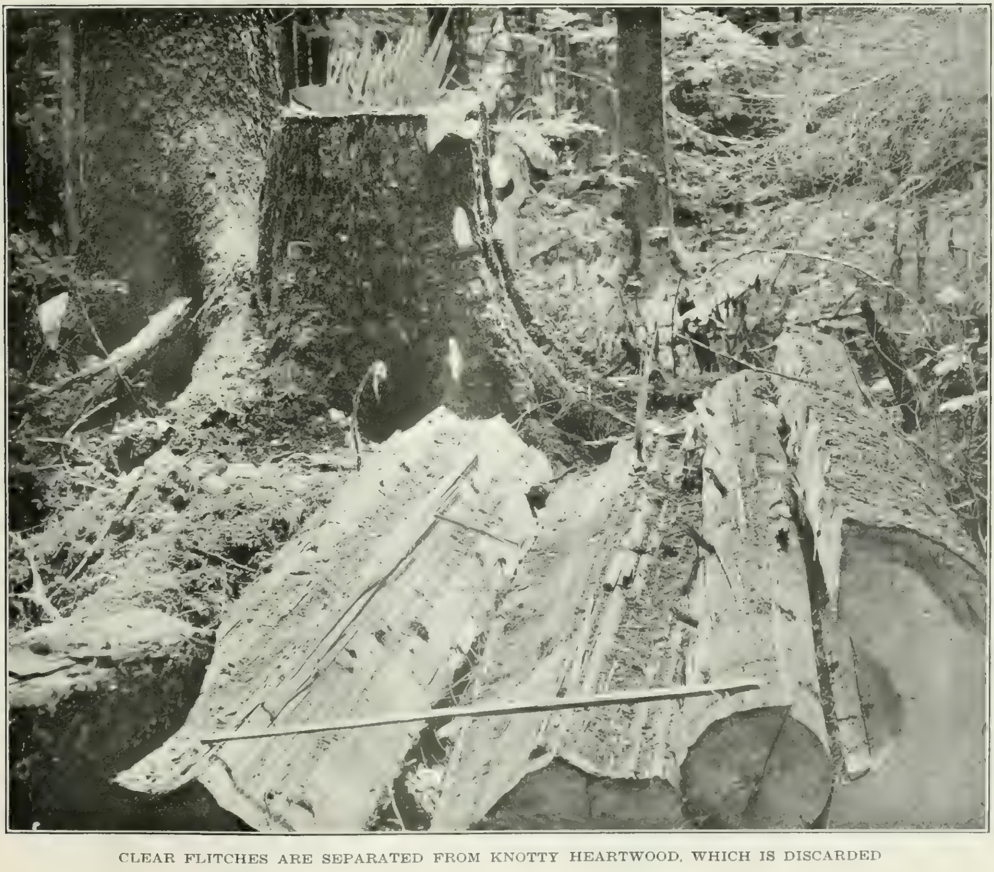
RIVING A LARGE LOG SO THAT IT CAN BE HAULED OUT BY MOTOR TRUCK

ROADS ARE LOCATED AND GRADED WITH GREAT CARE—A CORDUROY ROAD IS SHOWN AT THE LEFT

CAMPS ARE MAINTAINED ON STRICT STANDARDS OF MILITARY SANITATION

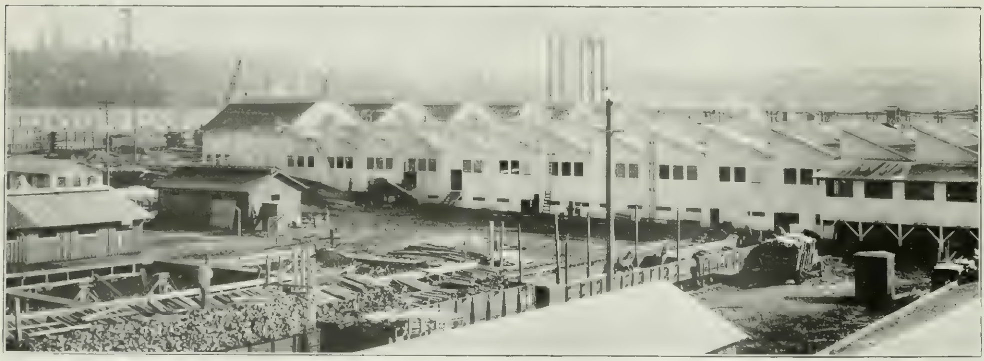
ROUGH COUNTRY NECESSITATES FREQUENT HIGH TRESTLES FOR SPRUCE RAILROADS

TRAINLOAD OF CLEAR SPRUCE LOGS—NO FASTENINGS REQUIRED ON THESE CARS



CLEAR FLITCHES ARE SEPARATED FROM KNOTTY HEARTWOOD, WHICH IS DISCARDED

BEING LESS AFFECTED BY HEAVY RAINS TIMBER CRIBBING IS OFTEN USED INSTEAD OF FILLS



VANCOUVER MILL WHICH NOW CUTS 16,000,000 FEET OF AIRPLANE STOCK PER MONTH

COMMERCIAL STOCK, A BYPRODUCT IN SECURING AIRPLANE SPRUCE, ACCUMULATED AT FIRST, BUT A MARKET FOR IT HAS BEEN DEVELOPED WHICH IS NOW EQUAL TO PRODUCTION

that the daily cut will increase by 500,000 ft. The use of a completely finished wing beam as a model saved, the first day it was used, 268 wing beams that would otherwise have been culled because of slight defects. The finished beam has tapered ends and hollowed sides, and defects at these points would be cut out, in any event, in the final trimming.

By extra reworking of material, the wastage is kept very low. In a cant with two or three defects two extra cuts are made to get each defect on a narrow piece, thus saving whole the pieces of standard size. These are some of the features that make possible the high percentage of perfect stock. At first, plans of wings, as constructed at various factories, were not filed at Vancouver. Therefore, many pieces unnecessarily long or just too short for wing beams were shipped. Since blueprints have been obtained as guides for cutting and shipping, the number of beams culled at the factories has dropped to two per cent.

It has not been practicable to cut to exact sizes of parts required by the allies, so spruce is shipped overseas in the largest cross-sections that can be secured clear. Dimensions of some of those being loaded for shipment when data for this article were collected were 8 x 20 in. by 20 ft., and 10 x 15½ in. by 25 ft.—clean, straight-grained sticks of perfect spruce. Of course, the 40-ft. length of the box cars puts a limit on the longest pieces that can be shipped. No open cars are used for airplane stock, and small cross strips are placed between layers so that the wood can season while en route.

The fire risk at the mill was great, of course, and no safety precautions could be neglected. Yet the expenditure of $95,000 which a sprinkler system would have cost was believed unwarranted. The mill fairly teems with men (all of them soldiers) at every hour of the day and night, all trained to military discipline, and the best protection was considered a complete fire patrol force, with adequate fire mains. Fire guards are on duty continually, principally on roof beats, and it is only necessary to sound the alarm to call the 4000 men at the plant to their fire stations.

Railroad Construction Rapid

Railroad building in connection with the spruce production program has involved some of the most difficult location and most rapid construction on record. Decision on most of the lines was made in the spring, and some 10,000 enlisted men have since been employed on the work. Construction forces were put in the field as close behind the location parties as feasible, and most of the lines will be completed before the rains set in.

Many miles of pack trails and truck roads were built to open up the work at as many points as possible. Some of the camps were entirely under canvas, others had framed mess-houses and barracks. Each one constituted a military unit, in charge of a commanding officer and a construction superintendent. All the sanitary measures of a regular Army camp were put into effect.

Standard gage was used where the lines have a permanent value, and where the construction could serve only in the present emergency narrow gage was ordered. The construction standards followed were planned for the purpose of carrying heavy logging traffic continuously in territory where the annual rainfall is from 100 to 180 in., concentrated between the months of November and May. Grades have been limited to 2% except in special cases, and the curvature kept below 6 degrees.

Great care has been taken to provide ample drainage where heavy cuts or fills were required, and all track is heavily ballasted. In some places beach sand 1 ft. deep is put on fills before the ballast. Some of the spurs are built entirely on logs 36 to 60 in. in diameter and 70 to 100 ft. long. These stringers, into which the ties are notched, are supported on cross logs or heavy timber cribs, the whole structure being put together with the use of donkey engines.

This construction was used frequently in the heavy timber. It did away with the need for clearing and grubbing, which often amounts to $10,000 per mile. Another type of construction used to save the cost and delay of clearing was the three-pile bent trestles with sawed caps and stringers. If rock prevented the driving of piles, cribs of 30- to 60-in. fir and hemlock logs were built up instead, all the work being done with logging equipment.

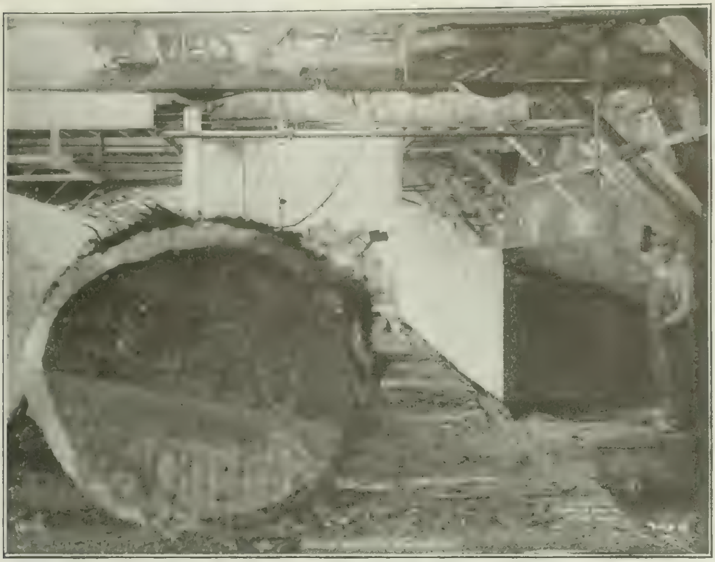
Water Delivery Without Wharfage

Many bridges were required on the lines along the coast. Some were 80 to 90 ft. high and of considerable length. On this work delivery by water, without wharfage facilities, was developed to a high degree. At first the coast guards in surf boats took charge of rafts as they were cast loose by the tugs, but after a more thorough knowledge of tidal currents was developed rafts of bridge timbers were regularly cast adrift, as far as three miles at sea, and came to the desired points on the beach without attendance. From the beaches motor trucks took the material over plank roads to its destination.

Some of the bridges illustrate the conditions and methods that often prevailed. The Alsea bridge is an 8800-ft. trestle, for which 6000 piles were cut nearby and driven with a piledriver built at the site. In another bridge 105-ft. piles were used, and are in service with a 75-ft. cut-off—this is said to be the record for height of unframed structures. Where power equipment could not be provided quickly, the lack was made up by manpower. In one case it was found to be time economy to make a cut 100 ft. deep with pick and shovel.

The operation of these railroads, newly constructed lines in a region of excessive rainfall and under very heavy traffic, will be the business of the department of railway operation recently added to the organization. The lines will not be common carriers. On railroad No. 1, 30 geared engines will be used to assemble log trains on the main line, and through trains will be handled by 15 Mikado consolidated locomotives. The latter are expected to make 125 engine-miles per day, the traffic on the entire line amounting to about 1400 train-miles per day.

The cost of getting out logs depends upon the location and density of the stand. The best spruce is on the Olympic peninsula, where in some sections 47% of the forest is spruce. But this is unusual. In the average stand tapped by the new railroads only about 17% of the trees are spruce. So-called good stands range from 10,000 to 40,000 ft. per acre, and a tree is cut for its airplane stock if it contains one straight-grained log 20 ft. long.



SAWING UP A HUGE LOG OF CLEAR NORTHWEST SPRUCE

Where timber cruisers make a favorable report, tree spotters are sent out to locate and number each spruce tree and estimate the footage of airplane stock it contains. On maps drawn to a scale of 10 in. to a mile the spotters mark the location and number of each tree, and fill in such topography as the loggers will need. Thus the plan for handling each log is worked out before the equipment goes into the woods.

Some Over-All Cost Figures

Where riving camps have been operated by cost-plus contractors, a check on the over-all cost has shown the average to be $105 per 1000 ft., while on the most expensive operation the cost was $114.97. Independent operators are being paid $130 per 1000 ft., but the need for lumber from this source will disappear as the Government railroads begin to deliver from the stands which they tap.

The railroads, mills and all equipment of the Spruce Production Division are being amortized on a 10-month basis, so that the entire cost of the emergency measures may be included in the rate as now quoted. Even on this basis the present cost of producing airplane stock is only $180 per 1000 ft. The allies are charged at the cost rate. Previously they paid as much as $300 for clear spruce, much of which was not useful, of course, because it was not sawed parallel to the grain.

Developing Market for Clear Spruce

The 35% of the Vancouver mill cut which is commercial stock (i. e., not suitable for use in airplanes) steadily accumulated, until it was apparent that some plan of disposal would have to be found. This meant developing a market for clear spruce, a problem that was put in the hands of a sales department organized in July. The department faced a threefold problem: (1) To clear the accumulation of commercial stock at the Vancouver mill; (2) to salvage a byproduct that would otherwise waste, and (3) to develop markets that would not encroach on or conflict with the sales channels already developed. In fact, unless the general situation in the entire Northwest field had been relieved, the production of airplane spruce would have suffered. Private mills could turn only about 25% of their cut into airplane stock, so they accumulated 3 ft. of commercial stock for every foot sold to the Government. Seven men experienced in marketing Western lumber in Eastern fields were sought out, and one was put in each of seven Eastern centers. These men have found in old fields new uses for the exceptionally clear spruce lumber; they develop new fields where they can, such as in foreign and Government factories and in lines where spruce has not been previously exploited. Their work is the more difficult because 80% of the stock is less than 6 in. wide, and the thickness ranges from ⅞ to 4 in., varying by sixteenths.

Despite the fact that Eastern markets did not know Western spruce, and in the face of a shorter haul on Southern pine, the new department developed in three months a business equal to the output of commercial lumber at the plant (about 400,000 ft. per day), and had on file orders for 12,000,000 ft. of the 20,000,000 ft. of accumulated commercial stock. This was done with prices kept on a par with current rates.

Although the Northwest is supplying 75% of the Government ship timbers and airplane stock, it gets only 10% of the Government orders for commercial stock. It is pointed out that relief from this situation is urgently needed, and that the mills cannot long continue operation under this unbalanced condition. The importance of the objection to hauling back empty cars is recognized, but the producers face the all-important problem of a continually increasing accumulation of commercial stock produced as an incidental to the special war orders.

Production Corporation Authorized

The United States Spruce Production Corporation has recently been established by Congress as a war-time business department of the Government, similar to the Emergency Fleet Corporation. The spruce corporation, capitalized at $10,000,000, will carry on as a general manufacturing business the work started by the Spruce Production Division. As principal stockholder, the Government backs the enterprise, and General Disque continues to direct the work as president of the corporation.

Touching on only the chief features of General Disque's professional record, it may be said that he entered the regular Army in 1899, and was advanced from

sergeant to first lieutenant in the Philippines. In 1913 he was a cavalry captain on the Mexican border; later, returning to the Philippines, he was assigned to construction work until 1917. Then he resigned to accept the position of warden at the Michigan State penitentiary, one of the few self-sustaining prisons in the country. After a notably successful administration there, when this country entered the war he applied for his old commission as cavalry captain. Instead he was made lieutenant colonel in the Signal Corps, and last October was sent to the Pacific Coast to report on the spruce situation.

When the executive staff for the Spruce Production Division was being organized the aim was to find the ablest men available on the continent. Lumbering as General Disque proposed to do it would be a new business, and exceptional talent was necessary. For department heads, particularly, he sought men of experience who had breadth and initiative. Such men were found, and for the win-the-war work they accepted the pay of a captain or a major, although in doing so the department heads have sacrificed an average of $10,000 per year.

The enterprise and enthusiasm which these men have put into their work has set a high standard in one of the great undertakings of the war, and General Disque credits his staff with a large measure of the year's success.

Compressing Concrete Increases Its Strength

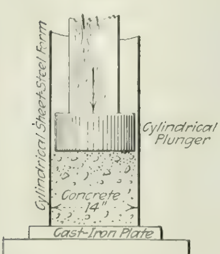
Plain Columns of Successive Layers Pressed Down Average Half Again as Strong as Those Poured for Full Length

By Frank P. McKibben
Professor of Civil Engineering, Lehigh University, Bethlehem, Penn.

DENSITY in concrete being an acknowledged aid to strength, an effort was made in some recent tests to determine whether this desired density can be obtained by compressing the concrete during deposition. While it is admitted that there may be difficulties in applying the process to construction, the fact that the tests show that strength can be materially increased by successive compressing of layers may lead to further investigation.

The records herewith given cover two types of columns: First, "ordinary concrete" columns, made of 1:2:4 concrete in the usual way, of which five specimens were tested, and, second, "compressed concrete" columns made of identically similar 1:2:4 concrete but compressed during the process of molding, the compressive loads varying from 25,000 to 40,000 lb.—that is, from approximately 160 to 260 lb. per square inch of cross-section. Ten of these compressed concrete columns were tested, eight at the age of 28 days and two at the age of 56 days.

All columns were approximately 5 ft. long and 14 in. in diameter, and no reinforcement whatever was used in any of them. The concrete used in both the ordinary and in the compressed columns was of uniform quality, proportioned in accordance with Taylor and Thompson's tables of quantities for a 1:2:4 mixture. The fine aggregate was Delaware River sand, a material too fine for good results, but commonly used until recently in the Lehigh Valley. The large aggregate was extremely hard, crushed limestone of excellent quality, practically all of which pasesd a 1½-in. mesh, the dust being screened out. The molds used were of sheet steel rolled into cylindrical form, care being taken to prevent the loss of water by making the forms tight.



METHOD OF APPLYING PRESSURE TO CONCRETE

The ordinary concrete columns were molded by spading concrete into the forms and tamping with an iron bar. Each compressed concrete column was molded in five layers, each layer being about 12 in. deep, and as each was placed in the form a pressure was applied to the upper surface of the concrete by means of a plunger. The pressure was allowed to remain on each successive layer for a few minutes, the plunger being then withdrawn; more concrete was spaded into the form, this in turn being compressed. Thus, the process of placing about 12 in. of concrete into the form and compressing the same was repeated five times to complete each column approximately 5 ft. in length. The plunger used in compressing the wet concrete was 13 in. in diameter, and the nominal inside diameter of the form

FORM IN WHICH CONCRETE WAS COMPACTED

The forms were stripped three days after the columns were molded, the column then being kept in wet canvas for four days. During the rest of the 28 or 56 days, in the two cases, respectively, the columns were exposed to the air of the laboratory.

The columns were tested in the Lehigh University 800,000-lb. vertical screw machine in a standard manner. Longitudinal and lateral deformations were measured.

Tables I and II give the main data of the tests. It is interesting to compare the weight of 147 lb. per cubic foot for the ordinary concrete columns with the average of 153 lb. per cubic foot for the compressed concrete columns, a difference of 6 lb., or about 4 per cent.

TABLE I. TABULAR VIEW OF ORDINARY CONCRETE COLUMNS

Column Number	Water Per Cent.*	Wt. of Column, Pounds (At Time of Testing)	Wt. of Column, Lb Cu Ft	Age in Days	Length, Feet	Diameter, In	Ultimate Compressive Strength, Lb per Sq In
P-1	8.6			28	5.0	14.56	2,390
P-2	7.9			28	5.0	14.34	2,420
P-3	8.0	851	147	28	5.0	14.58	1,640
P-4		888	147	28	5.02	14.81	1,240
P-6	8.0	815	147	28	5.0	14.25	1,180
Average,	8.1		147				1,774

* Ratio of water to cement plus sand plus stone

The compressed concrete columns failed more suddenly than the ordinary columns, and whereas in an ordinary concrete column failure occurs by crushing or by shearing on inclined planes the compressed column splits longitudinally on a diametrical section for a considerable portion of its length. The compressed concrete contains perceptibly fewer air spaces than does the ordinary concrete. Moreover, although the limestone was of very hard quality, practically all stones on the fractured section were pulled in two. Seldom in compressed concrete did stones pull out of the mortar.

The advantage of compacting the concrete is clearly shown by the high ultimate strength of the compressed concrete. For 28-day ordinary columns the average compressive strength is 1774 lb. per square inch, as compared with 2680 lb. per square inch for compressed concrete, a gain of 906 lb. per square inch, or 51%. Contrast this 51% increase in strength with the 4% increase in weight. It is quite evident that compacting is very effective.

TABLE II. TABULAR VIEW OF COMPRESSED CONCRETE COLUMNS

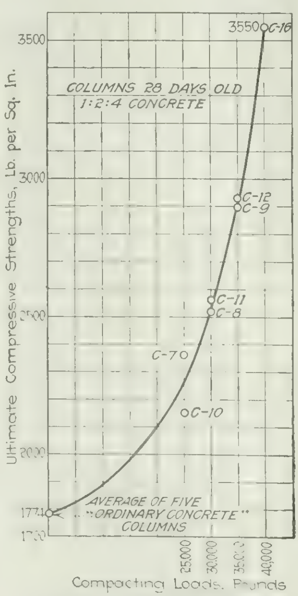
Column Number	Water, Per Cent	Load Used to Compact Columns, Lb	Aver. No. of In. Column Compacted at Each Application	Wt. of Column, Lb (At Time of Testing)	Wt. of Column, Lb per Cu Ft	Age in Days	Length, Ft	Diameter, In	Ultimate Compressive Strength, Lb per Sq In
C-7	8.6	25,000	1½	808	150	28	5.00	14.06	2,360
C-8	9.2	30,000	1	754	149	28	4.67	14.09	2,520
C-9	8.2	35,000	1	732	150	28	4.56	14.05	2,900
C-10	8.9	25,000	1 1/16	733	149	28	4.60	14.00	2,150
C-11	7.8	30,000	1¼	751	152	28	4.58	14.07	2,560
C-12	6.8	35,000	0¾	765	155	28	4.61	13.99	2,930
C-15	6.8	35,000	0¾	773	158	28	4.67	13.88	2,500
C-16	6.8	40,000	0¾	775	153	28	4.67	14.10	3,550
Average.....									2,680
C-13	6.5	25,000	0¾	763	155	56	4.60	14.00	3,590
C-14	6.0	30,000	0 13/16	790	154	56	4.7[illegible]	14.00	4,940
Average	7.6				153				4,265

Now refer to Table III, wherein compressed concrete columns are grouped with the compacting load as a basis. It is here revealed that a molding compression of 25,000 lb. produced an ultimate strength of 2255 lb. per square inch; a molding compression of 30,000 lb. produced an average ultimate strength of 2540 lb. per square inch; 35,000 lb. pressure gave an average of 2780 lb. per square inch for the three columns, C-9, C-12 and C-15. Observe that with the compacting load of 40,000 lb. for column C-15, the resulting compressive strength was 3550 lb. per square inch, a value almost exactly double the average of the five ordinary concrete columns.

TABLE III. COMPARISON BETWEEN ULTIMATE UNIT STRENGTHS AND LOADS USED IN COMPACTING COMPRESSED CONCRETE COLUMNS

Column Number	Age in Days	Compacting Pressure, Pounds	Ultimate Compressive Strength, Lb. per Square Inch
C-7	28	25,000	2,360
C-10	28	25,000	2,150
Average			2,255
C-8	28	30,000	2,520
C-11	28	30,000	2,560
Average			2,540
C-9	28	35,000	2,900
C-12	28	35,000	2,930
C-15	28	35,000	2,500
Average			2,780
C-16	28	40,000	3,550
C-13	56	25,000	3,590
C-14	56	30,000	4,940

For C-14, age 56 days, the ultimate compressive strength is 4940 lb. per square inch, nearly three times the strength of ordinary concrete at the age of 28 days. Of course, the element of time enters into this high compressive strength for C-14. The accompanying diagram illustrates even more strikingly than does Table III the effect of compacting the concrete. A careful study made by the writer shows that stress deformation curves for the compressed concrete columns are much more nearly straight than the corresponding curves for the or-



EFFECT OF COMPACTING ON STRENGTH OF CONCRETE

dinary concrete columns, many of the curves for the former being fairly straight almost to the ultimate strength.

Moduli of elasticity corresponding to unit compressive stresses of 500 lb. per square inch are shown in Table IV.

Additional tests on compressed concrete should be made to determine the proper amount of water to be used in mixing, the maximum intensity of load permissible during molding and the effect of using compressed concrete in spirally reinforced columns. It seems certain that up to some point not yet determined increased ultimate strength follows with increased loads for molding, but beyond that critical point the excessive pressure may remove so much water as to leave insufficient for proper hydration of the cement.

TABLE IV. MODULI OF ELASTICITY OF COMPRESSED CONCRETE COLUMNS FOR UNIT COMPRESSIVE STRESSES OF 500 POUNDS PER SQUARE INCH *

Column Number	Modulus of Elasticity Lb per Sq.In.
C-7	3,555,000
C-8	4,083,000
C-9	3,480,000
C-10	3,405,000
C-11	3,506,000
C-12	5,647,000
C-15	5,743,000
C-16	4,788,000
Average	4,276,000
C-13	3,474,000
C-14	3,606,000

* When tested, all columns were 28 days old, except C-13 and C-14, which were 56 days old.

Assistant Professor M. O. Fuller of Lehigh University and former students W. A. Stickel, C. W. Tanner, P. M. Teeple and C. R. Uhl deserve all credit for making these tests.

Buffalo Water-Waste Survey Saves Water, Coal and Labor

Pitometer, House-to-House Inspection and Fixture Repairs Produce Remarkable Results, With City Only Half Covered

By George C. Andrews
Water Commissioner, Buffalo, N. Y.

Water consumption and waste in Buffalo reached 339 gal. per capita for the year which ended June 30, 1917, based on a total pumpage of 61,471,000,000 gal. No systematic effort to reduce waste had been made for a number of years, with the result that, while ample pumpage capacity was available and an unlimited supply obtainable from Lake Erie, the increased consumption had overtaxed the mains. There was a consequent decreased pressure in the outlying sections. The prejudice against meters and the absurdly low rate of 2c. per 1000 gal. (since raised to 4c.) precluded the universal use of meters, and it was decided to make a thorough water-waste survey of the entire city. The results, with the survey only partly completed, have been notable as regards the saving of both water and coal.

The city was divided into ten sections. The Pitometer Co. of New York was engaged to survey one of these sections and then, if the results justified taking such a step, was to be engaged to survey the entire city. Work was started in June, 1917, and in September, 1917, the final report on section 1 was submitted. The results to be obtained were so evident from the start that surveys were ordered in two additional sections while work on the first section was in progress, and the balance of the survey was ordered in January, 1918.

The first section surveyed was divided into seven districts. The water was measured in each district by the pitometer method of isolating the district and measuring the consumption for 48 hours, and then comparing the minimum night rate with the total consumption. Where metered industries were in the district their consumption was read during the test period, and the readings corrected accordingly. At first, subdivisions were made at night of each block in the district, with the idea of locating underground leaks, but the house waste was so great and so constant in practically every district that this was abandoned until after a thorough house inspection had been made. In conjunction with the pitometer engineers 20 of the regular inspectors of the Water Department were employed. These men worked in pairs. They first made an inspection for house waste. Then, by shutting off the house cock, they tested by aquaphone for a leak in the service between the house and the curb box; and also, by shutting off the water at the curb, for a leak in the service between the main and the curb box. Blanks were prepared and a report was required on the conditions found at each house. At all places where faulty fixtures were found and services were in poor condition, a "notice to repair" was served. This notice stated the nature of the trouble and called for repairs in 24 hours, under threat of having the water shut off.

Each "notice to repair" was attached to a stub which was retained by the inspector. Approximately a week later a reinspection was made of the buildings where a "notice to repair" had been served, and if the repairs had not been made the water was turned off. In the first section surveyed this was not rigidly enforced, but practically 75% of the leaks were repaired at once. Where places were metered no inspection was made. All unmetered business places were served with a notice that a meter would be installed.

Waste Caused by Antifreezing Closets

A considerable number of antifreezing closets were found in this section. At first meter notices were served, but the department felt that it was not advisable to meter these places at that time and a special notice was printed calling attention to the waste of water by that type of closet and to the fact that it was almost impossible to keep it in repair. Notice was served that if the closets were not kept in repair meters would be installed. This notice resulted in the changing of a number of such closets to those of the tank style.

A considerable number of complaints came to the office at first from persons who had employed plumbers to make repairs; these plumbers had failed to appreciate the seriousness of small leaks and had unwittingly slighted their work. But these complaints became fewer as the work progressed and the plumbers did better work.

The results obtained in section 1 were, briefly, as follows:

Total consumption in 24 hours before survey, gal	12,345,000
Total consumption in 24 hours, after survey, gal	8,337,000
Reduction, gal	4,008,000
Percentage of reduction	32
Number of underground leaks	12
Leakage per 24 hours from underground leaks, gal	887,000
Number of services in section	8,000
Number of defective services found and ordered repaired	308
Percentage	3.9
Number of dwellings in section	7,889
Number of fixture leaks	3,449
Percentage of fixture leaks to dwellings	43.7

Section 2 comprised old, low-grade dwellings, mostly equipped with antifreezing or evasive closets. The total consumption in this section was 19,051,000 gal. per day, with a minimum night rate of 83.3%. Repairs ordered in this section were made much more promptly than in section 1, notwithstanding the fact that, as a class, the property owners were poorer. Unfortunately, an early winter accompanied by a heavy snow prevented a remeasurement of this section until spring. At that time, notwithstanding the fact that more than 6510 leaky fixtures and 431 service leaks had been repaired, no material reduction in consumption resulted. This is a section where selective metering must be employed, as repairs to antifreezing toilets are not permanent. The department has now raised the rate on this type of closet from $1.50 to $10 per year, and a large number have been taken out. Meters have been installed on several services supplying such closets, and the results are astounding. One place showed a consumption of more than 4000 cu.ft. per day, yet the owners still asserted that there was no waste. Considering the number of people living in this district, the consumption should not be more than 10,000,000 gal. per day, at the most liberal estimate.

Section 3 was a sparsely settled part of the city in which pipes had been laid twenty-five years ago, anticipating a quick development which is now just arriving. Most of the mains were laid in the sewer trench to avoid excavating rock, as the rock in this section is within 2 or 3 ft. of the surface. At the time of paving the streets service connections were made for all lots, with the result that hundreds of unused supplies had been in the ground for twenty-five years. As the services and the mains are in the sewer trenches, leaks are seldom indicated by water appearing on the surface. The total consumption in this district was 7,291,800 gal. per day, and the minimum night rate was 77.2%. A large number of broken, unfinished supplies and several cracked pipes were discovered by pitometer measurements, which alone accounted for a total of 2,805,000 gal. per day in this section. The number of leaky fixtures was practically in the same ratio as in section 1. Service leaks were in a slightly larger ratio.

The survey is now practically 50% completed, and the pumpage each month is showing a cumulative decrease as compared with the preceding year, as may be seen from the following:

PUMPAGE, IN MILLION GALLONS

Month	1917	1918	Decrease
June	4,560	4,527	33
July	4,835	4,676	159
August	5,092	4,666	426
September	4,611	4,118	493
October	4,614	4,069	545

The actual reduction in waste is much greater than indicated, as the industrial use of water, as shown by meters, is more than 10% greater than last year.

The reduction in pumpage has resulted in the saving of nearly 1000 tons of coal per month, and practically a 25% reduction in labor force at the stations.

The permanency of the work is shown by remeasurements in section 1, just one year after the work was completed, when practically no increase in the night rate of consumption was found.

Promising Results with Miles Acid Process of Sewage Treatment in New Haven Tests

Good Removal of Suspended and Settleable Solids and Bacteria—Effluent and Sludge Stable—Grease Utilization Problems—Local Conditions Favor Process at New Haven

EXPERIMENTS with the Miles acid process of sewage treatment at New Haven, Conn., indicate that although the process seems to have some rather serious limitations which might preclude its use elsewhere, yet it promises to be satisfactory for the conditions which prevail at New Haven. The following statements regarding the experiments and the results obtained are from a paper by Prof. C.-E. A. Winslow, professor of public health, Yale University, and F. W. Mohlman, chemist of the Connecticut Department of Health, read before the annual convention of the American Public Health Association last September.

The most extensive investigations of this process, so far conducted, have been carried out by the writers at New Haven, Conn., during 1917 and 1918. Conditions here seemed *a priori* unusually favorable to the process of acid treatment. It was desirable that the effluent to be produced should be clarified and disinfected but not necessarily nitrified—precisely the results which the Miles process aims to produce; and the sewage was known to be of low alkalinity on account of the presence of acid industrial wastes.

The experiments were conducted under an appropriation made by the City of New Haven, and directed by a committee of which the senior author was chairman and of which Prof. S. E. Barney and A. B. Hill were the engineering members, and with the junior author as chemist in charge of the plant.

The studies were made at two of the five different outfall sewers of the City of New Haven. Four different runs were made with the East St. sewage and one run with the Boulevard sewage, each run ranging from 24 to 75 days. In each case small wood tanks were used, the average detention period being four hours. The acid was applied in the form of SO_2 gas. The alkalinity of the East St. sewage is very low (averaging

only 50 p.p.m. for the four runs), so that it was necessary to add only 700 lb. of acid per 1,000,000 gal. of sewage treated, to secure an acidity of 50 p.p.m. (as calcium carbonate). At the Boulevard sewer 1130 lb. of acid per 1,000,000 gal. of sewage were required to secure an acidity of 50 p.p.m. (as calcium carbonate).

General Results of Miles Acid Treatment

The general results of the acid treatment were highly satisfactory. The removal of total suspended solids amounted to 61 and 66%, respectively, at the two outfalls, and the removal of settleable solids to 90 per cent.

The sewage of the East St. sewer is an abnormal one, having a very low bacterial count as a result of the presence of copper salts contributed by industrial wastes. During the first run at East St. an insufficient amount of acid was added, and the treated effluent had an average acidity of only 12 p.p.m. Yet even in this case the removal of total bacteria averaged 85% and of B. coli types 98%. The removal of total bacteria averaged 87% in the second run, 98% in the third, and over 99% in the fourth run and in the Boulevard test. The removal of gas-forming organisms was 89% in the third run and over 98% in all other cases. Of all samples of effluent examined at East St. 91% showed less than 10,000 bacteria, and 84% less than 1000 B. coli per cubic centimeter, while at the Boulevard 91% showed less than 10,000 bacteria and 41% less than 1000 B. coli per cubic centimeter.

Both Effluent and Sludge Stable

It is particularly important, from the point of view of the practical sewage-works operator, to note that both effluent and sludge were so affected by the acid present as to be stable for considerable periods, so that with a plant of this type no local nuisance need be anticipated. During the whole period of our experiments there were only one or two occasions on which slight signs of septic action were noticed in the tank, and the sludge was stored in barrels for weeks without the production of offensive odors.

From Aug. 17 to Sept. 27, 1917, we operated the Miles acid tank as a plain sedimentation tank, using the same quantity of sewage and the same procedure in all respects, except that the addition of acid was omitted. Only 40% of the suspended solids was removed from the sewage, as compared with 60% by the Miles acid process. Septic conditions were pronounced in the tank, as the increase in ammonia nitrogen and alkalinity indicate. Bacterial determinations were not made during this test, but there is no reason to suppose that the count decreased to an appreciable extent, particularly in view of the offensive condition of the sludge. The sludge was higher in moisture content than was the Miles sludge, and much less sludge and grease was recovered. This was partly due to the low suspended solids in the raw sewage, but even if there had been 105 parts, as in the acid tests, instead of 88, the sludge and grease recovered would have been, respectively, 360 and 70 lb. These quantities are 75% and 58% of the quantities recovered by the acid process.

The information obtained in regard to the amount and general character of Miles acid sludge is presented in the accompanying table:

CHARACTER OF MILES ACID SLUDGE AT NEW HAVEN

	East St. Sewer				Boulevard Sewer
Length of run	25 days	24 days	44 days	70 days	29 days
Total gallons sewage treated	260,000	239,400	407,820	602,220	145,500
Gallons wet sludge per m.g. sewage	3,750	4,025	3,200	2,600	5,375
Specific gravity	1,067	1,048	1,054	1,061	..
Per cent. moisture	86.6	88	86.3	85.7	92.5
Pounds dry sludge per m.g. sewage	503	483	439	368	403
Ether extract, per cent. dry sludge	23.7	24.0	29	32.6	30.9
Ether extract, pounds per m.g.	119	116	127	120	124
Volatile matter, per cent. dry sludge	47.2	51.2	57.3	63.8	78.5
Nitrogen, per cent. dry sludge	1.6	1.6	2.4	2.0	3.0

So far the results of the New Haven experiments were very favorable to the Miles process; but when the grease which had been recovered was studied with more care, in order to determine its real commercial value, the aspect of the matter began to change. The difficulty lies primarily in the presence of a large proportion of unsaponifiable material (waxes, mineral oils and similar substances) in the ether extract, substances of this kind being practically worthless and their presence necessitating costly processes of purification. The sludge obtained in the third, 44-day run when analyzed by Dr. Raymond Wells yielded 24% of grease, 46% of tankage and 28% of water. The grease analyzed as follows: Moisture and volatile matter, 11; unsaponifiable material, 21.1; free fatty acids (by weight), 40.2; neutral grease, 22.3; insoluble and metallic soap, 3.3; of the 40.2% of free fatty acids 14.4% was rosin and 25.8% actual free fatty acids. The degreased sludge contained 3.91% of nitrogen as NH_3, 0.96% of phosphoric acid as P_2O_5 and 51.88 % of ash. The grease obtained from the other three runs made with the East St. sewage contained, respectively, 19.8, 20.7 and 28.3% of unsaponifiable material.

Study of Unsaponifiable Material

In view of the fact that the East St. sewer receives contributions of mineral oil from a munition factory it was thought that the large amount of unsaponifiable material might be due to this cause, and the Boulevard plant was installed to test this point with a fairly normal domestic sewage. The result here was distinctly better, the proportion of unsaponifiable material being only 15.7% with 41.5% free fatty acids, 0.5% moisture and volatile matter and 1.3% insoluble impurities. Even this value is still so high as to impair seriously the value of the grease.

It seems probable that a fairly high content of unsaponifiable material is a normal characteristic of grease obtained from sewage sludge. Thorpe in his "Dictionary of Chemistry" says: "Sewage fats are characterized by large proportions of free fatty acids. The amount of unsaponifiable matter is also considerable. The nature of this has not yet been investigated. Probably it consists to a large extent of coprosterol which forms an important constituent of excrementitious matter." Lewkowitsch, in "The Technology and Analysis of Oils, Fats and Waxes," notes the presence of 11.6% of unsaponifiable material in the grease obtained at Cassel. The source of this material is apparently the feces themselves, for a review of the literature shows that of the ether extract of dried feces (which amounts to 27—35%) 12—14% is unsaponifiable matter, about half of the latter perhaps being cholesterol.

The usual limit for unsaponifiable matter in grease

to be used for soap making is about 5%, and unless grease containing 10—20% of material of this kind could be economically distilled it could be used only as wool grease, which is worth about half as much as garbage grease, or 5 to 6c. a pound, according to the high prices of 1918. Samples of the sludge obtained from New Haven sewage were submitted to Colgate & Co. and the Cobwell Corporation of New York and to Swift & Co. and Armour & Co. of Chicago, and the chemists of all of these concerns, after extracting the grease and studying it, were of the opinion that in its crude state the material was of practically no value to the soapmaker. If such grease is to be utilized it must first be freed from its impurities by distillation.

P. F. Wild, vice-president of the Falk Co., grease distillers, Pittsburgh, arranged to distill a 4-lb. sample of the grease obtained from the Boulevard sewage. The material was saponified and then decomposed, and the fatty acids obtained were distilled. The product which resulted was light brown in color but had a noticeable odor, although the chemist of the Falk Co. reported that it was much less offensive than garbage grease. He added that the grease can be worked in practical manner if the sulphurous fumes which are in combination with the oil can be removed. Otherwise, during distillation this considerable sulphurous acid involved is more or less destructive to the apparatus used, and imparts a rather disagreeable odor during the distillation.

The distilled grease thus obtained amounted to 70% of the crude grease, which yielded in addition 3% of glycerine and 22% of pitch.

According to the estimate of William M. Ware & Co., Boston, the crude product as obtained from the sewage should be worth 8.5c. a pound, and the grease from the East St. sewage (containing 25 instead of 15% of non-saponifiable matter) not worth more than 6.5c. The ether extracts obtained from both sewages varied between 116 and 124 lb. per 1,000,000 gal., but the extractions made for us by the Cobwell Co. and the Colgate Co. indicate that not more than 100 lb. could be safely assumed on a commercial scale in either case. On this basis the Boulevard grease would be worth perhaps $8.50 per 1,000,000 gal. The grease from tankage corresponding to 100 lb. of grease per 1,000,000 gal. would amount to 300 lb. for the Boulevard sewage. This grease-free tankage contained 4.8% of ammonia worth at $4.00 a unit (20c. a pound) $2.88 per 1,000,000 gal. The Boulevard sewage would therefore yield products worth altogether $11.38 per 1,000,000 gallons.

Grease From East Street Sewage

Our data in regard to the grease obtained from the East St. sewage is less satisfactory, since this material was not distilled on a commercial scale. Dr. W. S. Richardson, of Swift & Co., and Dr. Paul Rudnick, of Armour & Co., believed the crude product to be practically unsalable. Dr. M. H. Ittner, of Colgate & Co., found 20% of unsaponifiable material in his sample and emphasized the fact that the grease would have to be distilled and would probably yield less than 60% of fatty acids. G. A. Molleson, of Kuh & Valk, grease brokers, New York City, considered the grease as submitted to him to be unsalable and suggested that if the total of moisture, volatile matter and unsaponifiable matter could be brought below 20% it might be worth 5 to 6c. Dr. Raymond Wells of the Cobwell Corporation thought that even for use as wool grease distillation would be necessary, and that some of the mineral oils present in this sample might possibly go over in the distillate, making even the distilled product unsuitable for soapmaking. He thought 5 to 6c. a pound would be as much as the grease was worth. He noted also that the composition of the sludge was such as to threaten certain difficulties in extraction if the process were not carefully controlled. Dr. Rudnick had the same experience, reporting clogging in the separation of the finely divided sludge from the gasoline extract.

Altogether, in view of the peculiarly unfavorable characteristics of this particular sludge, we do not believe it would be safe to assume a value for the crude product of more than 5c. per pound. This estimate, however, we feel is not too high, in view of the possibility of distilling the grease and its suitability for wool grease if not for soapmaking. This would amount to a return of $5 per 1,000,000 gallons.

The East St. sewage should yield 350 lb. of tankage per 1,000,000 gal., but its tankage contains only 3% of ammonia, giving a tankage value of $2.09 per 1,000,000 gal., which, with a grease value of $5, would give a total return of $7.09.

Applicability and Cost of the Miles Acid Process

Based on the production of SO_2 gas by burning sulphur (assumed to cost $36 a long ton) and on drying from 85 to 10% moisture (coal assumed at $7.50 per ton) it appears that the acid treatment of the sewage from the East St. outlet should be materially cheaper than either Imhoff treatment or fine screening, under existing local conditions. With a fall in the price of grease after the war the outlook would be less favorable.

Cost estimates for the treatment of the Boulevard sewage are of a somewhat different character. The Miles process is here considerably more expensive—first, because of the higher alkalinity of the sewage, and second, because of the fact that the plant would be smaller and costs per unit volume therefore larger. If the problem of the Boulevard sewer stood by itself we should be somewhat in doubt whether to favor Imhoff or acid treatment, with the facts in hand. Since, however, the case for acid treatment seems so clear for the East St. sewer we are of the opinion that it would be wise to delay construction at other New Haven outfalls until the acid process has been tried out on a practical scale at the point where it promises best results.

Our experience with New Haven sewage lends no color to the hope that a net financial profit can be obtained by the use of the Miles acid process, except with sewage of exceptionally high grease content and low alkalinity. They do, however, suggest that for communities where clarification and disinfection are desirable —where screening would be insufficient and nitrification unnecessary—the process of acid treatment comes fairly into competition with other forms of tank treatment; and that it is particularly suited to dealing with sewages which contain industrial wastes, and to use in localities where local nuisances must be avoided at all costs and where sludge disposal could be provided for only with difficulty.

Great Lakes Yards Lead Coast Districts in Building Ocean-Going Ships

Produce Canal-Size Steamers in Large Numbers—Spirit of Coöperation—Yard Capacity Doubled—Side Launching—No Outside Fabrication—Equipment of Varied Character—Labor Shortage

(Passed by the Publication Approval Committee, Emergency Fleet Corporation)

(Continued from last week)

Additional space economy is realized in a number of yards by using dry docks as launching slips (Buffalo, Lorain, Toledo, Chicago). Water being required only at launching time, the docks between launchings are often occupied by vessels undergoing repairs. Assumption of control over dry docks by the District Manager a year ago assured coördination of the dock use with shipbuilding. This seizure, which had the hearty coöperation of owners and builders, had the object of assuring the least possible disturbance by interference due to repairs and ship reconstruction work. All repair jobs have been allocated to those yards and dry docks where they would cause least dislocation of shipbuilding. Riverside berths are found at Cleveland, where the available low ground is quite narrow; at Manitowoc, where a neck or peninsula is occupied by the shipyard and a series of peripheral berths has been developed; and at the Globe yard in Superior. Simple dock and berth construction is used on the Lakes. Depths of 12 to 15 ft. are required directly alongside the launching face of the berth and a bulkhead is therefore needed. Timber sheetpile construction is universally employed for this. Little other construction or foundation work is required at the berth, except keel-block stringers and some lateral piling or pile-supported bents.

Cranes of various types are in service. The principal cranes of the pre-war period are trolley bridges of two forms: Cantilevers running on tracks alongside the berth and reaching out over the full width of the berth, and gantry cranes straddling the berth. In the past year locomotive cranes mounted on portal or gantry substructures have been installed in many of the yards (Wyandotte, Ecorse, South Chicago, Manitowoc, Duluth) as part of the expansion of crane facilities necessary. These machines (Fig. 5) could be obtained more quickly than cranes of other types.

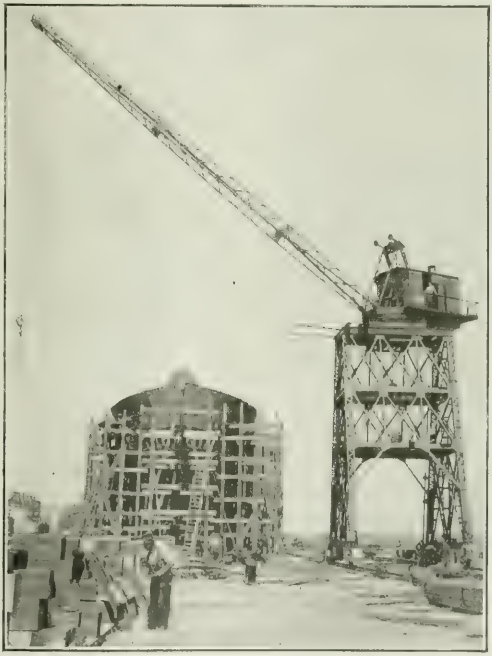


FIG. 5. SHIPBUILDING IN MANY LAKES YARDS HAS BEEN EXTENDED BY LOCOMOTIVE TOWER CRANES

Many of the yards found during the past year that more crane equipment was desirable for making full speed in the shipbuilding. In the slip-and-pier type of yard the oldest cranes are double cantilever machines, giving one hoist hook for two long berths (Fig. 6). This is the case at the Wyandotte, South Chicago and Superior yards. Most of the others had one crane for each long berth, giving one hook for two of the present short ships. The tendency during the past year has been to provide one crane per short berth, where possible. With arrangements like that shown in Fig. 6 increase of crane service proved difficult or impossible, but careful management succeeded in keeping these berths practically up to the normal rate of production made on other berths in the yard. Other handling equipment of the shipyards has been affected relatively little by the emergency shipbuilding needs. It includes locomotive cranes for general yard transportation and material handling, and shear-legs for placing boilers and engines in the ships. These latter machines (Fig. 7) are universal in the Great Lakes yards. Heights of 100 ft. and capacities of 65 to 100 tons are standard. No changes were required in this service. There has, however, been a general increase in the number of yard-service locomotive cranes, both on account of expansion of the yard track systems and because of increased need for transportation per unit of track.

Handling material direct from punch shop to shipbuilding berths was the prevailing system of yard operation in past years. Generally, little or no storage for fabricated material was provided. The pressure of war-time shipbuilding brought out a need for storage between shop and ship, in order to make fabrication and yard operations reasonably independent. Most yards have therefore set apart storage space and put up

additional plate racks for material ready for erection, in their rearrangement of facilities during the past year.

In the typical yard layout the punch shop is located close to the berths, usually about as indicated in the two sketches on page 980 of last week's issue. Cleveland represents quite precisely the normal arrangement for the riverside type of yard. The Manitowoc yard has its punch shop located somewhat farther back, virtually central to the tongue of land around which the berths are grouped. In the slip-and-pier yards the shop is located just far enough back of the slip-head to allow for one or several railway tracks to pass.

Short distance of transportation from shop to building berths has proved its value as a factor in speed of shipbuilding. This is prominent at Cleveland, where with the shop paralleling the berths the material passing out of the punch shop goes into storage directly under the craneway without intermediate handling, and when wanted is moved across to the ship without waste of effort. However, the slowing-up influence of long transportation from the shop is felt only where there is no storage near the ship; where there is ample storage facility along the building berths, as is the case at Lorain, the long haul from the shop does not appear to cause loss of time but results only in slight increase in transportation expense. In another yard, where conditions locate the fabrication at a distance from the principal berths, delays result because there is no space for fabricated storage at the berths.

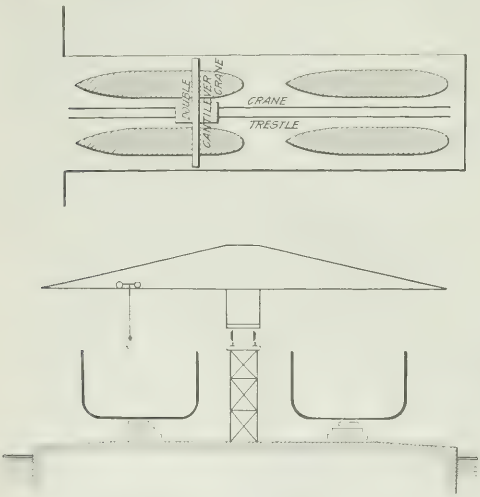


FIG. 6. FOUR BERTHS SERVED BY ONE CRANE HOOK

Making provision for such storage, and—what is just as important—for assembly of parts that can be riveted up in advance of erection, has been the subject of much careful planning in a number of the yards during the past few months. With the shop located close to the berths, it has sometimes been difficult to find the necessary space for this storage and assembly. The difficulty is pronounced in the pier arrangement of berths with berths grouped on a pier and equipped with a double cantilever crane running on a trestle. Conditions such as are sketched diagrammatically in Fig. 6 usually give no room for supply tracks to the berths, so that much extra crane travel is necessary and storage to serve as take-up between the shop and ship is not easily provided.

A radically new solution of the assembly problem has been brought out by the Wyandotte yard, in the shape of an assembly shop. By allowing the assembly work to be done under cover, and providing a machine riveter for it, this shop is expected to produce a large gain in economy and system of the assembly work. Furthermore, the Wyandotte shop will, it is estimated, increase the riveting capacity of the yard by more than 25 per cent. An assembly shop is also being built at Manitowoc.

Berth layout of such type as to furnish ample space for fabricated storage has proved of very decided advantage, and it was a factor in making possible record-speed shipbuilding at the Ecorse yard. At both Manitowoc and Ecorse the cantilever cranes serving the berths are mounted on wide-span gantry bases, and material is stored and preassembled in the space between the gantry track rails, close to the point of use in the ship.

Yard transportation is taken care of by standard-gage track systems in all the yards. Road-tractor haulage is just being tried out at the McDougall yard. A Fordson tractor was put to work, after the angle cleats on the wheel rims were burned off, and with various special trailers it is counted on for handling much of the miscellaneous yard transportation. If the experiment proves successful, tractor haulage may be adopted on a large scale in this yard.

Crane service is an essential factor in transportation in some of the slip-and-pier yards, where the space between the berths is too narrow to admit of either track or team roadways. All material must be moved from the space at the head of the pier by means of the shipbuilding cranes.

While all other yards in the district are using liners under the out-plates of the shell and tank top, the Ecorse yard of the Great Lakes Engineering Works joggles the frames and floor members. A single joggling press is able to handle all of the work. Some other yards are leaning toward the adoption of the same method. Wyandotte and Manitowoc also have installed frame-joggling machines for future use. Reduction of dead weight of ship and saving in cost are counted on.

The use of reinforced concrete was adopted as a time saver in building a new boiler and engine shop, 80 x 600 ft., at the McDougall yard. The boiler end of the building has been in service for some weeks, and the engine part is just being completed. There is a heavy crane runway in the main or clerestory bay of the building; the crane girders as well as the columns are of reinforced concrete. Steel roof trusses span both main and side bays, forming the only connection between the opposite concrete columns.

Pressed-steel building construction has also been employed in the rush work of yard expansion. At Ecorse a number of store houses for ship fittings have been put up, using pressed-steel frame and sheathing.

Shortage developed in the compressed-air equipment of practically every yard at an early stage of the shipbuilding drive. It was made more acute by the practice of operating many auxiliary machines by compressed

air—in some cases forging hammers, pumps and winches—besides tapping the compressed-air lines for blast connections to the rivet forges. Installation of additional compressors, and often revision of the entire compressed-air layout, due to inability to expand at the old site of the compressor house, was undertaken everywhere by the beginning of 1918. Generally, the increase amounts to virtually a doubling of the capacity originally installed. Ultimate compressor capacities of 1500 to 2000 cu.ft. free air per minute are represented in the installations that are now under way. To help out in their air supply several yards have been working night riveting gangs on the berths, but it has not been easy to carry on this work regularly or efficiently.

Buying compressed air from a neighboring industrial plant was resorted to at Wyandotte to tide over the air shortage. A neighboring industrial plant was able to release a 2000-ft. compressor, in the early spring of the current year, and the yard promptly bought the full capacity of this machine and tied it into its own air line by a pipe connection.

Care of air tools developed as a matter calling for special attention. The stock of air tools has had to be largely increased, and this, with the corresponding increase of the yard forces, necessitated much more careful tool-storage and repair systems. Larger air-tool rooms have been built in most yards, new and more systematic storage arrangements have been provided, and careful provision has been made for daily inspection and repair of the tools.

When war-time shipbuilding activities started, in 1915 and 1916, most of the yards had been shut down for some time, and were working along on repair and docking only, with small forces. The trained yard organizations were largely broken up. Skilled shipyard men were scarce, as the spurt in shipbuilding throughout the country had drained the Lakes district. It became necessary to build up working forces rapidly, in order to handle the urgent orders from abroad. Green men had to be trained for the work. The Manitowoc yard two years ago had less than 200 men, as against a present force of well over 2000; Lorain had only 400 or 500, where it now has about 3200 and is not yet fully manned; the Cleveland yard started work in 1915 with only 12 riveting gangs.

Training men therefore has been—and still is—one of the big problems of the shipbuilding situation on the Lakes. It was made the more serious by steady abstraction of men through recruiting by other districts. "The district has been systematically raided of its shipbuilders by yards elsewhere," said a man fully informed about Lake shipyard affairs.

What has been accomplished by developing new men is instanced by the fact that one yard, for example, has increased its riveting force by some fifty gangs (all made up of green men) and has in the meantime lost to other yards a large additional number. The same yard has developed 40 shipfitters, 27 acetylene burners, half a dozen blacksmiths and furnace men, and a complete punch-shop and bending-slab force.

Dilution was the principal process used in developing men, up to a short time ago. Its success in all instances depended on the teaching ability of the gang bosses and skilled men who had the green hands in charge. The best results were secured where closest attention was given to the problem—that is, where superintendents and foremen personally looked after the training process in detail.

FIG. 7. ENGINES AND BOILERS PLACED IN SHIPS BY SHEAR-LEGS

School training was started at a number of yards within the past year, partly on the initiative of the yards and partly through stimulation from the Industrial Service section of the Emergency Fleet Corporation. It has taken chiefly three forms: First, training the boys and raw men in blueprint reading and in details and terminology of ship construction, by a three or four months' course of night classes; second, training skilled men to act as field instructors; third, training foremen. While this school work is still in its early stages, its value has been demonstrated. The school cannot make skilled workmen, but it can make men quicker to learn certain kinds of work.

At Cleveland, where the evening instruction classes in blueprint reading and ship construction were taken up earliest, and a complete course of print lessons was developed, boys have been made into competent second-class shipfitters in a few months, and laborers who had no prospect of ever rising higher have been made over into dependable second-class skilled workmen. Many yard managers state that the training of skilled men as field instructors has had the result of making the instructors better workmen, besides enabling them to train green hands more rapidly. Considerable expansion of the schooling work is in progress now, under direction of the Emergency Fleet Corporation.

Piecework pay has been applied by all the yards to every item that could be handled in this way, generally all operations except punching, bolting and yard labor. Though the piecework rates are high, full-time work is secured, and often much overtime.

Night work has become the rule for the shops and for material distribution. In connection with the latter, the ship erection cranes are often run at night, distributing material. Ship erection and riveting have been carried on at night only in special cases, for speed. Where air shortage made it necessary to put part of the riveting force on the night shift, as at Wyandotte, difficulty has been found in keeping up this force.

Accommodations for the men are in most cases scarce and far away. The yards at Cleveland, Detroit and Chicago, which are in city districts affording reasonably ample accommodations, have had the freest labor supply. At some of the other yards the situation has been serious enough to require construction of dwellings by the yard or by the Government authorities. At Lorain

FIG. 8. PART OF SHIPBUILDING BERTH UTILIZED FOR PRE-ASSEMBLY

the American Shipbuilding Co. started a cottage development for its workmen, and this was subsequently taken over and expanded to a 250-house operation by the Emergency Fleet Corporation. A similar course of events at Manitowoc resulted in a 100-house development, now under way. The McDougall-Duluth Co. undertook its own housing construction early, and this has continued under the company's ownership and management. Forty houses were built in 1917—they were started even before the yard—and 105 additional ones were erected this year, which, with barracks in the same plot, provides for about 250 workmen.

A dormitory within the yard formed part of the Manitowoc Shipbuilding Co.'s solution of the labor-housing problem. The company equipped the second story of its store house as a bunkhouse. A large lounging and reading room was formed by cutting off one end of the loft, and the remainder of the space was divided up, by 6-ft. partitions of asbestos board on 2 x 4 frames, into rooms 6 x 9 ft. in size, containing each a double-deck steel bunk. The entire space, heated and ventilated by a blower system, has provided satisfactory housing for some 150 men. However, as the space is now needed for other purposes, a special dormitory or barracks building has been incorporated in the Government cottage development nearby, in order to accommodate the men now living in the yard bunkhouse.

A unique restaurant and cafeteria is also a feature of the Manitowoc yard. An old Lake passenger steamer was docked near the bunkhouse, and its main deck fitted up with a boarding section, for the bunkhouse men, a cafeteria section to provide lunches for other employees, and a galley. This is now being replaced by a restaurant of twice the size, fitted up in the old machine shop building near the Government dormitory.

An investment of well over $60,000 in a cafeteria is being made by the Great Lakes Engineering Works at Ecorse for feeding the employees, the distance of the yard from any settled district having made this provision for the workers imperative. At other yards no definite steps have been undertaken to provide boarding facilities.

Supplementing the general spirit of drive and progress in the Great Lakes district, an excellent working spirit appears in most of the individual yards. The fact that riveting averages are high is in itself a demonstration of this fact. The best working spirit, furthermore, is found in the yards which have the highest averages.

How the yard is managed appears to have much to do with its spirit. Where the management makes every effort to keep close to the daily work and close to the interest of the men, the results are good. One yard, which has proved a surprise to the whole district because of its excellent production despite the handicap of old equipment and cramped layout, is distinguished, inside the gates, by the fact that "the superintendent is unusually close to his men"—in close personal attention to training and progress of the men and in requiring that all discharge cases pass through his office and receive his attention, as well as in detail attention to the progress of work. The investigation of all discharge cases gives opportunity for checking up on disagreements between men and gang bosses or foremen, and getting prompt control of disorganizing conditions.

Equally important in its effects is the tying together of the executive staff of a yard by conferences between

FIG. 9. PRACTICE-TEACHING IN THE MANITOWOC TRAINING COURSE FOR INSTRUCTORS

the superintendent and all his foremen; most yards hold such conferences weekly, and the coördination and drive of their work are in a great measure dependent on the way in which these conferences are conducted. At Duluth group meetings help in centralizing the organization's efforts. The timekeepers of the plant meet on

Tuesday evening, at a dinner furnished by the company. They are privileged to discuss anything in the plant. Matters brought forward by them may, if desired, be taken up at the foremen's meeting, held on Wednesday, with the superintendent as chairman. This is an active meeting, aiming at discovering any impediments to progress in the organization or conditions of the yard. A meeting of yard executives is held in the general manager's office on the following day, to bring out all matters that came up during the week concerning personal elements in the organization. The minutes of the foremen's meeting are read, and where necessary are discussed and acted upon.

A system of noonday music meetings that has been developed—or, rather, that has developed itself—at the South Chicago yard of the American Shipbuilding Co. is said to have been decidedly effective in creating a yard spirit. A band was formed on the initiative of the men themselves, a band leader and a song leader came forward, and in a short time singing mass meetings were organized. These have now become a fixed institution, running three times a week, during the noon hour. Frank La Marche, superintendent, states that they have been a strong influence to hold the men in the yard at noon and arouse their intensely interested participation. They have made the men feel that they belong to the yard and that the yard's interests and work are also theirs—a sound basis for productive efficiency.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Hauling Heavy Girders Through City Streets—A Protest

Sir—In your issue of Oct. 31 there is described the hauling and erection of the large cantilever girders for the Park Avenue viaduct. I had occasion for giving close attention to this remarkable proceeding. While it was in the hands of very competent contractors upon whom no criticism is here intended, the undertaking in its essential features was an outrage, the repetition of which should not be permitted. You briefly mention mishaps and damage which occurred during the work. This is a very important subject, deserving far more attention than you gave it.

The bed of our streets is occupied by a bewildering assortment of electrical conduits, gas, water and steam pipes, sewers, and other substructures. These represent not merely utilities, but the mechanism of life in this community. The usual street traffic is in itself a severe test, but the impact of extraordinary wheel loads cannot be provided against *at all points* because of the variety, irregularity and intermingling of these substructures. Under the common law one may roll the planet Jupiter through the street should he so desire, because it is a public highway. All damage to any substructures resulting from the proceeding can be imposed upon the owner of such property.

For most of their journey through the city streets, six of these girders traversed the tracks of the New York Railways Co. These tracks are maintained by that company at great expense for construction and repair. In design they represent the accumulated experience of many years in many cities. The construction has been approved by the Public Service Commission and all municipal authorities having to do therewith. Its cost has proven too great for most of the cities in the world. The public would never consent to a fare which would pay a return upon the cost of such massive construction as would meet the impact of a 20-ton wheel load. And yet, because our laws provide no restraint, great damage was done to the company's property, no part of which can be recovered by it. Scores of its manhole covers, and in many cases also the frames, were reduced to scrap iron. As the truck wheels bumped over the granite blocks it was evident that the impact was breaking the cast-iron yokes upon which the rails are supported. At many places the trolley slot was closed up and on two occasions the power rails in the conduits were short-circuited. Just how much damage that company suffered only it can tell, but doubtless its track construction in 23rd St. east of Lexington Ave. is practically ruined.

Likewise, numerous sewer manhole covers disappeared from view as the load rolled over them. I am reliably informed that by the time three girders had been moved the entire reserve of manhole covers for sewers and trolley lines had been exhausted. On two occasions the truck wheels crushed the double-plated manhole covers over the splicing chambers pertaining to the underground electrical conduits. In one such case the conductors were short-circuited. Possibly such incidents as one man losing a leg and another having his foot crushed do not pertain to technical discussion.

While the apparent damage to the street paving may not have been impressive, I am convinced from close observation that the concrete base was sheared through at many places. Of course, the destruction wrought by the moving of the first girder was compounded during the journey of its five successors. Surely all of the paving in 23rd St. to Fourth Ave., and in Fourth Ave. to 40th St., will require repairs and replacement at a much earlier date than it otherwise would. No one pretends that street paving is expected to meet such tests.

But beyond the question of material damage is the more important matter of public safety. When 14 double teams of horses are lashed up to dragging an 80-ton load in a city street the possibilities of destruction become very great. Such cavalcades are not easily kept under control. In hauling one of these girders the horses could not be checked in time to prevent the girder crashing in the door of the Metropolitan Bank. While moving another girder, the horses stampeded and dragged the truck against the curbstone on the west side of Fourth Ave. below 32nd St., crushing the curbstone and plowing up the sidewalk; the truck did not stop until the end of the front axle had sunk to the ground. At that moment the forward end of the girder was heading directly toward the windows of the Park Avenue Hotel. The mere circumstance of that building standing back a few feet from the property line to the south averted a disaster. In view of this incident we

may realize how easily a portion of the elevated railroad could have been demolished.

Some engineers, like some statesmen, are prone to exploit their hobbies at the expense of others. In the case under discussion the engineer, his identity being unknown to me, *preferred* to have some girders 136 ft. long and weighing 70-odd tons apiece fabricated complete at Phoenixville and transported thence through the city streets to the place of erection. Apparently the authority over and responsibility for this public improvement was so distributed that no one was in a position to revise this engineer's judgment that there was sufficient justification for hauling a car of Juggernaut through the city streets, doing untold and unknown damage to property, and putting thousands of people in peril of life and limb. Accident and mishap are inseparable from such unusual undertakings. Engineers and contractors must not be free to impose the expense and peril upon the public.

In bridge building many splices and connections of vital importance are riveted in the air. I know of no reason why the viaduct girders should not have been spliced in the field. Surely such a procedure would have cost but a fraction of that incurred in transporting these ponderous girders from Phoenixville to Bayonne, lightering them thence to Manhattan, and then employing a large number of horses and of men at double pay for from 10 to 24 hours per girder. The expense of all of this must have been many thousands of dollars. It is instructive to note here that after one of the large compound girders in the Woolworth Building had been delivered at the site, the remaining ones were cut into three parts at the bridge works.

I am not in the confidence of Terry & Tench, but I will bet my weekly dole of thrift stamps that if they had planned the work the girders would not have been riveted up complete in the shop. Now, as the Park Avenue viaduct is a public improvement, will some one who knows rise in the meeting, and tell us just how much money was saved for the taxpayers by the methods employed? HERBERT W. ALRICH.

559 W. 164th St., New York City.

Wages of Common Labor vs. Engineers' Salaries

Sir—There seems to be a great deal of attention called lately—and rightly—to the salaries paid to engineers and draftsmen. I am of the opinion that in a majority of cases this class of professional labor is grossly underpaid. We find many firms and municipalities asking for the highest grade of professional training and experience in an applicant, and willing to pay the princely sum of $100 to $125 per month for it.

I noted with interest the article in a recent issue of *Engineering News-Record* by Mr. Newbrough, of Kemmerer, Wyo., which quoted the price of $4 per day paid to his green helpers. I have been unable to get any men at that figure. Our common laborer at the mines draws $4.44 per day of eight hours, and he does just the odd jobs around the outside. In order to get men to help on our surveys we have been obliged to pay the same, or even better wages.

When the wage of unskilled labor amounts to a minimum of $115 per month, how can one help wondering at the low salaries offered for trained professional labor in your "Positions Vacant" columns?

V. S. LAWRENCE,

Resident Engineer, Central Coal & Coke Company.

Rock Springs, Wyo.

What Can Be Done?

Sir—Following the signing of the armistice I lost a position paying $350 a month. I could easily qualify for the position described in the inclosed "want" advertisement in a daily newspaper, but it calls for a combination of a millwright and a mechanical, civil, hydraulic, and designing engineer—at $40 a week, or what a plumber would earn in less than that time.

Cannot something be done to correct such a condition —something that will raise the competent graduate engineer to the plane on which he belongs?

QUESTIONER.

Trigonometric Functions by Slide Rule

Sir—The writer suggests the following simple method for obtaining with the slide rule the cosine of an angle less than 45°, the secant, exsecant and versed sine, and naturally the sine of angles greater than 45°, all with one setting of the slide.

To illustrate, take 15°. Set the slide with indices in line and scale "S" adjoining "A." Set the runner to 15° and read on "A" the natural sine .2588. Transfer this to scale "D" and set 15 on the "T" scale to coincide. The cosine .965 is found on the "D" scale at the right index of "T." This is also the sine of 75°, and .2588 is the cosine of 75°. The secant 1.035 is found on the "C" scale at the left index of "D," or the left recess if the rule is not a duplex. Subtract one for the exsecant. The versed sine is on "D" scale when the cosine is subtracted from one, or can easily be read on the "D" scale.

The above is based on the principle that sine:cosine = tangent:radius, and consequently holds true as long as the sine is not changed. The natural sine as shown on the "A" scale must be set anew each time on the "D" scale. and then the other functions hold true.

Ironton, Ohio. T. S. SMITH.

Wisconsin Road Patrol Is Satisfactory

Road maintenance by the patrol system in Wisconsin has been managed successfully this year, the first season of the new patrol system, according to a report by A. R. Hirst, state highway engineer. Division engineers were required to make specific statements as to maintenance in each county, pointing out where the work done was inadequate and suggesting remedies. Instructions were then given to the county commissioners to remedy the unsatisfactory conditions. Road and bridge construction for 1918 is estimated as follows by Mr. Hirst: Roads graded, 640 miles; crushed stone paving, 110; gravel, 175; concrete, 38; shale, 25; miscellaneous, 15 miles; state-aid road expenditures, $2,400,000; 525 county-aid bridges, $715,196; 127 state-aid bridges, $259,626. The figures exclude Federal-aid work, the greater part of which has been postponed.

HINTS FOR THE CONTRACTOR

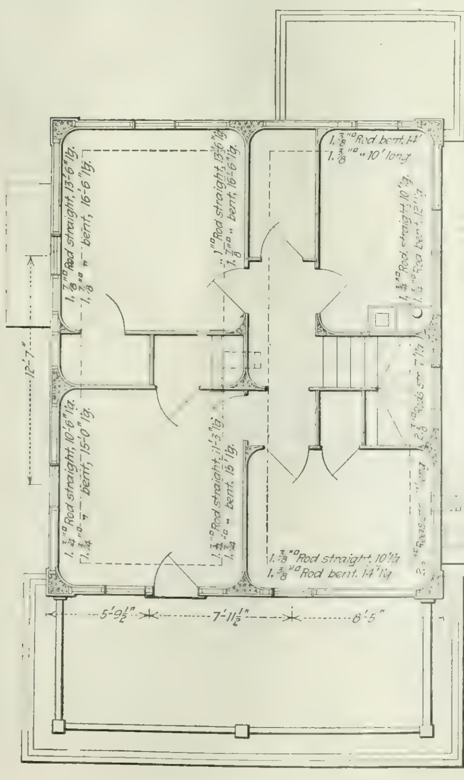
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Reinforced-Concrete House Built Without Forms

USING metal lath both for forms and reinforcements, a system of concrete construction has been developed which in practice appears to be very effective for small residences. It was devised by C. W. Donaldson and is controlled by the Donaldson Engineering Co. of the Keenan Bldg., Pittsburgh. In the house shown in the views and drawing the costs were about the same as for a similar house of standard wood construction.

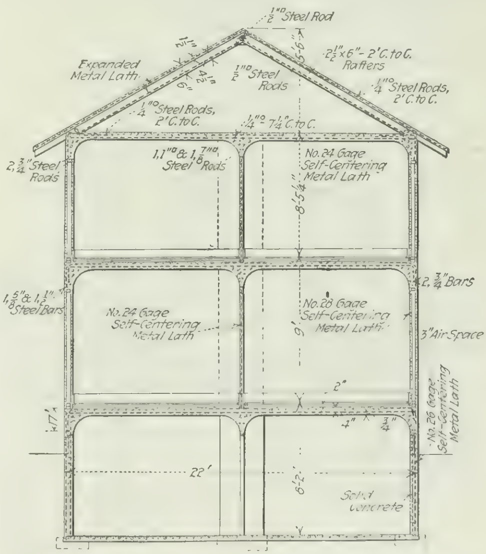
As adapted to house construction, the system comprises a column, beam and girder frame with reinforced-concrete floors and with nonbearing walls and partitions built up by plastering on metal lath. The frame is of concrete poured on the metal lath and plastered outside the lath for finish. The partitions are built as in an ordinary plaster job, and the outside walls are made up of an inner and an outer partition, with an intermediate air space.

A peculiarity of the system is the bending of the metal lath sheets to form the column and beam sections.



LOOKING INTO ROOM BEFORE CONCRETE IS POURED

In the basement, where there are no partitions, the columns are circular, but above the first floor the columns are formed by bending a metal lath for the partition



ELEVATION AND PLAN OF SMALL RESIDENCE BUILT UNDER DONALDSON SYSTEM

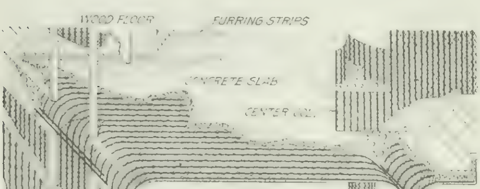
and the inner wall at the corners of the room to form a triangle, inside which concrete is poured to make the column. In similar fashion, the metal lath sheets of the floors are curved down at the ends to form triangles which make the beams.

The construction proceeds exactly as it would in a column, beam and girder building. The metal lath circular forms for the basement columns and the metal

lath for the outside walls are set up for the lower story, and concrete is poured in the columns and plastered on the walls. Metal lath, cut to 30-in. width and bent to the proper curve and length for a single full span, which is about a maximum of 12 ft., are then placed spanning

FINISHED CONCRETE HOUSE BUILT WITHOUT FORMS

the bearing columns and strutted for support. This floor metal is bent at the corners with about a 12-in. radius and secured at its ends. It will hold its shape against the weight of the concrete used to form the floor. The concrete is then poured to a thickness of about 3 to 3½ in. for the floor slab, and running down into the triangle beam to form the beam there. If



DIAGRAMMATIC VIEW OF FORMLESS CONCRETE HOUSE CONSTRUCTION

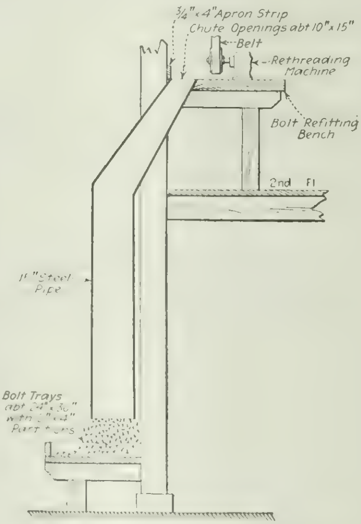
necessary, the beam and the columns can be reinforced by rods in the proper location. As soon as the concrete has reached an initial set, the outside of the metal lath is plastered to a finish, the protruding concrete from the openings of the metal lath forming a bond for the plaster. When an ordinary plastic mix is used the concrete does not drop through the openings in the meta lath, but protrudes just enough to form this bond.

The operation then continues from floor to roof in orderly manner. The roof, which can be either flat or sloped, is made up of reinforced-concrete girders poured inside metal lath and topped with a metal-lath reinforced slab. The staircases are also made of poured or plastered concrete on metal lath. The only forms required are the struts for the temporary holding of the slab.

Bolt and Rivet Reclamation Facilitated by Simple Chuting System

BOLTS and rivets reclaimed at the yards of the Manitowoc Shipbuilding Co., Manitowoc, Wis., are chuted according to size directly from the refitting benches to trays. Refitting is done on the second floor of the tool shop.

Scrap rivets, used bolts, etc., are collected at the shipbuilding berths in ordinary tin buckets, these being carried to the refitting shop by hand. Sorting is done on a work-bench along the outer wall of the shop, as



BOLT CHUTES AT MANITOWOC SHIPYARD

indicated by the sketch. Bolts sized here are delivered to rethreading machines, and when refitted are returned to be thrown into the proper chute.

Openings about 10 x 15 in. along the back of the bench lead to 15-in. steel pipe chutes which pass downward and through the wall of the shop building. Outside they turn down vertically, ending a foot or so above a plank trough or platform built along the wall about 2 ft. above ground. Partitions of 2 x 4-in. strips divide the trough into a series of trays, one under each chute; the trays are about 24 in. wide and 30 in. long. Each tray is marked with the diameter and the length of the rivet or the bolt, so that the men from the bolting and riveting gang passing to get a stock for their work can pick out at a glance the material which they need.

NEWS OF THE WEEK

New York, December 5, 1918

Would Expedite Highway Development

Secretary of Agriculture Favors Larger Appropriations from the Federal Treasury for Such Work

Coöperative highway construction under the Federal-aid road act must be resumed as quickly as possible and in full measure, stated David F. Houston, secretary of agriculture, to a conference of editors of agricultural journals held in Washington. He cited not only the importance of good roads, but also the desirability of furnishing worthy projects on which to employ labor during the readjustment period. He said that public roads are worthy projects and that it would be to the public interest to make available for road construction larger appropriations from the Federal treasury, to be used separately or in conjunction with state and local support.

"There need be no delay in the execution of such a program," said the secretary; "the nation has already provided the machinery in the Department of Agriculture and in the state highway commissions. The Federal-aid road act was fruitful of good legislation, and each state in the Union now has a central highway authority with power and funds to meet the terms of the Federal act. These two agencies, in conjunction, have been engaged in devising well considered road systems and in making surveys, plans and specifications. The task will be one of selection, and those roads should be designated for improvement which are of the greatest importance, with due regard to such military and other needs as are proper for consideration. There is no necessity for any departure from this scheme. The suggestions made have been canvassed with the President, the Secretary of War, and the Postmaster General, and these officials are in accord with the view that additional funds should be made available to the Department of Agriculture, and that they should be expended through the existing machinery."

From unexpended balances of Federal appropriations for the past two years, from state funds beyond the amount necessary to meet the Federal allotments, and from other money available during the coming fiscal year, approximately $75,000,000 will be available for expenditure during the calendar year. Next year, however, if all the balances are expended during this year and it is necessary to rely solely on the funds accruing next year, there will be only $20,000,000 from Federal appropriations."

American Society Development Committee Divides Work into Four Main Groups

Subcommittees Appointed on Technical Activities, Internal and External Relations and Public Affairs

The Committee on Development of the American Society of Civil Engineers, at its first meeting, Nov. 14, in Chicago, divided its work into four principal groups, appointing a subcommittee for each group. The committee also passed resolutions outlining future work, including recommendations that the society adopt the principle of becoming an active force in national affairs; that the importance of engineering in the reconstruction period should be brought forward nationally, and that the subjects assigned to the subcommittees should be discussed at the annual meeting of the society in January.

An executive committee was appointed, consisting of the following members: Onward Bates, chairman; Baxter L. Brown, W. L. Darling, H. L. Haehl, E. S. Nethercut, Frederick C. Noble and H. R. Safford.

Subcommittee Groups

The four divisions of work assigned to the subcommittees are:

Technical Activities, including (1) meetings, papers, and committee work; (2) sections or divisions of the society for specialized lines of work; (3) coöperation with specialized engineering societies and other organizations, and (4) standards in engineering practice.

Internal Relations and Local Associations, including relations with (1) local associations; (2) coöperation between the society's local associations and those of other national societies and local societies; (3) rearrangement of the grades of membership; (4) student engineers; (5) young men of the profession, and (6) personal service bureau.

External Relations with the Engineering Profession, including relations (1) with other national societies and related organizations; (2) with local societies other than the relations referred to above; (3) amalgamation of engineering societies, and (4) American engineers in foreign service.

Relations to Public Affairs, including (1) professional status of the engineer; (2) legal status of the engineer, and (3) public status of the engineer.

The members of the committee appointed by the chairman to the subcommittees are as follows:

Committee on technical activities, Robert A. Cummings, chairman, and George R. Putnam. The chairman of this subcommittee was authorized to name three other members.

Committee on internal relations and local associations: Frederick C. Noble, chairman; Richard L. Humphrey, George G. Anderson, Edgar S. Nethercut, Gardner S. Williams, Clifford M. Holland, H. L. Haehl, George C. Mason and J. H. Brillhart.

Committee on external relations with the engineering profession: S. Everett Tinkham, chairman; Thomas L. Wilkinson, E. B. Thomas, William H. Hoyt, Arsène Perrilliat, H. R. Safford, and Arthur Pew.

Committee on relations to public affairs: W. L. Darling, chairman; J. C. Ralston, Charles Hansel, George Butler, Frank T. Darrow, C. J. Tilden, John L. Hall, B. L. Brown and Paul G. Brown. This subcommittee may appoint its own divisions.

Asks Full Co-operation

In outlining the manner in which the subcommittees' work would be taken up, the committee's report states:

"The committee is undertaking through its subcommittees a broad survey of the functions and purposes of the society in its relation to its members, to its fellow societies, and to the public. The committee earnestly urges the fullest discussion of the subject by the members of the society, who are requested to communicate any matters of interest to the secretary of the committee.

"It is the intention that the subcommittees shall analyze and study the available data and information, and the recommendations of these subcommittees will be considered by the Committee on Development.

"The committee will keep in close touch with the work of similar committees of the other national engineering societies, and will endeavor so to coordinate its work as to be, as nearly as practicable, in harmony with their action on related matters of common interest. The committee will thereafter submit its final report with its recommendations.

Discussion at Annual Meeting

"In order to assist the subcommittees in their work, it is expected that there will be a discussion of the subject at the annual meeting and also by the local associations. While the committee will be glad to have a discussion of all

the items on its program, it believes that, in view of the limited time available at the annual meeting, the best results will be secured through discussion of the following subjects: Technical activities, relation of the society to its local associations, relation of the society with other national societies and related organizations, and relation of the engineer to public affairs."

The resolutions adopted by the committee included the following: "Resolved, that it is the sense of this committee that the American Society of Civil Engineers should adopt the principle of becoming an active national force in economic, industrial and civic affairs."

Because of the urgency and importance of reconstruction measures at this time, says the report of the committee, resolutions were adopted advocating that "prompt action be taken in providing means for keeping at Washington representatives of the engineering profession charged with the duty of keeping fully advised as to all matters in which the engineering profession should have a voice, and of attempting to secure participation by engineers in the planning of the methods of dealing with reconstruction problems by Governmental agencies or otherwise, including the drafting of bills, and in the carrying out of the work of reconstruction.

"We suggest that the matter be taken up through the executive committee, the committee on reconstruction, or the committee on public affairs of the Engineering Council, or by all of these agencies, and that active work be done at Washington at once."

The committee adjourned to convene in New York on Monday, Jan. 13, preceding the annual meeting of the society.

Capital Issues Committee Favors Highway Construction

Where materials and labor are available, bond issues for the construction of highways and other public improvements will receive favorable consideration, according to a statement given out by the Capital Issues Committee. The economic importance of a project will be a determining factor, and it is thought that public demand for a project will have considerable influence with the committee. The full text of the statement follows:

"The Capital Issues Committee has voted that, hereafter, where material and labor are available, issues for the improvement of highways and for building schools and hospitals and systems for water, sewage, drainage and irrigation, and for improvement of fire and police protection, will receive favorable consideration when economic importance is shown to exist, and that the committee will likewise give favorable consideration to industrial and public utility issues where the improvements contemplated are compatible with readjustment to a peace basis."

Disposition of Railways, Development of Roads and Land Reclamation in President's Address

Threatens Prompt Return of Railroads if Congress Delays—Use of Soldiers in Reclamation Work Advocated

The questions of the disposition and development of the railroads, plans for the reclamation of arid and swamp lands and the development of highways and waterways were the engineering topics in the President's recent address to Congress. He stated that it was not fair either to the public or the owners of the railroads to leave the questions of control unanswered, and asserted it was his duty to relinquish control of the roads before the expiration of the statutory period, unless a clear legislative solution were promptly forthcoming.

The president called attention to some 300,000,000 acres of land that could be made available for cultivation, and suggested the direction of thousands of returning soldiers to the reclamation of the arid, swampy and cut-over areas of the country.

In approaching the subjects, Mr. Wilson brought out the need for prompt and intensive consideration of the reconstruction problems. He pointed to the speed with which the country has moved toward a peace footing in the three weeks since fighting ceased, a speed which threatened to outrun any inquiry that may be instituted and any aid that may be offered. It was for this reason and because of the complexity of the railroad problems that he deemed it necessary to take immediate action himself if the proper solutions were not promptly approached by Congress.

Asks Counsel on Railroads

Although Mr. Wilson stated that the railroad problem caused him the greatest concern, that he went to Congress for counsel—having, as he said, no confident judgment of his own and no answer ready—he outlined a middle course of Government supervision as against the alternatives of private control or absolute Government ownership, and said he was ready to state with confidence that it would be a disservice to the nation and to the owners of the roads to return to the old conditions unmodified, the conditions of restraint without development, in which, he said, there is nothing affirmative or helpful.

In amplifying the three alternatives which, in his opinion, are open, the President stated that they would be, first, simply to release and return the roads to the old conditions of private management, unrestricted competition and multiform state and Federal control; second, to employ the opposite extreme of complete control under Government ownership, or, third, to adopt an intermediate course of modified private control, under more unified public regulation—as, for instance, by regional corporations in which the railways would be in effect a single system in defined areas.

Mr. Wilson is persuaded that the country's chief need lies in a new policy for the development of all means of transportation, railroads, waterways and highways. Whether the old policy be changed much or little, it cannot remain as it was, he said, and he hoped that Congress would institute at once a complete and impartial study of the whole problem and prosecute it as rapidly as possible.

He concluded that part of his address by saying that he was ready and anxious to release the railroads at a very early date. Waiting until the statutory limit was reached would be, he said, hurtful to every interest concerned because of the prolonged doubt and uncertainty.

Advisory Engineers Appointed by Shipping Board

The following is the recently appointed advisory engineering board of the Port and Harbor Facilities Commission of the United States Shipping Board:

General William M. Black, chief engineer, U. S. A., Washington; Col. Bion J. Arnold, Chicago; J. E. Greiner, Baltimore; H. McL. Harding, New York, consulting engineer of New York State Barge Canal Terminals; John Meigs, former commissioner of docks, Philadelphia, and Calvin Tomkins, former commissioner of docks, New York.

The Port and Harbor Facilities Commission was appointed to study and make all practicable recommendations to secure an early, practical and commercial improvement in the existing terminal and port conditions in this country and a greatly increased berthing frontage.

State-wide Water-Waste Survey

Acting for the Connecticut State Council of Defense, Department of Fuel Conservation, Caleb M. Saville, manager and chief engineer of the Hartford Water Department, will make a state-wide survey of water waste in Connecticut and its relation to fuel conservation. It is intended to submit recommendations for legislation on this subject to the next session of the Connecticut legislature.

Places 5565 Engineers in Five Months

Since July 1, when the division of engineering of the United States Employment Service was inaugurated, 5565 technical men have been placed. The monthly placements were as follows: July, 483; August, 1053; September, 1514; October, 1944; one-half of November, 571.

Canadian Contractors Organize at Ottawa Meeting

As the result of a conference held in Ottawa Nov. 27-28 by general contractors, subcontractors and dealers in builders' supplies, an organization was effected under the name of the Association of Canadian Building and Construction Industries. Officers were elected as follows: President, J. P. Anglin; vice-presidents, one for each province, Nova Scotia, J. C. Hardy; New Brunswick, Mr. Grant; Quebec, P. Galarneau; Ontario, Frederick Armstrong; Manitoba, E. Case; Saskatchewan, William Wilson; Alberta, Mr. McKenzie, and British Columbia, Mr. McLean; honorary treasurer, C. A. Crane, Ottawa; honorary secretary, R. H. Dancy, Toronto. Resolutions were adopted urging the Government to proceed without delay with deferred construction work; requesting that no public works should be undertaken except by Canadian contractors—this rule to apply also to all concerns acting for the Government or operating under Dominion charters of incorporation—and that Canadian materials should be used for all Government work.

On Nov. 28 these resolutions were presented to the Government by a deputation from the association. The Hon. F. B. Carvell, minister of public works, in replying to the deputation, stated that it had always been the policy of his department to use Canadian materials in all public works, and that policy would be adhered to in the future. As regards the construction of dry docks, however, the Government could make no promises, as all it could do under the act was to subsidize the company undertaking the work. The Hon. Dr. Reid, minister of railways, said arrangements were already being effected for large expenditures in railway improvements.

National Civic Federation To Study Reconstruction

Samuel Gompers, president of the American Federation of Labor, was the chief speaker at a reconstruction conference held in New York City Dec. 2 under the auspices of the National Civic Federation. "Dangers as grave as if not graver than those during the war confront our people now," he said. "Contentment is stagnation. A healthy discontent is an awakening of aspirations for better things. Hungry stomachs do not make for reasoning brains."

Acting in accordance with a plea made by Frank Morrison, secretary of the American Federation of Labor, the conference passed resolutions, subject to approval by the executive council of the National Civic Federation, favoring the payment by the Federal Government of all volunteer war workers from the time of their discharge to their employment by private industry, together with transportation expenses to their new place of work, and also favoring the prohibition of immigration for a period of five years, or at least until every voluntary war worker and every returning soldier finds employment. Other resolutions requested the executive council of the Federation to appoint a committee on coöperation between employers and employees, which should also consider the efficiency of Government operation of public utilities; also a committee, to be headed by V. Everit Macy, president of the National Civic Federation, to study reconstruction and Government ownership abroad.

The prevailing spirit of the conference was in favor of hearty coöperation between employers and employees. As one speaker put it, group consciousness in this country should be kept down. The war was won by concentration on a single object. If we become dismembered we shall go back to pre-bellum conditions. But if we act on the basis of a composite consciousness we shall go forward. In furtherance of these ideas, the executive council of the National Civic Federation was asked, by resolution, to provide ways and means for harmonizing group differences of opinion.

Mechanical Engineers Hold Annual Meeting in New York

The thirty-ninth annual meeting of the American Society of Mechanical Engineers was held this week in New York City. At the opening session on Tuesday evening the president of the society, Charles T. Main, of Boston, delivered the annual address, taking as his subject, "Broader Opportunities for the Engineer." He dealt especially with the responsibilities now resting upon the engineering profession in the reconstruction and readjustment following the war. The newly elected president of the society, Dr. M. E. Cooley, dean of the colleges of engineering and architecture of the University of Michigan, also addressed the members. Honorary membership in the society was conferred on Charles M. Schwab and Orville Wright.

The other officers whose election was announced are as follows: Vice-Presidents: Fred R. Low, editor of *Power;* Henry B. Sargent, president, Sargent & Co., New Haven; and John A. Stevens, consulting engineer, Lowell, Mass.; managers: Charles L. Newcomb, general manager, Deane Pump Works, Holyoke, Mass.; F. O. Wells, president, Greenfield Tap & Die Corporation, Greenfield, Mass., and Charles R. Richards, dean, College of Engineering, Universiay of Illinois; treasurer, William H. Wiley.

A Billion Dollars for Drainage and Flood Control

At the annual meeting of the National Drainage Congress, to be held at Chicago Dec. 13-14, Congress will be asked, according to present intention, for an appropriation of $1,000,000,000 for land drainage, river regulation, flood control and the national development of natural resources, water power and unused lands.

Engineering News-Record War Correspondent Commissioned

Robert K. Tomlin, Jr., previously managing editor of *Engineering News-Record,* who went to France in December, 1917, to become war correspondent of this journal and Paris representative of the McGraw-Hill Co., Inc., has been commissioned in the Corps of Engineers with the rank of captain and is now stationed at Tours, France. His work is to compile the military engineering history of the American Expeditionary Forces, which he entered Sept. 1.

Mr. Tomlin was graduated from Harvard University in 1907 with the degree of B. S. in Civil Engineering. During his course he served as instructor two summers in surveying and field engineering work at the Harvard engineering camp, Squam Lake, New Hampshire. His next work was in the tunnels of the Pennsylvania R.R. under the East River, New York City, and in the crosstown tunnels leading to the Pennsylvania terminal. He left the Pennsylvania to join the staff of the Catskill Aqueduct, where he served in the executive division of the Northern Aqueduct Department, New York Board of Water Supply, at Poughkeepsie. In March, 1909, he became assistant to the editor of *Engineering Record,* later becoming associate editor assigned to the municipal and sanitary engineering fields. In 1913 he became managing editor of *Engineering Record* and in April, 1917, at the time of the consolidation of *Engineering News* and *Engineering Record* he became managing editor of this journal.

Proposes Corporation to Unite Engineering Societies

W. H. Woodbury, in collaboration with W. A. Clark and O. H. Dickerson, all members of the American Society of Civil Engineers, has submitted in a letter to Alfred D. Flinn, secretary of the Engineering Council, a complete set of articles of incorporation for a proposed "United Engineering Societies of America."

Both the civil engineering and the electrical engineering societies have committees on development working on problems of wider usefulness. The purpose of the proposed United Societies is stated to be to create an instrument "by which united action can be obtained by members of the engineering profession, their associates, assistants, and organizations throughout the American continent, upon all matters relating to engineering, engineers and allied enterprises and persons, for general benefit and improvement." Its plan of operation shall be "to maintain clubrooms, clubhouses, buildings, and grounds in connection therewith, and to hold such technical and social meetings as may aid in carrying out its general purpose and object."

The government and management of affairs in the proposed society shall be vested in a body of delegates, with one delegate for each state having a

membership of one hundred, plus one delegate for each four hundred members in excess of one hundred. Delegates are to be elected for a term of two years and recalled at the pleasure of their constituents. Membership is divided into the following classes: Members, associates, juniors and affiliated associations. It is stated that "membership in an affiliated association shall confer upon the individual member all the rights and privileges of direct membership, subject to the same requirements as to professional training and experience. An affiliated association may be a national society, local club, state association, subsection or subordinate section of a national or state society."

Mr. Flinn, in commenting on this announcement, lists the following cardinal elements desired for such a national society: (1) Autonomous local, state and national societies; (2) membership of any society in a representative national association, embracing all engineers; (3) membership for individuals who do not wish to be members in any other society; (4) combined action in local, state and national matters—civic, professional and social—of common concern to engineers; (5) a scheme for representation and membership in the United Societies which will prevent any person being counted more than once; (6) common standards for membership of various grades in all member societies and the United Societies; (7) inducement to membership in the United Societies through a national or other society, by the adjustment of views. To these Mr. Woodbury adds: (8) Direct responsible representation and (9) definite organized action to better the engineer's economic condition.

Urges McAdoo To Recognize Engineers' Services

In a letter to William G. McAdoo, director general of railroads, Alfred D. Flinn, as secretary of the Engineering Council, asks early action upon the classification and compensation of civil, mechanical and electrical engineers and their technical assistants on the staffs of the railroads. He states that a number of engineers have brought to the attention of the Engineering Council the fact that the schedules in "Wages of Railroad Employees" and supplements thereto, as issued by the Railroad Administration, do not mention the men performing engineering services.

After admitting that such omission may be due to accident or oversight, which omission is too often the reward for quiet, industrious modesty competing with insistent, organized demands, Mr. Flinn requests that "technical engineers be given suitable separate classification with rates of compensation in accord with their duties and the expense to which they have been put for their education and their training in preparation for their present duties and responsibilities."

Engineering Societies Establish Employment Bureau

Replying to Letter on Reconstruction Commission, President Wilson Favors Existing Machinery

At a special meeting of the Engineering Council called to meet on Nov. 21 to determine approximate limitations on its field of activity, and to consider a working program, it was decided that an Engineering Societies' Employment Bureau should be established at once, principally to meet the new need which has arisen for an agency to aid engineers who have been in military service to find suitable positions. The four secretaries of the founder societies of the United Engineering Society are appointed as the board of managers, and Walter V. Brown is made secretary in immediate charge. This action was taken as the result of the joint meeting held the preceding day by the secretaries of the founder societies and the American Engineering Service. The resolutions further provided that the American Engineering Service be instructed to turn over its entire office equipment and records and instruct its operating staff to report for further service to the bureau when organized, and that thereupon the American Engineering Service be automatically discharged. It was determined that the work should be started on the basis of no charge, with headquarters in the Engineering Societies Building, New York.

Praise for Engineering Service

The work of the American Engineering Service was cited as having been of inestimable value to the Government through the coöperation between the four founder societies and the Government, and a resolution was passed expressing high appreciation of the accomplishments of George J. Foran and his associates during his chairmanship.

As defining the field of activity of the Engineering Council, the following resolution was passed: "The Engineering Council understands its field of activity to be approximately as follows: (1) Council may deal with any matter of general interest for which joint action of two or more of its member societies would have been appropriate, if Council had not been established; (2) Council may initiate and carry through projects of the general character defined in the by-laws, for which the necessary financial provision has been made; but Council shall not undertake expenditures in excess of appropriations for its uses made by the United Engineering Society on behalf of the founder societies and the contributions from other member societies, unless specific provision shall have been made therefor by subscription, donation or otherwise; moneys received by Engineering Council shall be turned into the treasury of United Engineering Society and disbursed by it, for the purposes designated; (3) Council may take up, and in its discretion act upon any matter of general interest referred to it by any member society or by any other society, national, state or local, or any branch of Government, or by any individual or group of individuals."

It was further resolved "that Engineering Council will as a rule avoid considering any matter which is specifically within the province of only one member society and not of the others."

A letter was addressed to President Wilson on Nov. 15 by J. Parke Channing, in which he said, in part:

"I am advised that you have under consideration the appointment of a reconstruction commission to develop a comprehensive program for the nation's conversion from a war to a peace basis.

"As chairman of Engineering Council, I respectfully ask that you consider the appointment of at least one engineer upon this commission, basing my recommendation upon the fact that all construction and practically all manufacturing is under the management of engineers."

Under date of Nov. 20 the following reply was received from the White House:

"My dear Mr. Channing:

"I have your letter of Nov. 15, which Mr. Rickard has been kind enough to hand me. You may rest assured that I realize what a service engineers can render in reconstruction problems from time to time. We are handling reconstruction questions just now by a process of consultation between existing instrumentalities, which I hope will prove useful and effective.

"Cordially and sincerely yours,

"Woodrow Wilson."

It was voted to abolish the War Committee of Technical Societies, and the chairman and the members of the committee were thanked for their patriotic service.

Government Lets Contracts for Mississippi Barges

Contracts have been let for the building of 40 steel barges and six towboats for use on the Mississippi River, through the inland waterways division, United States Railroad Administration. The contracts have been awarded as follows: Fifteen steel barges, Dravo Construction Co., Pittsburgh; 25 steel barges, American Bridge Co., Pittsburgh; four towboats, Marietta Manufacturing Co., Point Pleasant, W. Va.; two towboats, Charles Ward Engineering Works, Charleston, W. Va. These contracts represent a cost of approximately $6,170,000.

In tests a year ago one river boat towed 12 barges, each carrying 590 tons of freight cars for service in France, from St. Louis to New Orleans, at what was claimed to be a 50% saving in time and 30% saving in cost. At present there are five boats and 15 barges in operation making regular trips under the Railroad Administration.

Americans to Rebuild Grand Canal of China

Siems-Carey Company Engineers Making Extensive Survey to Meet Modern Conditions

One of the most remarkable enterprises in the field of hydraulic engineering now under way anywhere in the world is the repair and modernizing of the Grand Canal of China. This is not only the longest canal in the world, but the oldest. The first and most important section was completed about 540 years before the Christian era. The Grand Canal with its feeders constitutes the greatest artificial inland waterway system in the world. The main canal itself is nearly 1000 miles long, extending from the great commercial city of Hanchow, south of Shanghai, north to Peking. Besides the main canal, there are hundreds of miles of feeder canals.

Canal Nearly 2500 Years Old

For part of the distance the canal was built by dredging and straightening the channels of small, natural streams, but hundreds of miles were built entirely by artificial excavation in the great plain which forms the delta of the Hoang-Ho or Yellow River. The navigable channel of the canal is 50 to 100 ft. wide and about 6 ft. deep, about the same as that of the old Erie Canal. Much of the system was constructed, as noted above, nearly 2500 years ago, and extensions were made in the fifth and seventh centuries of the Christian era.

When the great flood of sixty years ago occurred in the Yellow River many miles of the canal were filled with mud, but the southern half still floats thousands of cargo boats and affords probably the cheapest inland waterway transportation in the world. On this portion of the canal vast quantities of rice, tea, coal, salt and oil are carried in small barges propelled either by sails or by men hauling tow ropes or wielding poles. Only a few years ago the Standard Oil Co. operated a fleet of 500 boats carrying oil on this portion of the canal.

Operation of the Locks

The locks on this ancient canal are built of the highest quality of granite masonry, much of it equal to the finest ornamental work in a modern city park. Mechanically, however, the locks are crudity itself, their construction antedating, of course, the double-gate lock chamber invented by Leonardo da Vinci. The Chinese lock gates are merely a single set of individual stop logs extending crosswise of the lock chamber from wall to wall, their ends resting in grooves in the granite masonry on either side. The total height of lockage is commonly about 5 or 6 ft. Boats are not locked through until a considerable fleet has accumulated in the basins on either side. To open the gate the stop logs are pulled out one by one by means of ropes hauled by man-power. Boats in the upper basin then ride down the swift current between the lock walls, and then the boats on the lower side are pulled up against the current by long ropes of bamboo hauled by scores of hands.

One of the obvious tasks in modernizing this old canal is to substitute modern locks for these ancient ones. In many places, where the topography permits, several lifts will be consolidated into one. Dredging and other work will, of course, be required to fit the canal for modern requirements.

The most difficult problem of all in connection with the canal is the matter of flood control where the waterway is crossed by "China's sorrow," the Yellow River. The enterprise is too vast to be undertaken immediately as a whole, in China's present financial condition. What is now being done is to make thorough surveys of the whole length of the canal and work out a comprehensive engineering scheme for the entire improvement, and then select some section, perhaps 100 miles in length, where the funds now available for improvement, about $6,000,000, will yield the best return in the improvement of traffic and the drainage or irrigation of the wonderfully fertile lands along the canal.

American Engineers on Work

A contract for carrying out these improvements has been made between the Chinese Government and the Siems-Carey Canal & Railway Co., a subsidiary of the American International Corporation of New York City. John R. Freeman, of Providence, R. I., began the study of this problem soon after his return from China a year and a half ago, and is acting as consulting engineer to the American International Co. in carrying on these investigations. For some two months an organization of American engineers has been at work in China collecting preliminary data, using as a basis the investigations made by the Chinese South Grand Canal Conservancy Bureau which, under the direction of a wealthy Chinese, Pan Fu, has been making surveys of this region for the past three years.

The chief engineer is Joseph Ripley, who was for years superintendent of the United States Government canals at Sault Ste. Marie and was a member of the International Commission which dealt with the Panama Canal. He has been for several years senior consulting engineer for the New York Barge Canal. The assistant chief engineer is J. W. Beardsley, who is especially familiar with conditions in the Orient through his five years' service as Director of Public Works in the Philippine Islands. Other important members of the organization are R. H. Merrill, former division engineer on the New York State Barge Canal; R. D. Goodrich, formerly deputy state engineer of Wyoming and later city engineer of Lansing, Mich., and H. Brodie and H. B. Merrick, from the engineering faculty of the University of Michigan. Mr. Freeman has general charge of these investigations.

Reconstruction Platform Adopted at Rochester

Conference Looks to Holding War-Time Gains, for Efficiency and Humanity, Made Under Federal Control

Crystallizing the thoughts advanced at the Rochester reconstruction conference held by the National Municipal League Nov. 20-22, the following platform was adopted:

During the war, as measures of necessary national efficiency, numerous matters formerly within private control passed to the control of the people. Some of these things should undoubtedly be returned promptly to private enterprise, but the American people will miss a great opportunity if they allow certain of these temporary powers to slip through their fingers in the next few months, namely:

1. The long desired Federal employment service has been created, and the national Government has assumed responsibility for connecting employers and workers in the only right and efficient way. This service should be encouraged to extend its sphere to include the education of employers in modern principles of employment.

2. Corporations, particularly those doing an interstate business, have become a great source of Federal revenue, and may reasonably be expected to continue to be such. Federal control and supervision of their practices should be continued and extended, for they create national, not merely statewide, problems. Effort shall be made to free them from conflicting and ineffectual state regulation by a Federal incorporation procedure.

Future Control Advocated

3. The Government has assumed control of railroads, telegraphs and telephones, opening the opportunity for either Federal ownership with private operation, or Federal ownership with Federal operation, or a reorganization by economical regional systems under a method of control that will protect the private capital by insuring a reasonable return, yet removing speculative and anti-social features of the private ownership of the past with its relatively feeble and negative system of regulation. Whichever principle is adopted is a smaller matter than that the essential features of our present control should never be relinquished.

4. The Federal Government has acquired by its merchant fleet and its War Trade Board intimate knowledge and capacity for mobilizing our resources for foreign trade. Factors which will be valuable in normal peace times should be retained.

5. The Federal Government through its Food and Fuel Administrations and its War Industries Board acquired a command over basic resources which played a vital part in securing national efficiency. Every effort should be made to preserve the nucleus of these valuable agencies in such form and with

such powers that we may achieve some part of that efficiency in peace.

6. The Federal Government has manifested grave interest and exerted its war powers to influence the cost of living and prevent profiteering. It should continue to exert its peace powers toward the same beneficent end.

7. The Federal Government has concerned itself effectively in the problem of housing industrial workers, and has placed upon a new basis of prestige and authority the American movement for garden cities and suburbs. Its interest in this aspect of the welfare of the workers and the efficiency of industry should not now lapse, but the Labor Department's bureau of industrial housing should be continued and its powers broadened to include educational work and reseasch into our vast industrial housing problems.

8. As a measure of protecting the effectiveness of its soldiers and industrial workers, the Federal Government has found it necessary to use its influence with local governments regarding moral and health conditions. Such Federal interest in local governments should not lapse, but should eventuate in the continued attack upon vice problems by the Public Health Service and in the formation of a Federal bureau of municipalities in the Department of the Interior to collect and distribute information on municipal matters.

Transport Committee Inquires Into Highway Snow Removal

An inquiry into the possibilities of snow removal on the main highways of the country has been instituted by the Highways Transport Committee of the Council of National Defense. The committee has formed a definite program of removal, based upon the realization of the importance of unhampered highway transportation in the delivery of foodstuffs both for home consumption and for shipment to our allies, and requests the coöperation of the states where trouble from snow is to be expected. The general subjects of inquiry, as set forth by Raymond Beck, the committee's field engineer, follow:

1. As to the powers of the state highway department or commission for removing snow: If such powers are not specifically covered by statutes, whether maintenance funds can be used in an emergency?

2. What coöperation and work can and will be undertaken by the counties and state?

3. What coöperation and work can and will be undertaken by the municipalities and state?

4. What snow-removal machinery, such as scrapers, plows, etc., are available for use by state, county and municipalities?

5. What preliminary measures can be undertaken which will prevent the drifting of snow, such as location and erection of snow fences and the elimination of air-obstructing hedges and fences which cause objectionable drifting?

6. Attention by state highway department or commission, through its field organization and in coöperation with the state Highways Transport Committee, to physical conditions along the highways tending to cause drifts; recommendations as to the best means of dealing with same by preventive methods.

7. The making of a snow-removal report on every snow storm on such highways as are designated to be kept free from obstruction by snow, so as to allow continuous essential highways transportation.

Merge Canadian Government Railway Systems

The Hon. J. D. Reid, Canadian minister of railways, announced that the management and operation of the Government railways, consisting of the Intercolonial and its branch lines and the National Transcontinental between Winnipeg and Moncton, N. B., have been transferred to the board of directors appointed to manage the Canadian Northern Ry. system.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

The Society of Automotive Engineers will hold its winter meeting in New York Jan. 12-14. The technical sessions will be devoted to war and post-war subjects, and the views of many men who have been engaged actively in France with our Army, or with the allies, will be given. A number of scientific subjects relating intimately to the automotive industry will be discussed. Among them are topics such as types of post-war automobiles, thermodynamics of internal combustion engines, road tractors, and facts ascertained from the use of motor trucks in the war as affecting commercial practice. The meeting will be held at the Hotel Astor.

The San Francisco Association of Members of the American Society of Civil Engineers held a special meeting Nov. 15 to consider the question of licensing engineers and to discuss the future policy of the organization toward the draftsmen's union. After a general discussion it was decided to prepare a licensing bill.

The Canadian National Safety League has been incorporated by Lucien B. Howland, Colin A. Campbell, Arthur Hewitt, W. J. L. McKay and John F. H. Wyse, all of Toronto, with head office in Toronto, for the purpose of safeguarding the public from danger from automobiles, railroads, street railways and all forms of vehicular traffic.

The Washington Irrigation Institute will hold its sixth annual meeting in Yakima, Dec. 17-18, at the time of the meeting of the Washington State Land Association. Plans for the development by returned soldiers of the arid and logged-off lands of the state will be discussed.

The Engineers' Club of Philadelphia will hold a regular meeting Dec. 17, at which Frederick K. Morris, of Columbia University, will read a paper entitled "The Fourth Year," illustrated with motion pictures and lantern slides. Mr. Morris will present a brief review of the events leading up to the war situation existing at the beginning of 1918, following this in detail with a discussion of the strategy employed by both sides in the past few months. Thomas F. Armstrong will read a paper on "Guilty or Not Guilty" at the weekly luncheon of the club, to be held Dec. 10.

The Providence Engineering Society, Providence, R. I., was addressed by Harlow C. Clark, editor of the official publication of the American Electric Railway Association, on Nov. 26. John McCormick of the city highway department of Providence was elected secretary of the society, succeeding Leroy Meehan, resigned.

The Texas Association of Members of the American Society of Civil Engineers will hold its semi-annual meeting at Dallas, Dec. 13-14.

The Engineers' Club of Trenton, N. J., held a special meeting Nov. 25, at which Lieut. James H. H. Muirhead, British Royal Engineers, read a paper on "Personal Recollections of War Operations on Inland Waterways, Particularly with Reference to the Human Element."

The Oregon Irrigation Congress will hold its annual meeting at Salem, Ore., Jan. 9-11, preceding the opening of the legislature. J. W. Brewer, Portland, is chairman of the committee in charge of the program.

The Houston Engineers' Club was addressed Nov. 27 by Lieut. A. W. Landstrum, who spoke on "A Brief Survey of the Sewage-Disposal Situation in the Air Service, United States Army."

PERSONAL NOTES

JOHN R. FREEMAN, Providence, R. I., has resigned the presidency of the Providence Gas Co. The resignation will take effect Jan. 1, and Mr. Freeman will be succeeded by Charles H. Manchester, at present vice president and treasurer of the company. Mr. Freeman became president May 14, 1917, succeeding the late John W. Ellis. He has also acted as chief engineer, and under his direction a new coal gas plant has been constructed for the company. Mr. Freeman resigns his position in order that he may be free to undertake the responsibilities in connection with his work as consulting engineer for the improvement and modernization of the Grand Canal of China, which is being undertaken by the American International Corporation of New York City, as described on p. 1049.

JOHN H. LEWIS, state engineer of Oregon, has resigned to become chief engineer and general manager of the Warmsprings Irrigation District, Malheur County, Oregon. Mr. Lewis has served 14 years as state engineer; he left the employ of the United States Reclamation Service in 1904.

J. L. HAUGH, engineer of capital expenditures, Northwestern Region, United States Railroad Administration, has been appointed engineering assistant to the Regional Director, with headquarters in Chicago, succeeding Ralph Budd, who resigned to become chairman of the board of directors of the Chicago, Burlington & Quincy R.R., as mentioned in *Engineering News-Record* of Aug. 15, p. 338. Mr. Haugh has been acting as engineering assistant to the Regional Director since Mr. Budd's resignation.

PERCY A. CUPPER, previously assistant state engineer of Oregon, is the successor as state engineer of John H. Lewis, who has resigned to become chief engineer and general manager of the Warmsprings Irrigation District, Malheur County, Oregon, as noted elsewhere. Mr. Cupper was recently elected superintendent of Water Division No. 1. As a result of Mr. Cupper's appointment as state engineer, it is expected that the Governor will recommend to the next legislature that the office of water division superintendent in the western district be merged with the office of the state engineer.

T. J. WYCHE, chief engineer, Western Pacific R.R., under Federal Manager W. R. Scott, of the combined Southern Pacific-Western Pacific, has resigned to become chief engineer of the Western Pacific's corporate interests and of the Denver and Rio Grande. Mr. Wyche will divide his time between San Francisco and Salt Lake City.

WILLIAM M. KINNEY, inspecting engineer, Universal Portland Cement Co., has been appointed general manager of the Portland Cement Association, succeeding H. E. Hilts, resigned. Mr. Kinney was born in 1885, and is a graduate of the Lewis Institute, Chicago. In 1906 he entered the service of the Willamette Iron & Steel Works, Portland, Ore., as a draftsman, and was later employed by the Universal Portland Cement Co. in the inspection bureau. From 1908-14 he was

WILLIAM M. KINNEY

assistant inspecting engineer for the company at Pittsburgh. Afterward he became inspecting engineer and engineer of the information bureau of the company. He is vice-chairman of the committee on cement of the American Society for Testing Materials and is secretary of the committee on concrete roads and pavements of the American Concrete Institute.

C. E. COX, valuation department, Chicago, Milwaukee & St. Paul Ry., has been appointed engineer of capital expenditures, Northwestern Region, United States Railroad Administration, succeeding J. L. Haugh, who has been appointed engineering assistant to the Regional Director, as noted elsewhere.

JAMES W. COSTELLO, previously connected with the city engineering department of Philadelphia, is now director of municipal hygiene, Newark, N. J. He will have charge of street cleaning and refuse disposal.

ANDREW GORHAM TAYLOR, assistant United States engineer, Duluth district, succeeds Clarence Coleman, whose death was noted in *Engineering News-Record* of Nov. 7, p. 871, as engineer of the district.

H. W. BROWN, division engineer, Pennsylvania Lines West, with office at Zanesville, Ohio, was recently appointed also division engineer, Ohio River & Western Railway.

WILLARD A. BURTON was appointed recently assistant engineer, Kansas State Board of Health, in charge of inspection of water-supply and sewage-disposal plants.

C. S. TILLETT has been appointed acting signal engineer of the Grand Trunk Ry. system, with headquarters in Montreal, in succession to B. Wheelwright, who has been appointed engineer maintenance of way of the Grand Trunk lines in New England.

W. C. MARION has been appointed county engineer with headquarters at Yakima, Wash., succeeding Lieut. O. E. Brashears, who resigned to enter military service.

GEORGE B. HUGHES, district county road engineer at Ely, Minn., has been appointed city engineer of Ely, succeeding Charles A. Nutter, resigned.

F. A. COLLAR has been appointed assistant division engineer, Ohio River & Western Railway.

OBITUARY

CAPT. MYRON H. PECK, Second Engineers, U. S. A., was killed in action in France Oct. 9. He received his technical training at the University of California, being graduated in 1897. For several years he was professor of civil engineering at the Imperial University in Pekin. He returned to the United States in 1910 and engaged in various engineering work, including jetty construction at the mouth of the Columbia River and the improvement of the channel at Mare Island. He was commissioned second lieutenant of engineers in the National Guard of California in 1916 and saw service on the Mexican border. Later he entered the Engineer Officers' Reserve Corps and was assigned to Camp Lee, Virginia. From there he sailed for France early in January of this year.

PROF. W. MUIR EDWARDS of the University of Alberta, died at Edmonton Nov. 14. He was 40 years old and was born at Montreal. In 1900 he was graduated from McGill university, winning the British Association medal in applied science. After some practical experience in engineering he became lecturer and afterward assistant professor at McGill University. From that position he was called to become professor of civil and municipal engineering in the University of Alberta.

WILLIAM W. KILLOUGH, previously chief engineer of the Charlotte water-works, Charlotte, N. C., died in that city Nov. 20.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

New Liquid Fuel Developed by Army Engineers

Shows Higher Efficiency Than Gasoline in Automobile, Airplane and Stationary Engine Tests

The development by the research and development division of the General Engineer Depot of a new liquid hydrocarbon, which has been named "Liberty fuel," is reported from Washington, D. C. The report states that under extensive tests in automobiles, motor cycles, trucks, tractors, stationary engines and hydroplanes, and under wide variations of weather, loading and operation, the new fuel developed an average greater thermal efficiency than the best gasoline.

It has been developed under the direction of Maj. O. B. Zimmerman, the specific problems having been solved by Capt. E. C. Weisgerber, in charge of the chemical section of the Research and Development Division. Captain Weisgerber, it is stated, is a gas and oil engineer of extensive technical and practical experience, and is considered by the division as one of its most practical thinkers in solving chemical problems, having specialized in the hydrocarbons. The fuel is a result of several years' work and tests in the laboratories of the Bureau of Standards, Washington. The report states that it explodes at temperatures below zero, requires less air or oxygen and leaves less carbon residue than any gasoline.

In operation with the "Liberty fuel" the engine works more easily than with gasoline, the mileage per gallon in various types of machines is uniformly greater, and no deteriorating effects have been noted on the lubrication.

It is said that the cost of manufacture will be less than that of gasoline at present; the raw materials used are plentiful and can be easily obtained. Therefore, although the process is still new, it is believed that the supply, when production is put on a commercial basis, will be ample.

Restrictions on the Use of Coal Still Further Reduced

War restrictions on the use of coal have been removed still further by the Fuel Administration. By the recent ruling the manufacturers of window glass, clay products and cement may use as much fuel as they need. The order went into effect Dec. 2. Under the original orders, manufacturers of window glass were compelled to reduce their use of coal 50 per cent., makers of clay products from 15 to 50 per cent., and makers of cement 25 per cent.

Chairman Baruch Resigns from The War Industries Board

Bernard M. Baruch, chairman of the War Industries Board, has forwarded his resignation to President Wilson, to take effect Jan. 1, 1919. No announcement of acceptance has been made.

The restrictions placed on industry made necessary to complete the war program having been removed, and the board's activities having been curtailed as rapidly as its relations with industries permitted, Mr. Baruch felt that his services as chairman could be spared. It is stated that it was this reason, and not the desire of the President to name him as Secretary of the Treasury, that caused Mr. Baruch to resign.

Reducing the Personnel of the Fuel Administration

A reduction of the personnel of the Fuel Administration will be effected by the transfer of certain sections to other regular Government departments. The statistical bureau will be taken over immediately by the Geological Survey, and the conservation bureau and the engineering program by the Bureau of Mines. The assurance of a normal coal supply for the country makes this reduction possible. An index of the approach of normal conditions is afforded by the return of anthracite miners from the Army to their work in the mines. Miners to the number of 231 were recently released from Camp Dix, 145 from Camp Lee, 105 from Camp Shelby, 87 from Camp Upton and 22 from Camp Mills.

Survey of Labor Situation To Be Made by Employment Service

An immediate survey of the labor situation in industrial centers throughout the country will be made by the United States Employment Service, according to a statement issued by the Department of Labor. The machinery for this survey has been set in motion by the Employment Service at the request of the Secretary of War and the Chairman of the War Industries Board.

The purpose of the information sought is, it is said, to enable the War Department and the War Industries Board as far as possible to avoid labor difficulties through the too rapid curtailment of war contracts and demobilization of the Army. It is expected that the information will give the Government a view of the immediate labor situation, so it will know as early as possible in which centers there is a shortage or a surplus of labor, and how rapidly demobilization in these centers can be effected.

Treasury Department Delays War Contract Cancellation

Agreement to Terminate Contracts on 75 Per Cent. Payment Basis Not Approved by Comptroller

Disapproval by the Comptroller of the Treasury of certain plans of the War Department will delay the liquidating of unfinished war contracts. The form of the agreement which is disapproved provides that the United States shall pay to the contractor 75 per cent. of the minimum amount fixed by the contracting officer as that to which the contractor is entitled. In addition it provides for the payment of a sum not to exceed 10 per cent. of the cost of the unfinished article, as a reimbursement to the contractor for expenses and obligations incurred.

In the letter from the Secretary of War to the Comptroller of the Treasury which brought forth the decision, it is explained there are numerous contracts outstanding for munitions which, on account of the ending of hostilities, must be terminated. He also states that it is his opinion that since many war contractors are willing to forego prospective profits on the remainder of the work and terminate the existing contracts, it should be done on a basis which would amount substantially to compensation for expenses incurred plus a fair profit not to exceed 10 per cent. of the cost of the unfinished article on hand.

Contractors' Estimates Not Conclusive

The Comptroller writes in part, in his reply to the Secretary of War:

"Having no authority to decide the form of contracts, the only question properly before this office is whether a payment may be authorized, the sum being 75 per cent. of the amount found by the contracting officer to be the minimum amount for which the contractor is entitled to be reimbursed. The making of the supplemental agreement and the simple certifying of the amount by the contracting officer from the statement and estimate of the contractor will not be sufficient nor conclusive upon the contracting officer."

There are further difficulties in the situation, brought out in another part of the decision, in that orders for war materials have not been legally executed unless signed by Government contracting agents and the contractors. By this ruling orders for war materials running into large amounts are rendered open to question, because in the rush of carrying out the enlarged war program many orders were communicated to the manufacturer by tele-

phone, telegraph, or letter, and had not been reduced to contract form when the armistice was signed and the demand ceased. The decision therefore makes it impossible to terminate the contracts on the basis on which the War Department intended to proceed. The Secretary of War was asked how many contracts lacked the necessary clauses and signatures. He replied that he did not know the number, but that he thought it was not large.

Highway Industry Forms Reconstruction Committee

A Highway Industries War Service and Reconstruction Committee was appointed by S. M. Williams, president of the Highway Industries Association, to coöperate with similar committees of American industry in a conference during the present week at Atlantic City, N. J. This conference is held under the auspices of the National Chamber of Commerce. It is hoped that an impetus will be given to highway work throughout the country, through the interest aroused at this conference and at the convention to be held next week in Chicago, and that official Washington, being aroused to its importance, will give highway development the prominent place which it deserves in Governmental affairs. The personnel of the committee and the associations which the various divisions represent are as follows:

Representing the Highway Industries Association, its executive committee, as follows: W. T. White, Cleveland, Ohio; A. N. Johnson, Chicago, Ill.; W. P. Blair, Cleveland, Ohio; A. P. Sandles, Columbus, Ohio; A. R. Hirst, Madison, Wis.; E. J. Mehren, New York, N. Y.; S. T. Henry, Washington, D. C.; H. G. Shirley, Washington, D. C.

Representing the American Association of State Highway Officials, its executive committee, as follows: Lt.-Col. W. D. Uhler, Washington, D. C.; G. P. Coleman, Richmond, Va.; W. G. Thompson, Trenton, N. J.; J. N. Mackall, Baltimore, Md.; C. F. Stern, Sacramento, Cal.; P. D. Sargent, Augusta, Me.; W. S. Keller, Birmingham, Ala.; Ira L. Browning, Salt Lake City, Utah; E. Duffy, Albany, N. Y.; Max L. Cunningham, Oklahoma City, Okla.

Representing the American Automobile Association, its executive committee, as follows: David Jameson, president, New Castle, Pa.; A. E. Batchelder, executive chairman, Washington, D. C.; Carl J. Fisher, chairman, touring board, Indianapolis, Ind.; George C. Diehl, chairman, good roads board, Buffalo, N. Y.; Eugene Burton, chairman, legislative committee, Newark, N. J.

Representing the Highway Transport Committee, Roy D. Chapin, chairman, Highway Transport Committee, Washington, D. C.

Representing the Office of Public Roads, L. W. Page, director, Office of Public Roads, Washington, D. C.

Prices Stationary—Federal Control Lifting and Government Work Starting

No Marked Decline in Sight, and Probably Little Change Until Spring, Is Opinion of Material Dealers and Users

That there is no marked indication of a general decline in prices, and that the situation would continue so until spring, is the opinion of the majority of producers and consumers consulted in New York. Inquiries were made of a number of representatives of various industries, who state that, although there is hesitation, the quiet market is more or less seasonal. The administration, however, is lifting war restrictions and advertising a large amount of construction work.

The price agreement between the steel producers and the War Industries Board will continue until Dec. 31, the end of the quarter-year period for which prices have usually been fixed. It is believed that price-fixing by the War Industries Board will cease at that time but, as pointed out by the President in his recent address to Congress, it is impossible to state to what extent priorities and other supervision will be necessary to fulfill the shipping and other requirements in connection with the reconstruction period in Europe, the shipping of Army supplies and the return of troops. The almost universal use of steel makes the unfilled steel orders an index of trade, but as yet it has been impossible to judge the extent with which the reconstruction demand for steel will offset or balance the cancellation of unfilled Government orders. It is reported that the shipment of ore on the Great Lakes will close earlier this season than in several years.

The price of finished lump lime which last month was \$2.70 is now \$2.90, and an equal advance is noted in common lime, which has advanced from \$2.45 to \$2.65. Producers state that this is due to the general increase in the cost of materials and labor. The price of 10c. for barrel charge remains the same. The only increase in cement is due to the increased charge for bags, the average quotation from 23 cities being \$3.40, including the bags. A sharp decline in hypochlorite of lime, or bleaching powder, from 6½c. to 3c., is noted. The producers state that it is difficult to explain it, save that the cessation of hostilities terminated the heavy demand from the Federal Government. On the other hand, crushed-stone producers state that there will be no reduction in the price of their product; at present there is no demand, and none, they say, could be created by a reduction. The present price will, therefore, remain until the opening of the construction season will indicate the demand on which to base prices.

Public works and foreign trade, it is pointed out, must be the stabilizers in this period of transition. Although less than a month has elapsed since the end of fighting, the Supervising Architect has already set dates for the opening of bids on postoffices and public buildings that will run into many millions of dollars. This is the result of the foresighted preparations for the resumption of activities he has made in his office ever since the order to cease active operations was given when war was declared. The Secretary of Agriculture has indicated the willingness of the administration to enter into active Federal road construction and the Navy Department is proceeding with the expansion decided upon before the war started.

As to foreign trade, the Department of Commerce in a recent bulletin stated that France alone would spend \$700,000,000 immediately in reconstruction work, and that the coöperation of American manufacturers was essential. Spain is restricting the export of construction materials and machinery, thus indicating an acute situation in that country.

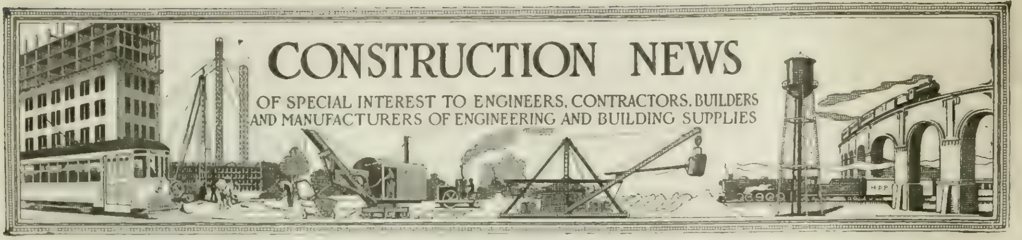
Business Notes

H. L. Wraight, 1016 Woolworth Building, New York, has been named local representative for the American Nitrogen Products Company.

The McClintic-Marshall Export Co. has been formed to sell, in the foreign field, the products of the McClintic-Marshall Co. and the Riter Conley Co., with sales office at 50 Church St., New York. The office will be in charge of R. W. Knight, formerly contracting engineer for the Pittsburgh district.

The Associated Metal Lath Manufacturers, Zenas W. Carter, commissioner, announce the removal of their general offices from 901 Swetland Building, Cleveland, Ohio, to Rooms 813-815, Woodward Building, Washington, D. C. Information regarding the use of metal lath, for either stucco exterior or plaster interior construction, for housing or commercial buildings, will be furnished free at all times, upon request to the association.

John Brooks Emory, general superintendent of the Poole Engineering & Machine Co., Baltimore, Md., has resigned to accept a similar position with the Morgan Engineering Co., Alliance, Ohio.



Price advances are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No 2 Southern	$37 60	$37 60
Northern Basic	34 80	34 80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna 2X	39 55	39 55
Virginia No. 2	41 70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39 15*	39 15*
Virginia No. 2	40 50†	40.50†
Basic	36.90*	36 90*
Grey Forge	36 90*	36 90*
Bessemer	39 10*	39 10*
CHICAGO		
No 2 Foundry Local	34 50	34 50
No. 2 Foundry Southern	39 00	39 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35 40	35.40
Basic	34.40	34.40
Bessemer	36 60	36 60

* F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh		Chicago	
	Current	One Year Ago	Current	One Year Ago
Standard bessemer rails	$55 00	$38.00	$65 00	$38 00
Standard openhearth rails	57.00	40.00	67 00	40 00
Light rails, 8 to 10 lb	3.13½*	43.50	3 13½*	43.50
Light rails, 12 to 14 lb	3.09*	39.00	3 09*	39 00
Light rails, 25 to 45 lb	3.00*	30 00	3 00*	30.00

* Government price.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots together with the warehouse prices at the places named:

	Pittsburgh				
	Current	One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, 9/16-in. and larger	$3.90	$5.00	$4.50	$5 30	$6.15
Track bolts	4.90	7.00	5.50	Premium	7 50
Standard section angle bars	5.25	3.50	4.45	Premium	5.15

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

		7 In x 9 In by 8 Ft. 6 In.	6 In x 8 In. by 8 Ft
Chicago	Plain	1 48	1 33
San Francisco	Douglas Fir—Green	1.35	96
San Francisco	Douglas Fir—Creosoted	2.70	1 92

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0 70	No 1	$0 55
No 2	80	No 2	65
No. 3	90	No 3	75
No 4	.98		
7x9x8 white oak			1 05
7x9x8 red oak (No 4) $0 80		No. 5	87

Note:—Add 36c. each for treatment

PIPE

STEEL—From warehouses at the places named the following discounts hold for steel pipe

	Black		
	New York	Chicago	St Louis
¾ to 3 in. butt welded	40%	[illegible]	40%
3½ to 6 in lap welded	36%	[illegible]	36%
	Galvanized		
	New York	Chicago	St Louis
¾ to 3 in butt welded	28%	[illegible]	27%
3½ to 6 in lap welded	25%	[illegible]	24%

Malleable fittings, Class B and C, from New York stock sell at + 15% list prices. Cast iron, standard sizes, 5% off.

Note—There is an additional charge [illegible] cartage

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Month Ago	One Year Ago	Chicago	St. Louis	San Francisco	Dallas
4 in	$70 70	$70 70	$59 [illegible]	$69 [illegible]	$6[illegible] 00	$85.50	$74.00
6 in. and over	67.70	67.70	56.50	66.80	60.00	82.50	71.00

Gas pipe and 16-ft lengths are $1 per ton extra.

CLAY DRAIN TILE—The following prices are per **1000 lin. ft.**:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco
3	$35 00	$35 00	$22 50	$30.00	
4	51.00	50.00	27.00	40.00	$45.00
5	65.00	65.00	45.00	50.00	65.00
6	90.00	90.00	55 00	60.00	90.00
8	130.00	130.00	100.00	80.80	150.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$0.117	$0 093	.	$0.125	$0.09	$0.138
4	.117	093		.125	.15	.138
5	.1755	1395	.	.175	.1875	.207
6	.1755	.1395	$0.16	175	.225	.207
8	.273	217	22	25	.3475	.2875
10	4095	3255	30	375	.45	.4025
12	5265	4185	43	475	.60	.5175
15	702	558	65	.63	.9375	.78
18	.975	775	96	1 00	1.275	*1.02*
20	1.17	93	1 14	1 20	1.71	*1.20*
22	1.56	1 24	1 46	1 60		1.56
24	1.755	1 395	1 64	1 80	2 125	*1.80*
27	2.60	2 08	2 00	2.75	..	*2.70*
30	2 88	2 304	2 70	3.45	.. ..	*3.30*
33	3.78	3 06	3 25	4.00	......	*4.20*
36	4.305	3.485	3 55	4.35	......	*4.80*

	3	5	8	12	24	36
Boston	$0.12	$0.18	$0.28	$0.54	$1.80	$6.75
St. Paul	.12	.18	25	.45	2 00	4.75
Seattle	.15	.....	.33¾	.64	2.00	......
Kansas City	.12	.18	.25	.50	1.80	4.60
Los Angeles	.0825	1375	2475	.44	1 50	......
New Orleans	.118	132	.27	.459	1.75½	.. ..
Cincinnati	108	162	.252	.486	1.62	3.99¾

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8000 gal. minimum f.o.b. place named:

	Current	One Year Ago
St. Louis, 35% asphalt	$0.09	
Chicago, 15-20% asphalt	.10	$0 06½
Chicago, 100% dust layer	.11	.08¾
Dallas, 40-50% asphalt	.09	.07
Dallas, 60-70% asphalt	.10	.08
Dallas, 75-90% asphalt	.11	.09
San Francisco, 75-95% asphalt	2 10	1.92

ASPHALTUM—Price per ton in packages and bulk in carload lots:

	Brand	Package	Bulk
Chicago	Mexican	$35 50	$33 00
San Francisco	California	16 50	13.50
Dallas	Texaco and Mexican	32 00	30.00
Seattle	D grade	23.10	... ..
Denver	Trinidad	59 00	.. ...
Denver	California	39.00	. ..
St. Louis	Standard	25.40	22.90
New Orleans	Mexican	30.00	26.00

PAVING STONE—

New York	Manhattan	$2.80 sq.yd.
	Other boroughs	2 80 sq yd.
New York	5-in granite	2.80 sq yd.
Chicago	About 4x8x4 dressed.	*2 70* sq yd.
	About 4x8x4 common	*2.85* sq.yd.
San Francisco	Basalt block 4x7x8	57.75 per M
Kansas City	Limestone	2.75 sq.yd.
Boston	5-in granite	*89.00* per M
St Paul	Sandstone	1.75 sq yd.

FLAGGING—

New York	Bronx	$0 20 sq.ft.
	Manhattan	.21 sq.ft.
	Queens, 5 ft. square	20 sq.ft.
	5x20-in. cross-walk	70 lin ft.
Chicago	18 in wide	*.80* lin.ft.

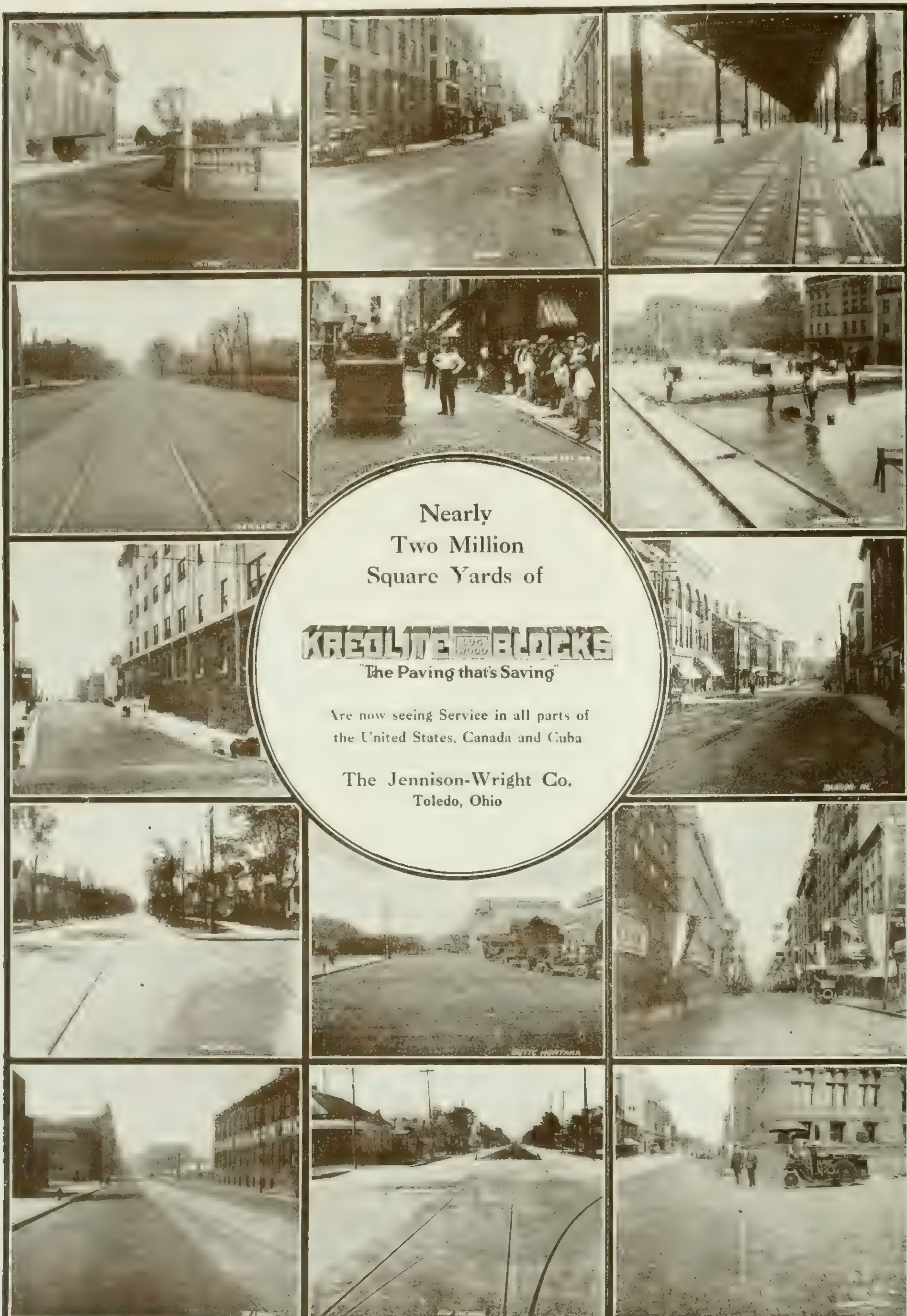
WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3½	16	$3 25
New York	4	16	3 50
Chicago	4	16	3 10
Chicago	3½	16	2.95
Chicago	City specifications		3.10
St Louis	3½	16	2.45
St. Louis	4	16	2.60
St. Louis, Minneapolis spec	3½	..	2 40
St. Louis, Minneapolis spec	4		2 55
Seattle	4	16	2.15
Boston	4	20	per M 49.50
St. Paul	Minneapolis specifications		2.50
Dallas	3½	18	3 17
Dallas	4	18	3.56

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
December 12, 1918

lacing Steel In New 3500-Ton Government Concrete Ocean-Going Ship at Fougner Yard on Long Island


Nearly
Two Million
Square Yards of
KREOLITE LUG WOOD BLOCKS
"The Paving that's Saving"
Are now seeing Service in all parts of
the United States, Canada and Cuba
The Jennison-Wright Co.
Toledo, Ohio

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

Volume 81 — NEW YORK, THURSDAY, DECEMBER 12, 1918 — Number 24

Buffalo Makes Good Start in Reducing Its Water Waste

BUFFALO has so long been a horrible example of water waste that it is a pleasure to be able at last to point to it as an illustration of how waste may be cut down and coal and labor saved by a few months of intelligent, systematic effort. What has been accomplished by a water-waste survey of only a part of the city was told by the water commissioner of Buffalo on p. 1033 of last week's issue. When the whole city has been covered greatly increased savings may be expected, but there will yet remain as a possibility and a duty the installation of water meters, in order to hold down and reduce waste further, and also as the only just method of distributing the cost of water service among consumers.

Shall We Lose Much of War Benefit?

WE CONFESS utter inability to understand the President's statement, in his message to Congress last week, that there was no need to appoint a special reconstruction agency, on the theory that the return to a peace basis will outstrip any study that can be made. Existing agencies, it is true, may be able to assist in solving some of the problems, but existing agencies do not promise well in such a task as the disposition of our railroads. Even the President indicates rather plainly his lack of faith in Congressional handling. We had thought that reconstruction included more than the discontinuance of war contracts. We took it to embrace the railroad problem, the revamping of the Sherman act, and all manner of legal and legislative formulation which will preserve the good things developed by the war. The President apparently does not so hold—much to the detriment, it seems to us, of the country. We stand to lose by neglect much that we might gain if adequate studies were made.

Centralization of Materials Standardization

TWO papers on standardization of materials in England, presented last week before the American Society of Mechanical Engineers, touch intimately the proposals current for the creation of a new body to deal with standardization in the United States. So far these proposals have appeared to lack a specific objective. The papers mentioned suggest that with regard to purposes and governing conditions the two countries exhibit radical differences. If such differences exist, it will be obvious that most careful study of the subject is necessary before centralized American standardization can be discussed with profit in concrete terms. That the British standardization work depended on Government participation is also of peculiar significance at the present time, when questions of centralized action by or with aid of the Government are, and for some time will continue to be, in a state of suspense. After thoughts in this field have crystallized, careful and broad-gage discussion will furnish a working basis for determining the proper scope of standardization work in this country, and the need for displacing or centralizing existing agencies. These are questions for primary disposition. The subject of international coöperation—which, as an ideal, undoubtedly takes precedence—must as a practical matter become secondary. The existing requirements and facilities of American industry and technical organization promise to be the governing elements in the problems of the moment.

Concrete-Base Track Departs From Standard Type

A RADICAL development in railway track construction is embodied in the unballasted concrete-slab construction now in use on the Northern Pacific Ry., and described on another page of this issue. Its importance lies in the facts that this track has been built for main-line conditions in open country, and that it has given good results during four years of service. The general idea is not new, for track built upon a permanent concrete base has been the subject of several designs. Nor is the fact of actual construction new, since a concrete base is the fundamental feature of some types of track employed for tunnels and large passenger stations. But unballasted track with a concrete base on open main line is a marked departure from standard practice. Cost figures are not available, but the maintenance cost is reported as being far below that of track of the ordinary type on the same line. It is to be noted also that while maintenance is a source of continual work and expense on ordinary track, it is likely to be required only intermittently and at long intervals with this type of construction. Altogether, the Northern Pacific experiment seems to be a big step ahead.

Edgar Marburg Memorial Scholarship

NO MORE appropriate form of memorial to the memory of Edgar Marburg than the proposed permanent scholarship in his own institution, the University of Pennsylvania, to which he gave practically the whole of his working life, could be conceived. The plan an-

nounced in our news pages, by which the American Society for Testing Materials is collecting the funds for a memorial scholarship, is worthy of the highest commendation. This form of recognition would appeal to Dr. Marburg himself, because his whole heart went out in the true teaching instinct to develop young engineers into men worthy of the great profession to which he gave his life. It is to be hoped that the future students who will benefit by this scholarship may fully appreciate the honor and repay it a hundredfold by their later contributions to engineering progress. It is unfortunate that only members of the A. S. T. M. have been asked to subscribe. There is no doubt whatever that thousands of other engineers the country over would be glad to add their tribute to a man who had been their inspiration and guide either in the days of their early training or in their engineering experience.

Public Works the Only Available Safety Valve

THREE weeks ago we strongly advocated a policy of extensive public works construction, so that such works might "take up the slack" in the transfer of labor from war to peace occupations. Since that time a great movement has gotten under way for inaugurating public works on a large scale. One hears of it from every direction. The President advocated such a policy in his message, the Secretary of Agriculture declared for increased Federal highway appropriations, the business men of the country assembled at Atlantic City saw in it a safety valve in the possible labor crises, the War Labor Policies Board is polling the Governors and the mayors as to the construction programs of their respective states and cities, and chambers of commerce throughout the country are getting back of the movement. The policy is one that all may and should indorse. Those who scruple about recommending expenditures at higher costs than may prevail when really normal conditions are here must face the far more serious alternative of quelling the disturbances that are inevitable if there is widespread unemployment. The bill to the public from such a situation will be far heavier than the excess payment for public works inaugurated under present conditions. No less scrupulous a man than the President does not hesitate to recommend immediate beginning on a large construction program. The movement should have the support of every thinking man and of every engineering society and contractors' organization. These bodies can help much by bringing their influence to bear on their local chambers of commerce and their Congressional and state representatives.

A Wave of Liberalism Sweeping Over American Business

NO ONE came away from the mammoth reconstruction congress at Atlantic City last week without a lifting of the spirit. One had only to mingle with the groups, catch the chance phrase and grade the emphasis of applause, to feel the optimism, the idealism and the fine sense of service which pervaded the meeting. The American business man, as represented by the 5000 upstanding, prosperous representatives there, realizes in his heart that he faces a new day. He knows that his partnership with labor is no longer a mere catchword, and the solidarity of the world no longer a dream. Therefore he spontaneously rises in wild applause when the richest man in the world announces an industrial creed of startling radicalism; therefore he pays a unanimous tribute to an assertion that commerce is service and the goods of the United States must be shared freely with the world.

But when these same business men come to set down their conclusions in cold blood, they not only are hampered by the iron rigidity of words, but their ingrained conservatism is such that they hesitate to express openly that which their actions have shown they feel. Many of the 32 resolutions adopted in Atlantic City are perfunctory; more are elusive, and some have too much of that "let-us-alone" spirit which did more than anything else some years ago to discredit business. Taken all in all, they probably represent the dry bones of the proceedings, but somehow they fail to reproduce the flavor of the congress itself.

Reconstruction is only a word; what it tries to represent is the program for a new era. It was too much to expect that in a few day's conference—even so diversified and talented a one as that held last week—such a program could be evolved in finished form, but if those who were at Atlantic City succeed in bringing home to their friends and associates an adequate interpretation of the spirit in which American industry is going into the business of rebuilding the world, the words of the program as embodied in the 32 resolutions have no importance. Those who eventually must frame the reconstruction policies of this country cannot possibly miss realizing the wave of liberalism that has swept over American business.

Railway Street-Crossing Floors and Bridge Floors

PROGRESS in waterproof floor construction for railway street crossings, as reviewed in the article on p. 1081 of this issue, has come about through a process of successive approximation applied to a many-sided and changeable problem. The recorded experience is equivalent to a long series of experiments, made at the cost of many thousands of dollars; it should be valued accordingly. Still greater value can be given to it if the observations and experience of other engineers who have had the same problem to deal with are joined to it.

One prominent characteristic of the problem which bridge engineers have had to solve in the case of railway crossings over streets is the evolution of the problem itself during the course of its solution. This is so common in engineering as to be virtually characteristic, and it would be a mistake to look on the progressive perfection of design as being necessarily a trial-and-error process. The early solutions are in many instances quite perfect adaptations to the conditions imposed on the designer. Subsequently, experience with one form of construction leads to imposing further requirements, which are then met by a more highly developed construction. Thus the problem and its solution advance abreast of each other. Time is required for progress of this kind, and accordingly the record

of floor constructions given in this issue extends over a considerable span of years.

Recalling the early stages of development of street-crossing floors—for example, the period when open floors with drip pans suspended below them were used—it may be seen clearly that the demands made upon the designer became continually more severe and complex. What shaped the history of the subject was not so much the growth of the engineer's ability, but the growth of the world's needs and wants. These have now reached a high level, as indicated by the highly developed solutions. No such high level has been reached in the closely related field of bridge floors in general.

Up to now the question of bridge floors in general has never been approached from the point of view represented in Mr. Welty's article. Other demands were controlling, chief among them the demand for rigidity and power to absorb vibration, and the quite opposite demand for lightness. Various floor types of great merit have been brought out; yet in the main we are still on the basis of the primitive solution, the open-tie floor.

Looking forward, the possibility may be seen of great elaboration in bridge-floor construction. When such development comes, it may ultimately converge toward the line of advance in street-crossing floors. If that prove to be the case, we may ultimately have a single general-service type of floor, meeting the demand for waterproof character as well as that for rigidity and freedom from vibration, and possibly also the demand for lightness. But before such a result can come definitely into prospect, much further evolution of the bridge-floor problem itself must take place. Pending this, bridge-floor designs are bound to show forms of construction differing radically from those discussed in the present issue.

A Great Opportunity for Service to Engineers

AN OPPORTUNITY to do real good in connection with the readjustment of our national activities to non-war conditions is open to the employment bureau just established by the national engineering societies. An unusual proportion of engineers entered war work in one way or another. The time is at hand when this war work will be ended and a large number of these engineers must find employment. Their pre-war engagements were such that no place awaits their return from war service. Many of them are young men who cannot afford to remain long without work. The direction of these engineers to places where their training will be useful is an undertaking not only of national benefit, but the best possible way for the engineering societies to win the loyalty of the profession. Only a false viewpoint prevented this work from being undertaken with vigor years ago.

If anybody will examine critically into the reasons why engineers fail so lamentably to make an impression on public affairs, it will be found that one explanation lies in the pitiful lack of coöperation among them in anything beyond the reading of voluminous papers on subjects about which the public cares nothing. The very best coöperation, the fundamental coöperation, among men engaged in any line of work, professional or commercial, is that which helps them secure for themselves and their families more of the pleasures of life. These pleasures generally call for time, or money, or both. Coöperation which only results in the distribution of a little more special information is incomplete and deceptive, for it creates the impression that all that is needed for success is to know how. This is hopelessly fallacious; knowing how must be supplemented by ability to sell that knowledge to the man who needs it. Lack of salesmanship is what holds down the engineering profession, and not lack of knowledge.

This is shown by the condition facing thousands of engineers, and particularly civil engineers, who will soon be looking for engagements. They have no idea where these engagements can be found; they must hunt about until they happen upon something which they can do. Few of them have probably had to hunt long heretofore, or to state their qualifications in a business-like way. They may have recommendations from former employers, which mean little in most cases to prospective employers. So far as help in securing employment is concerned, they are left far behind the skilled workmen who will return from the Army and the Navy.

In undertaking the task of helping these men to obtain employment, the societies will render a service of which they may well be proud. It is assumed, of course, that the task will be properly done. This does not mean merely to receive the names of engineers looking for engagements and to send the names to applicants for engineering assistance. That is but the beginning of helpful employment service. What must be done is to go out into the world and "sell" engineers to those who need them. The country must be taught that the best place to come for engineers is the employment bureau of the national societies, and that can be taught by intelligent publicity only. It means a careful sifting of the record of each civil engineer who is looking for an engagement, in order that the essential facts about him shall be given fairly and clearly. It even means keeping a record of men who are not out of jobs but whose talents are not fully utilized in their present engagements. Needless to say, the bureau, too, should be a watchful counselor regarding what is adequate engineering compensation.

In short, the societies should help their members and engineers generally to obtain the work for which they are best suited. That is a really useful service which will go far to help the prosperity of the members of the profession, and it is only by visibly increasing their prosperity that the general public will in turn give them a higher rating. When the steam-shovel man gets higher pay than the assistant engineer who is in charge of the work, the public inevitably says that the shovelman is the more important fellow. The public does not know that the shovelman's wages have been raised by the shrewdest kind of coöperative work, that the engineer's salary is kept down on account of a false feeling that it is unprofessional to act together to obtain engagements and that the engineer is on too elevated a plane to care much about what he earns, except in the midst of his family circle.

The societies' employment bureau has a great opportunity. Every engineer will look to it for results and will coöperate to the utmost to make it a success.

Building a Government 3500-Ton Concrete Ship

Fougner Yard Has Concrete Ways—Reinforcement Tacked to Outside Forms and Finish Put on With Cement Gun—Air Hammers on Forms Compact Concrete

ONE of the Emergency Fleet Corporation's new concrete ships is fast approaching completion in the yard of the Fougner Concrete Shipbuilding Co., on Flushing Bay, Long Island. The ship was started on Aug. 20; the first run of concrete on this 3500-ton vessel was poured on Nov. 6, and it is expected to launch early in January. The company is associated with a Norwegian firm of the same name which has for some years been building small concrete craft, but in the construction of this new ship, the second largest concrete vessel yet attempted, the contractors, in coöperation with the supervising Government engineers, had to elaborate old methods and devise new ones, so that much of the work was really of a pioneer nature. Important among the details of the construction were the use of framed trestles carrying the outside forms, the suspension of inner form frames, the tacking of the outer steel on the forms with subsequent covering by cement-gun concrete, and the use of air hammers on the forms to compact the concrete.

CONCRETE SHIP ON FLUSHING BAY WAS BUILT ON REINFORCED-CONCRETE SHIPWAYS

OUTSIDE TRESTLE FOR CONCRETE SHIP ALSO IS SUPPORT FOR OUTER FORMS

The ship has a dead-weight carrying capacity of 3500 tons, is 281 ft. 9 in. long, of 46-ft. beam, and 26½ ft. molded depth. It was designed by the Fougner company and revised and approved by the Concrete Ship Section of the Emergency Fleet Corporation. The design is, however, not to be confused with that of the standard 3500-ton concrete ship designed by the corporation, and described in *Engineering News-Record* of July 4, p. 17. The Fougner ship has heavy transverse frames spaced 4 ft. on centers, a center and two side keelsons, four bulkheads, one fore, one aft and two inclosing engine and boiler rooms. The deck is carried by two continuous girders forming the hatch coamings and is supported by widely spaced concrete-filled pillars made of heavy iron pipe with flanged heels and heads. The side keelsons are placed so that the steel pillars are carried at their intersection with the floor-beams. The launching ways are placed directly under these side keelsons, so that any unbalanced loading obtained in launching will be distributed readily to the adjacent floor-beams.

One of the distinctive features of this ship is the omission of deep tanks, the feed and ballast water being carried in the double bottom. The raised portion of the tank top is then used as the main boiler and engine floor. The bridge, forecastle and poop decks are all of concrete.

In general, the bottom and side shells are 5 in. thick. The side shell reinforcement consists of two layers of diagonally placed reinforcement of $\frac{1}{2}$-in. and $\frac{5}{8}$-in. square deformed bars. The deck varies somewhat, with an average thickness of 4½ in. At 6 ft. above the water line a horizontal bilge girder is carried all around the ship, running flush with the tank-top slab. This girder is used for stiffening the bilge and is also utilized in making the first stop in the concreting operation, which takes in the floor system up to the center of this girder. The side slabs are considerably thickened at the bilges and at the deck line, to permit the carrying of the heavy longitudinal steel reinforcement in these regions. The floor-beams and the frames in general are 8 in. thick, except in the tank-top section, where they are 5 to 6 in.

Trestle and Staging Details.—The yard of the company is situated at North Beach, Long Island, on the west shore of Flushing Bay. It was originally the site of a summer garden resort, with the usual accompaniment of dance halls, roller-skating rinks, etc. These buildings were admirably suited for the purpose of shipbuilding—the skating floor, for instance, of matched lumber, making an almost perfect mold loft, and the dance hall being readily adapted to the uses of a carpenter shop. At the side of the Government yard the company is building, in an entirely separate plant, several concrete barges and lighters.

The preliminary work of building the Government ships consisted of the construction of reinforced-concrete and pile ways, and the dredging of the outshore area to provide sufficient depth for launching. The

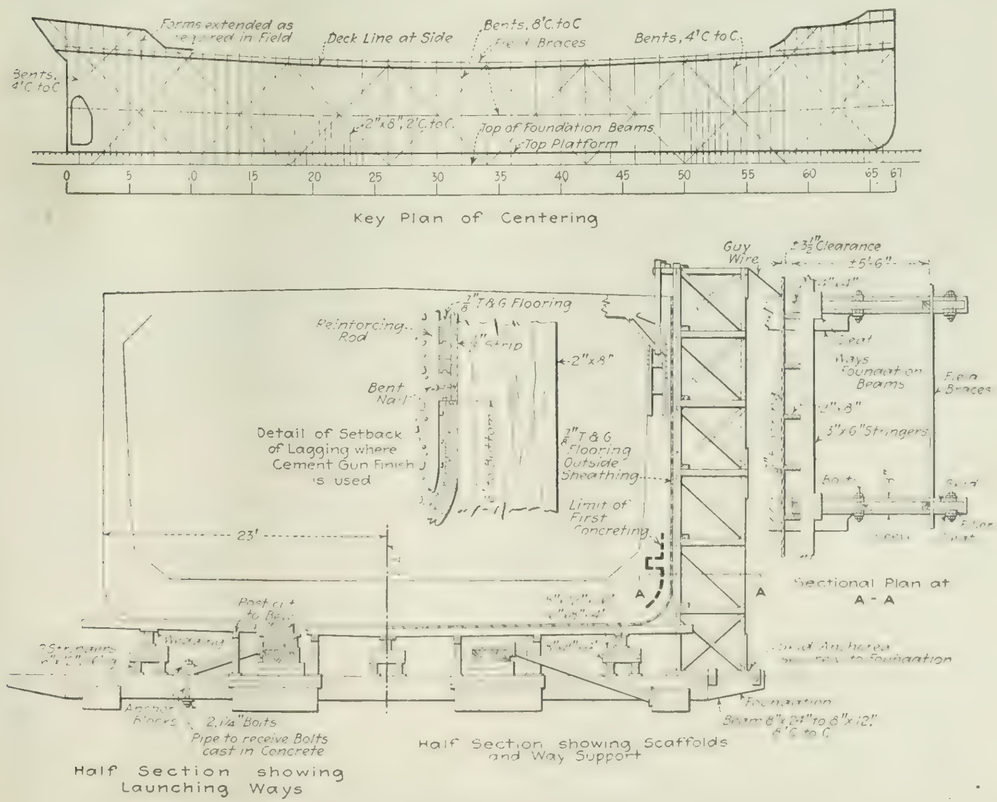
SHEET-IRON BAND AROUND DOGS PERMITS SMOOTH BENDING OF DEFORMED BARS

ways shown in the drawings and in some of the views consist of a shore section of four longitudinal concrete girders carrying transverse reinforced-concrete beams, the whole being sloped $\frac{5}{8}$ in. per foot to the front. The concrete beams were provided with bolt holes to which the forming and trestling of the ship could be attached. The outshore end of the ways are of timber on wood piles. Both sides of the ways were approached by an industrial track connecting to the other parts of the yard and to the concrete mixing plant immediately alongside of the ship. Each concrete tower is provided with a derrick for handling material over the ship.

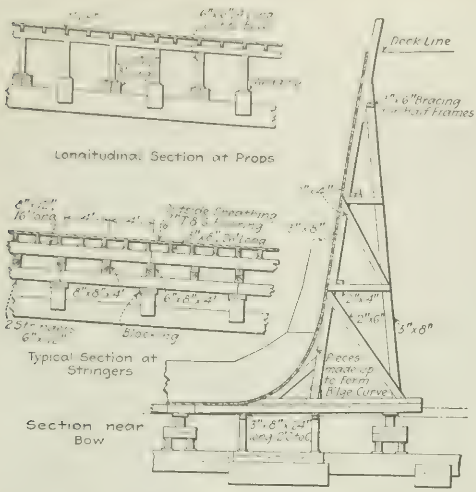
The first operation in the erection of the forms is in the placing of the floor. A continuous platform of 2 x 8 in. floor-beams was carried from the bow of the ship to about 20 ft. aft of the stern post, resting on the concrete ways. These platform beams were set at a pitch corresponding to the dead-rise of the ship and in general 2 ft. on centers, except that at every 16-ft. interval the beams were doubled up on account of the stripping of the bottom sheathing, which is made in 16-ft. panels. Under the bulkheads the floor-beams were set 1 ft. on centers for 4 ft. on either side. The platform was carried on shoring consisting of three longitudinal sets of stringers and four 6 x 6 in. stringers carried on 6 x 6 in. posts 4 ft. on centers.

As illustrated in one of the drawings, provision is made for setting the launching ways between the two rows of 6 x 6 in. posts.

The falsework carrying the side sheathing is made up in two general schemes. About one-half of the vessel's section is rectangular, except for the dead-rise and a 3 ft. radius of bilge. For the length of this section, then, transverse bents $5\frac{1}{2}$ ft. wide and 34 ft. high



DETAILS OF OUTSIDE FORMS AND FLOOR SUPPORTS ON FOUGNER SHIP



CURVE OF SHIP REQUIRES IRREGULAR FRAME FOR FORMS

are set 8 ft. on centers. These are carried by, and securely bolted to, the concrete ways. The bents are set perpendicularly to the pitch of the ways, and are thoroughly braced to each other by means of longitudinal and cross-bracing on the outer sides. At the inner sides, longitudinal stringers are carried at each panel point. These stringers carry the 2 x 8-in. upright studs set 2 ft. c. to c., so as to meet the platform beams. At the bilge a segmental filler is nailed directly to the upright and the platform beams. The sheathing consists of ⅞-in. T. & G. made up into 3 x 16-ft. shop panels, for the straight portion of the bottom and sides. Where the shell has marked curvature no attempt was made to keep the sheathing in shop panels.

At the fore and after portions the scheme of carrying the falsework for the sides is modified. Bents of triangular or trapezoidal section, conforming very nearly to the body lines of the section in question, are set directly on the platform beams 4 ft. c. to c. so that for every frame there is a corresponding bent. Half-frames are then obtained by framing upright studs between the bents. These bents are all securely braced to form a continuous trestle.

No mold-loft work is required for any of the falsework described above except for the final curves of the fore and after bents, which are obtained by nailing to the inner posts a filler piece or curved stud cut to conform to templets, which were laid out full size in the mold loft. The sheathing is then nailed directly to these fillers, thereby completing the outside shell. To secure additional stability, in addition to the cross bracing every fifth bent is guyed to the ground. All the bents above described are framed complete in the shop and erected by means of ginpoles.

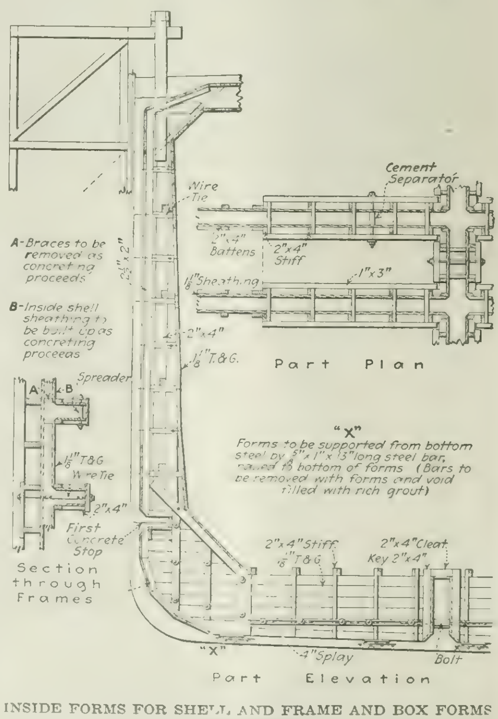
An essential feature of the above method of framing is that practically the entire centering may be stripped in panels and integral bents. This centering may then be used again for other ships of similar type, and with slight modifications it may be re-used for ships of other types or dimensions.

Inside Forms.—The inside forms may be divided into four general groups: (1) Forms for typical floors; (2) for tank-top floor; (3) for side frames and inside shell; (4) for deck.

The forms for the typical floors were made up as boxes in the shop. These boxes are keyed at the four corners by means of 2 x 4-in. keys. The pieces forming the splays at the bottom have no keys at their intersections, and no difficulty was experienced in stripping. To hold the boxes in position, when set, cross cleats are nailed to the 2 x 4-in. battens at the top, and ⅝-in. through bolts, with cement spreaders, are used at the bottom.

An essential detail is the use of the bolt stringers which hold the bottom bolts. When the bottom slab is poured, short, removable boards are spanned across the two 1 x 3-in. stringers, and the puddling and finish of the bottom slab is worked from these temporary platforms. The forms are supported from the longitudinal steel reinforcement by means of iron flats 13 in. long nailed to the bottom of the splay pieces. The results have been very satisfactory. The boxes are assembled and marked in the shop, and hauled and set as units. By shifting slightly the corner keys, any small variation required in fitting the boxes is readily taken up. Contrary to expectation, very little difficulty was experienced in fitting the boxes. All the inner panel forms have been stripped and no difficulty has been encountered, the boxes collapsing very readily, with practically no damage.

The carpenters were supplied with shop details for



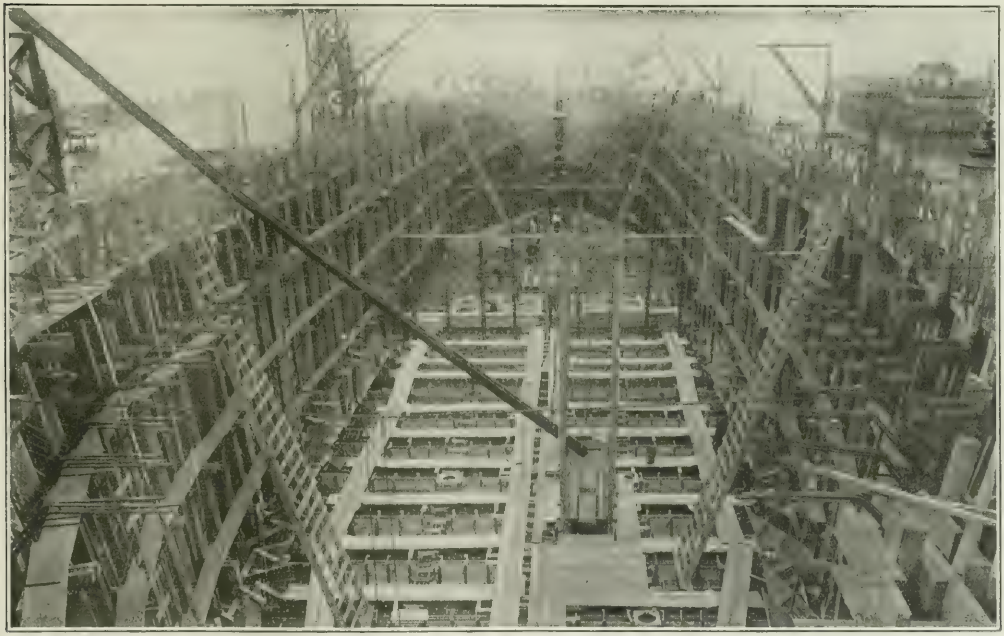
INSIDE FORMS FOR SHELL AND FRAME AND BOX FORMS FOR FLOOR

all the straight form work, but at the fore and after end full-size paper patterns are laid out in the mold loft. The tank forms are constructed similar to the typical floor forms. The tank-top slab itself was poured after the floor forms were stripped. The panels supporting the tank-top slab were made in sections, and are supported on skeleton frames. These skeleton frames are made up of 2 x 4 in. posts inserted in the bolt stringers, which are removed from the forms and used as headers in their respective panels. The panels supporting the slab are made so that they will readily pass through the tank-floor manholes when stripped.

The side frames were all made in the shop and hung from cantilever braces extending from the outside bents. They are tied transversely by means of wire ties 2 ft. c. to c. For longitudinal bracing, through

It consists of 3 x 6-in. oak timbers spaced in 1 in. apart, the slots being used for the oak dogs shown in the view. Bending of the larger rods—that is, those up to 1¼ in. in diameter—was done on this table by hand. Some difficulty was found at first in getting the curve of the bend smooth, the tendency being to take the chord line between the dogs. This difficulty was obviated later by interposing a piece of ¼-in. sheet iron between the steel and the dogs, and this iron is shown in the view of the bending table. After this the curve of the rod follows the templet exactly, although some skill was required in knowing how far beyond the curve to bend in order to take up the elasticity of the steel. The smaller steel was bent in a manufacturer's bender.

Some difficulty was anticipated in placing the shell steel so as to guarantee the necessary ½-in. concrete

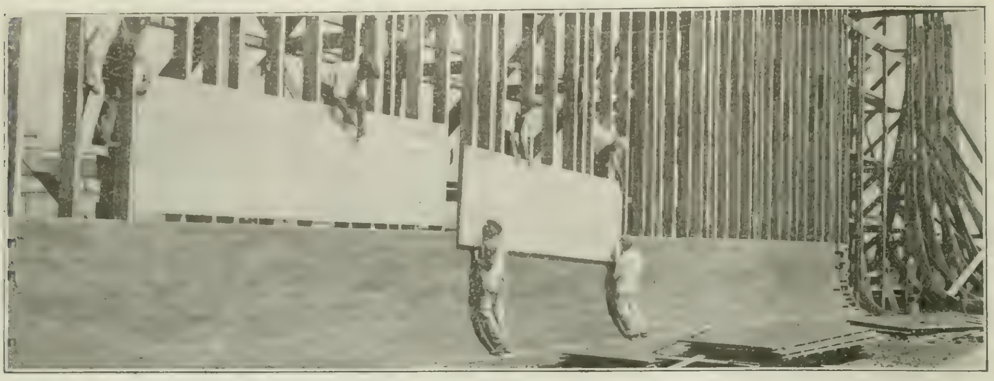


INTERIOR OF FOUGNER 3500-TON CONCRETE SHIP READY FOR CONCRETING FIRST RUN UP TO TOP OF BILGE CURVE. TWO MIXERS OUTSIDE FEED TWO INTERIOR TROUGHS FROM WHICH CONCRETE IS WHEELED TO PLACE

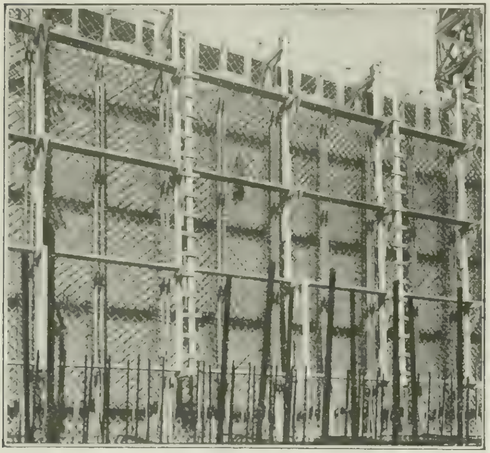
bolts and cement spreaders were used. The cargo battens were afterward bolted through these cement spreaders. The deck centering is similar to that used in ordinary building construction. The posts which carry the inside scaffolding used in concreting the sides are used also to carry their share of the deck forms, and are erected accordingly. The inside shell forms are in panels 2 ft. deep between frame forms, and are slid down one at a time, leaving one panel open for the pouring of the concrete in the shell.

Steel Placing.—At the time when the templets were made in the mold loft for laying out the outside forms, similar templets were made for each frame from which the frame steel was bent. The templets were taken to the steel-bending table, and the proper curve was laid out there. One of the views shows this bending table.

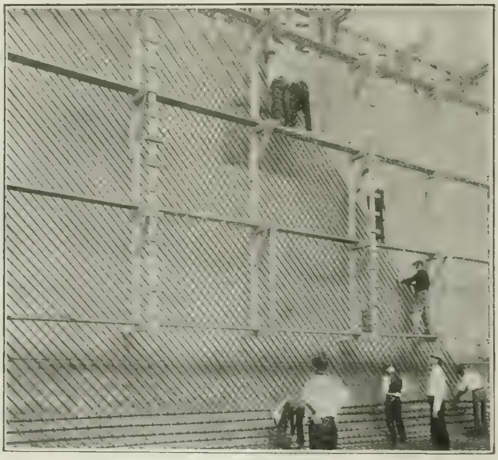
covering. It was decided to secure the proper placing of this steel layer by bringing in the outer form the ½ in. and tacking the outside steel directly to it. At a point 6 ft. above the bottom of the boat this inset was made, as shown on the accompanying detail sketch, by tacking a ½-in. strip to each vertical stud and continuing the tongue-and-groove lagging of the form panel against this strip. The outside rods then were tacked directly to these outside forms. At first staples were used, but later ordinary 8-penny nails bent over the rods proved to be easier to place. When the outer form is stripped the concrete will be flush with the outside of the steel reinforcement. A ½-in. coat of cement-gun mortar will then be shot over the entire outer shell of the ship. The contractor has successfully used the cement gun in casting the shells of a number of barges



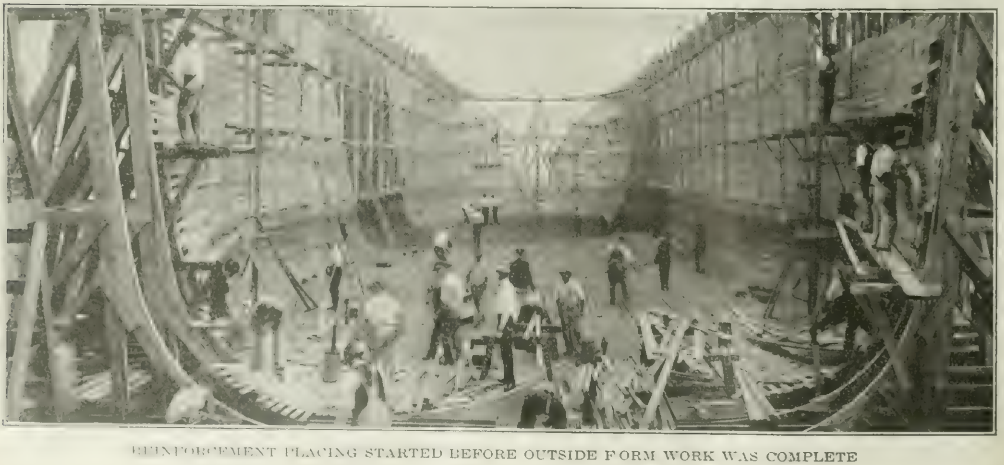
STRAIGHT SIDE FORMS ARE IN 16 x 3-FOOT PANELS. BILGE FORMS ARE NAILED ON CURVED STUDS AND HAVE TO BE DESTROYED IN TAKING DOWN



HANGING INSIDE TRESTLES ARE USED TO PUT UP INTRICATE SHELL REINFORCEMENT

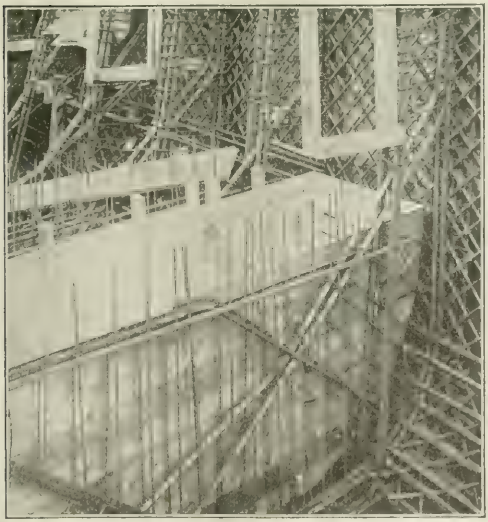


DIAGONAL OUTSIDE BARS NAILED DIRECTLY TO OUTSIDE FORMS AND BENT IN PLACE

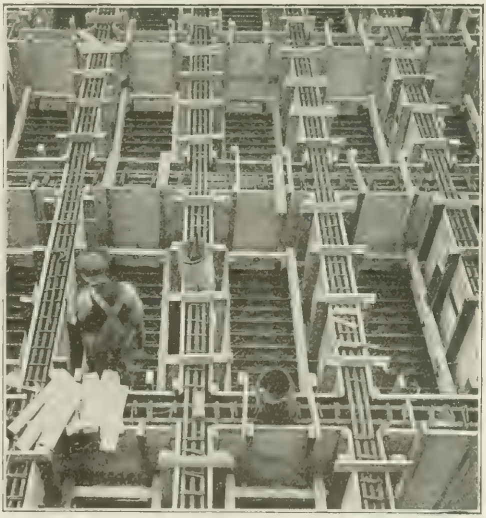


REINFORCEMENT PLACING STARTED BEFORE OUTSIDE FORM WORK WAS COMPLETE

NETWORK OF REINFORCEMENT AT STERN INVOLVED LABORIOUS DETAIL OPERATIONS IN PLACING



BOX FORMS AT BILGE ARE CUT VARYING WITH THE CURVE OF THE SHIP AT THE BOW AND STERN, AT EACH FRAME



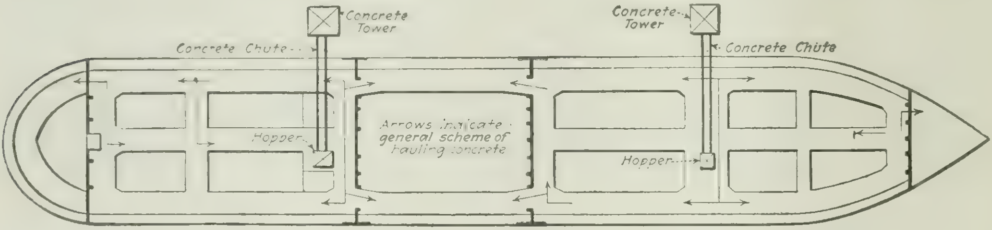
BOX FORMS IN FLOOR NEARLY READY FOR CONCRETING. GIRDERS RUNNING ACROSS ARE KEELSONS. CLOSE SPACED GIRDERS ARE FLOOR FRAMES

which he is building in his adjacent yard. Tests indicate that no difficulty need be feared in forming a satisfactory bond between the new and the old concrete.

The first operation of steel laying is to place the longitudinal floor bars. These are held up from the floor on precast concrete blocks 4 in. square and about 1 in. thick, with a ½-in. horizontal groove around all four sides to give a bond to the concrete subsequently placed. On the curve of the bilge a similar block 4 x 2 in. is used, but this block has a short piece of wire cast in it, and this wire, in the placing, is tied around the rod to prevent the slipping of the block down the curve of the bilge. The side rods being ½ and ⅝ in., these bars are not bent before being placed in the ship. They are put on in diagonal rows, as shown in some of the views, and can be bent directly around the curve of the bilge in the forms. They are spliced by wired overlaps in the floor of the boat. The bottom rods are not wired in their splices, but have a 30-in. overlap with a 4-in. hook on each rod. The bending of this 4-in. hook is quite expensive on the 1½-in. rods. A special point of advantage in the Fougner boat is the 7½-in. thickness of the shell at the bilge. This gives somewhat wider tower. Inside the ship were two movable towers, each carrying an elevator hopper of about 2-yd. capacity. The general layout for wheeling and placing was one continuous runway encircling the ship near the sides, connected by transverse runways placed at the center of every other panel in the floor system. The layout is shown in one of the drawings.

There were two gangs of men on each of the hoppers, with sixteen men to each gang wheeling barrows. In the center of the frames and for the whole bottom, the concrete was dumped directly into the forms from the barrow, but in the side frames and the bilge shell galvanized-iron hopper chutes projecting out into the ship were provided. Concreting started at the quarter points and proceeded toward the bow and stern, and at the middle and proceeded toward the hoppers. A slow-setting cement was used, so it was possible to join up all the concrete before the initial set had taken place, and a continuous monolithic structure was obtained for the whole bottom and bilges.

The Emergency Fleet Corporation's special cement, 90% through a 200 sieve, was used on the work. The special light-weight burned clay aggregate of the Fleet



LAYOUT OF PLANT AND RUNWAYS ON FOUGNER SHIP FOR CONCRETING OPERATIONS

leeway in the bending of the rods around the bilge, and does not require quite as careful work as though the bilge were of the same thickness as the shell and the floor. It does, however, add somewhat to the weight of the ship.

After all the floor steel is placed, the frame steel is erected and wired in place. This is very detailed work, as the network of the finished frame steel in one of the views will show. Great care is taken to keep the steel properly spaced, so as to permit the concrete to run around all the pieces.

Concreting.—The hull, up to and including the deck, is to be poured in three stages, each of which is one continuous operation. The first pouring was to the middle of the side stringers, the second to the middle of the top bracket of the side frames, and the third includes the main deck, the poop and the forecastle. The bridge deck, tank top, coal bunkers and shaft tunnel will be poured afterward, as convenient. The concreting has been carried successfully to the second stop, practically completing the hull up to the deck.

The first pouring, which includes the bottom floor system up to the middle of the side stringer at the 6-ft. water line, involved the placing of about 450 cu.yd. of concrete in 32 hours. Two ½-yd. mixers were set up at the quarter points outside of the ship at the base of towers which fed into a cantilevered chute from each Corporation could not be produced in time for this ship, so the so-called Steers' gravel and Cow Bay sand were used instead. This gravel consists of ⅜-in. washed gravel mixed with 50% of washed coarse grit. The mix is 1 cement, ⅜ sand, and 1⅓ mixed gravel, giving a 1 : 2 concrete. Concreting started at 7 a.m., Nov. 6, and was completed at 5 p.m., Nov. 7.

With the steel closely spaced, difficulty was feared in tamping or spading the concrete in order to insure density. Instead, a full equipment of air hammers, provided with blunt-nose tools, was kept continually in action against the outside and inside forms while concrete was being poured. Experiments have shown that the effect is better than tamping or spading. In the actual operation, concrete which apparently had reached the full height of the forms settled 3 or 4 in. under the action of the hammers.

The second pouring involved the placing of about 350 yd. of concrete in 24 working hours, concreting starting at 7 a.m. Nov. 25, and ending 10 a.m., Nov. 26. Two stagings for the runways were used simultaneously; the upper for the wheeling and placing of the concrete, and the lower for the tamping by means of the air hammers, which were also used on the outside of the vessel at the same time.

The elevator hoppers already described were raised as required to the various stagings. Four gangs of four

men each were used in wheeling. The concreting was carried on from the quarter points, toward the bow and stern, and toward amidships.

The initial work on the ship was carried on with surprising rapidity, considering the fact that this was the first large vessel built at the yard. The first work on the floor forms was started Aug. 20, and the floor concreting was started Nov. 5. With the experience gained in this pioneer construction and with the forms, templets and machinery now available, the time and expense of building a second similar ship is considerably reduced.

The vessel was designed by the Fougner company, subject to the approval of the Concrete Ship Section of the Emergency Fleet Corporation, of which R. J. Wig is chief engineer. The Fougner Concrete Shipbuilding Co. is headed by Herman Fougner, president. C. P. M. Jack was retained as consulting naval architect. The design of the concrete hull and form work is in charge of Joseph Di Stasio, the designing engineer of the company. The marine work is handled by H. A. Christensen, and H. A. Hyman, the company's superintendent, has charge of the work at the yard. The Concrete Ship Section of the Emergency Fleet Corporation is represented on the work by Walter R. Harper, as resident engineer.

Principles Controlling the Layout, Marking and Maintenance of Trunk Highway Systems

Detailed Account of Methods Followed by Wisconsin Recently in Inaugurating a 5000-Mile System of State-Maintained Highways—Patrol System, Paid For by State, Is Administered by Counties

By A. R. Hirst
State Highway Engineer of Wisconsin
(Paper read before the Joint Highway Congress, Chicago, Dec. 12, 1918).

It is seldom that an engineer supervises the laying out, from the foundation, of a complete state highway system. Therefore, the experience obtained by Mr. Hirst in his work in Wisconsin will be of value to those who face a similar problem. The ideal system proposed was one interconnecting every county seat, affording access to the state's agricultural, scenic, manufacturing and resort interests, and connecting with the principal highways of the adjoining states. As soon as a highway was designated as part of the state trunk system, the state took over its maintenance, in this respect departing radically from the usual policy of undertaking maintenance only after the state has reconstructed a route. The results have fully justified this course, a 50% improvement over conditions existing at the start having been effected during the first season of control. The marking system adopted will also prove of interest to highway engineers and officials.—Editor.

This subject has been deemed worthy of discussion at this time because many states have laid out or are about to lay out state highway systems or state trunk highway systems.

One of the principal reasons why the American states have not yet secured a system of highways comparable to those in European countries is that, until very recently, the counties and states built highways without having in mind the building of any definite system, and the expenditures were scattered on so many roads, of varying importance, that the results have not been as apparent as the expenditures justified. It is becoming increasingly evident that, if our states are to have a completed system of modern highways within this generation, their expenditures must be largely concentrated upon definite and restricted systems of highways, and not spread indiscriminately on all roads, as in the past.

In order to make possible this concentration, the state highway systems must be most carefully selected, for this policy of concentration will meet much opposition, which opposition will in many cases prevail unless the basic layout is honestly, logically and adequately made.

I have ventured to discuss the principles which should underlie the creation of a state trunk highway system, because Wisconsin has in the past two years established such a system, and our methods of doing it and the lessons we have learned in the doing of it will doubtless be of interest to the states which have, or will shortly have, similar problems.

It is probably germane to state at the outset that the whole cost of establishing, marking, administering and maintaining the Wisconsin trunk highway system, and the state's share of the cost of all Federal-aid construction on it, are made available by appropriating 75 per cent. of the net proceeds of the motor vehicle license fees for these purposes. The remaining 25 per cent. goes back to the counties for the maintenance of other main roads.

What Should a State System Comprise?

The first questions which present themselves are, "What is a state trunk highway system, and what percentage of the public highway mileage of a state should be comprised in an adequate system?"

Our conception is that *a state trunk highway system is a system of highways interconnecting every county seat in the state, also every city or village having a population of 1000 or more; offering full access to the agricultural, scenic, manufacturing and resort interests located within the state; and connecting also with the principal highways of all surrounding states.*

We believe that the state trunk highway system should include approximately 10% of the total public highway mileage lying outside the limits of incorporated cities and villages. This percentage may be high for some of the more thickly populated states, and it may be low for the sparsely settled ones.

The present Wisconsin state trunk highway system, shown by the accompanying map, comprises 5000 miles, or about 6½% of our total rural road mileage. This system, however, is not entirely adequate; we expect that the legislature will add from 1500 to 2500 miles within the next few years, bringing it up to about 10%. In the sparsely settled sections of Wisconsin the present system comprises 10% of all road mileage, and in the fully settled and partly settled counties it comprises about 6%. It passes through 71 out of 71 counties (100%); 728 out of 1242 townships (58.6%); 120 out of 125 cities (96%) and 157 out of 253 incorporated villages (62%). The aggregate population of the cities, villages, and townships through which the system actually passes is 81% of the total population of the state.

State Trunk Highway System Should Be Generous

We are convinced that a state trunk highway system should be generous rather than niggardly. Objection may be made that the more miles there are in the system the longer it will take to construct it. We doubt the force of this objection. In practically every state the construction of a complete state trunk highway system with adequate, modern types of pavement must wait upon bond issues. We believe it is much easier to pass a bond issue in the average county, or in the average state, to build an adequate system of highways, than to build one that is inadequate. It will usually be easier to bond a county for $3,000,000 to build an adequate system accommodating the great majority of the people, than to bond it for $1,000,000 to build a smaller system accommodating a minority. On a larger scale the same principle is true for states. Human nature is still human nature, and men still largely vote for that which directly benefits them, and vice versa.

Summing up, therefore, we believe that the state system should consist of an adequate mileage accommodating, as far as through lines of intercounty communication are concerned, all the people in every section of the state. Usually it will require 10% of the road mileage of a state to accomplish this result, but this figure is subject to increase or decrease, varying with the degree of development of the state or its sections.

Selecting the System

We have already stated that any state system, to be successful, must be honestly and fairly selected. It follows, therefore, that the selection should be largely in the hands of disinterested engineers—subject, however, to review by a fair tribunal and made only upon the fullest knowledge of all roads which are proper candidates for positions upon the system.

In our state the selection was made jointly by the State Highway Commission and a committee of five from the legislature, appointed by the Governor. There was complete coöperation between the two bodies, and we believe that the result reached jointly was much more satisfactory to the people of the state than action by either body alone would have been.

Probably the best way to outline the methods which we believe should be used in selecting a system is to give briefly the methods we used in Wisconsin.

The first step in the layout was to select and place upon a map all roads in the state which, from the best available information, were the main lines of travel. These were studied very carefully, and another map was made showing a tentative system, including the most desirable routes but not exceeding the maximum mileage allowed by the statute. These highways were strategically located so that parallel highways were placed a reasonable distance apart, and so that the areas untouched by any road were approximately equal in territory of equal development. As a result of this very careful preliminary work, it was found that the tentative system coincided largely with that finally selected.

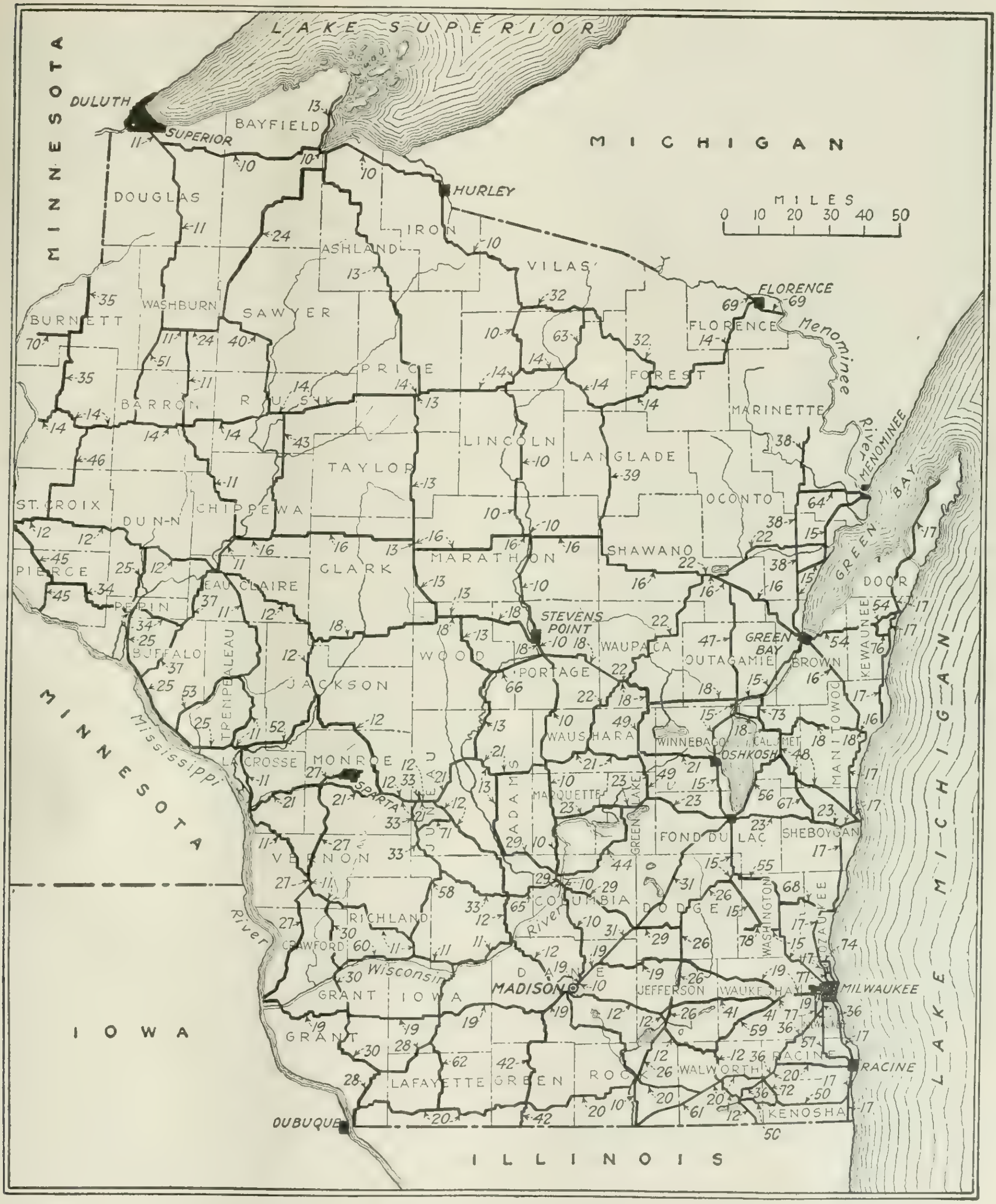
After this had been done our division engineers made a careful reconnaissance survey of all the routes on the map, together with competing routes, where such existed, and such other routes as seemed to them to be worthy of consideration. This survey was made by automobile; the division engineer, who drove the car, acted as observer, and was assisted by a recorder who kept a record of all features of the road by tenths of miles on a prepared pad sheet. The features recorded included the character and condition of the road and its surface, culverts, bridges, drainage, soil, the character of surrounding country, cheese factories, creameries, school houses, farm houses, mail routes, railroad crossings, turns, hills, bad conditions generally, and all other information of engineering and public interest. The actual mileage on the various routes was, of course, taken. By tabulating these sheets it was possible, in case of doubt between two competing routes, to get a very close idea of their comparative merit. It is unnecessary to go into further details of the methods used in this survey, especially since they have been described in various publications.

The cost of this automobile reconnaissance survey was about 80c. per mile of road. The accurate knowledge it gave us of the physical condition of each road was well worth the cost. Incidentally, in the later hearings we were often enabled to confound, with the extent of our precise information, local partisans who claimed not wisely but too well.

Hearing at County Seats

After all probable routes had been surveyed, hearings were held at each county seat. Large-scale maps showing the routes under consideration in the county and vicinity were displayed, and the advocates of all routes, especially the competing routes, received full opportunity to present their views. As evidence of the interest in the layout, most of these county hearings were attended by from three to six hundred persons and much valuable information was obtained. The important result, however, was that the people knew that all possible routes had been investigated and that the advocates of all of them had received a fair chance to be heard.

After a series of hearings covering a particular section of the state, the State Highway Commission and the legislative State Trunk Highway Committee, which sat jointly with the commission in many of these hearings, met at Madison and determined the official system



MAP OF WISCONSIN'S 5000-MILE STATE TRUNK HIGHWAY SYSTEM SHOWS ROUTES AND ROUTE NUMBERS

for that section. Important considerations in arriving at the final layout were the population served, the grades, the supply of materials locally available for construction and maintenance along the various roads, and the transportation facilities available where local materials were not to be had. In many cases the choice between competing routes was determined by the character of the soil over which the two passed. Where one road was largely on good clay soil, for instance, and the other lay largely in sand, the clay route was usually selected because of its greater ease of maintenance, and because, naturally, it usually served better farming territory. Wherever two routes of equal general value were in competition, the one which served the most local purposes was the one selected.

It is interesting to note that in repeated instances

routes entirely different from the ones formerly used were discovered and established with great advantage. Railroad grade crossings were avoided whenever possible, and by changing established routes we were able to eliminate dozens of grade crossings from the routes of through travel, without expending an extra dollar. Travel often gets accustomed to using a certain route and retains it long past the time of its superiority.

In laying out the 5000-mile system in Wisconsin about 7500 miles were surveyed. About five months were required by all the necessary operations, and the total cost to the state was approximateely $20,000, or at the rate of $4.00 per mile for each mile finally located on the system, including the cost of the final survey (described hereafter) made in the spring of 1918.

Condition of System

Maintenance was taken over by the counties under the general direction of the state on May 1, 1918, as required by law. As early as possible in the spring of 1918 a second survey of the lines as finally established, connected and numbered was made. This survey was for the twofold purpose of recording the condition of the highways by tenths of miles at the minute when state maintenance began, and for the second purpose of determining the location of the mile posts and patrol sections, the information to be placed upon the direction and danger signs, and their location, etc. This second survey was made in the same general manner as the first, but, due to experience gained in the first survey, it required less time, and, though probably more information was gained, the cost did not exceed 65c. per mile.

We feel that a condition survey is necessary at the exact moment when the maintenance of the system is begun—first, to obtain an accurate measurement of the system as finally laid out, and, second, to make a record of the exact condition of the system so that improvements made can be later registered and compared with the original condition.

We have worked out a system of progress reports using colored crayon and tack entries on charts and maps, so that the past and present condition of any section of the system and all structures on it can be determined at a glance. It is impossible to describe the details of this record system, but we shall later publish a full description after it has been fully developed.

Tabulation of the Condition Survey

A tabulation of this final condition survey (made as of May 1, 1918) shows that there were actually 4999 miles of road on the system subject to state maintenance. Of this 167 miles (3.34%) were deep sand; 2363 miles (47.29%) earth in good condition, 535 miles (10.70%) in poor condition; 1001 miles (20.02%) of good gravel surfaces, 126 miles (2.52%) of poor; 573 miles (11.46%) of good macadam, 102 miles (2.03%) of poor; 120 miles (2.40%) of concrete; and 12 miles (0.24%) of other superior surfacing (brick, sheet asphalt, etc.).

Roughly summarizing, we took over 702 miles (14.0%) of sand and poor earth roads; 2363 miles (47.3%) of good earth roads; 1706 miles (34.1%) of various surfacings in good condition, and 228 miles (4.6%) of various surfacings in poor condition. A road or surface was classed as "good" when it was in condition to be maintained by ordinary patrol methods, as "poor" when it required extensive repairs or reconstruction before it could be so maintained.

We also took over 9904 culverts, divided as follows: Concrete 4140 (42%); stone 1050 (10%); wood 1164 12%); steel and miscellaneous 3550 (36%), and 1951 bridges (water structures over six feet in span) divided as follows: Reinforced concrete 393 (20%); stone 199 (10%); wood 324 (17%), and steel and miscellaneous 1035 (53%). Culverts, therefore, averaged two per mile of road, and bridges 0.4 per mile of road.

There were on the system 617 grade crossings, 20 overhead crossings and 21 undergrade crossings with railroads and interurban railways.

It may safely be said that we took over "some job!"

(To be continued)

Engineering Education Affected by War Experience

Dr. C. R. Mann Discusses Future Changes Due to War Training — Effects Upon Academic Standards

SPEAKING before the Boston meeting of the Society for the Promotion of Engineering Education, Dr. C. R. Mann announced some of the results of war training methods and discussed the vital problems which now confront the engineering colleges of the country, suddenly relieved from the duty of handling the Student Army Training Corps and facing the necessity for getting back to a routine peace basis. Without attempting to go into details, he indicated the steps which he believes to be most likely to lead by experiment to sound conclusions. The principal points brought out by Dr. Mann follow:

On Apr. 10, 1918, 10,000 young men were called to the national service by the War Department and placed in schools for two months of intensive military and technical training. By June 15, 50,000 men were in training at 155 schools. This number was continued through the summer, and 25,000 men, prepared for service as technicians in the Army, were graduated each month. Before the signing of the armistice, 130,000 men had been so trained and contracts had been let for training 220,000 more.

Made Careful Survey of Army Needs

Before beginning this instruction, a careful survey was made of the needs of the Army, to determine the specifications for every job for which soldiers were to be trained. The shopwork was then planned to teach each man to do the particular job for which he was best adapted and for which he was to be held responsible in the Army organization. The instruction consisted of a series of projects carefully graded in difficulty and requiring for their accomplishment the exercise of ingenuity and resourcefulness.

In like manner, the humanistic work was designed to answer the many questions asked by the soldiers

concerning the issues of the war. The class work in these war issues courses was a continuous discussion of these questions, and it was accompanied by outside reading. Some 40,000 questions of soldiers were collected, sorted and classified, and a brief manual was issued containing the questions most frequently asked, together with references to documents in which answers might be found. Propaganda for any point of view was avoided, the men being helped to discover the facts which would enable them to draw their own conclusions. The course was given by the coöperation of all the best men in the different departments involved.

Technician Training Highly Successful

Military officers state that after two months of the combined training the men made as good progress as is ordinarily the case after two months devoted to military training alone in the cantonments. In the shopwork the men acquired skill and understanding of their problems at an amazing rate. Bank clerks, barbers, salesmen and others who had never worked with tools before have been converted into satisfactory technicians for Army use. The war spirit, the reality of the work, the progression from application to theory, and the snap of military discipline, have all joined in producing results that before the war were pronounced impossible by the schools.

In the experiment of training young men for officers' training camps in the Students' Army Training Corps in colleges considerable difficulty was developed in adjusting the military with the academic routine. Nevertheless, 85% of the schools have just expressed their desire to retain the system to the end of the present academic year. Unfortunately, this cannot be done, because the removal of the military necessity makes it impossible to utilize sufficient appropriations.

Reorganization of Industrial Production

The reorganization of industrial production is a task requiring a type of engineering ability that is at present very rare. It is the function of the technical schools of the future to develop men who can and will accomplish this intricate task. At present the curricula are not designed to secure this result, because their avowed aim is to impart knowledge of the laws of physical science and of the properties of materials. If we are to accomplish this task, we must add to this knowledge an understanding of the methods by which human wills are coördinated for team play, not only in individual organizations, but also in national enterprises.

The larger outlines of the coming industrial system are now emerging from the toil and turmoil of the war. When the war began everyone was certain that it could not last long, because the bankers would stop it. Now everyone recognizes that the fighting continued so long as adequate supplies of men and material were maintained. This means that national strength in war depends upon the production of men and supplies rather than on the financial system. Therefore engineering, not banking, is the foundation of democracy's power.

The war has also indicated the methods by which engineering schools can train engineers competent to meet successfully the heavy responsibilities that are now theirs. This experience seems to indicate that the following are the steps most likely to lead by experiment to conclusions of sound merit:

1. The War Department's experience with training soldiers shows that the first essential of effective teaching is a clear definition of the result desired. To place emphasis on production rather than on knowledge of the laws of physical science, new specifications of the essential factors will have to be written. This may be done from a study of the actual operations of engineers in productive enterprises, or by joint action of national engineering societies.

Knowledge Developed by Specific Tasks

2. The content of the courses and the methods of instruction must be organized in such a way that every fact presented and every problem solved is relevant or contributes obviously to the acquisition of some information or the development of some power required or mentioned in the specification. Knowledge is always specific and is developed best by mastery of specific tasks.

3. Real military training and discipline have been demonstrated to be an essential element in the training of every engineer. The purposes of the military machine are to keep men physically fit and to train them so that each willingly subordinates his own individual desires and efforts to a common purpose to be achieved by the entire group. Therefore careful consideration must be given to the question of how much military training is desirable, or what better substitute, if any, can be found to accomplish the same all-important results.

4. The Army has long recognized that soldiers are better fighters if they have an intelligent conception of the issues of the battle. This was inculcated by the war issues course. Would the introduction into engineering curricula of a similar course, dealing with the issues of peace, be the best method of solving this intricate problem for engineers? The humanistic needs of the engineer are not satisfied by the current practice of requiring several years of linguistic training and brief courses in modern history or economics. Would not a course in which the wealth of material in history, in literature, in art, and in philosophy was focused upon the modern burning issues of peace prove to be a most effective way of broadening the outlook of men who are specializing in the highly technical branches of applied science? In order to facilitate experiments along these lines, the War Department has arranged to supply the schools with materials dealing with the peace conference, the formation of a league of nations, and the reconstruction of our industrial system.

Rating and Testing Methods

5. The final large contribution of the war experience to educational practice has been made in the field of rating, testing and classifying men by objective methods. The Army test for general intelligence has been found a most valuable method of selecting and classify-

ing men for all sorts of Army work. In one hour's time this test yields results which correlate so highly with the results of many months of personal experience that all recruits are now required to take it when they enter the service. The War Department was about to require that all students in the Students' Army Training Corps take this test. The sudden demobilization of the corps necessarily interrupted this experiment, but it is believed that the schools will find it a most useful one to carry further.

The Committee on Education and Special Training, Washington, D. C., is prepared to supply the necessary blanks and instructions.

Objectve Tests as Incentives

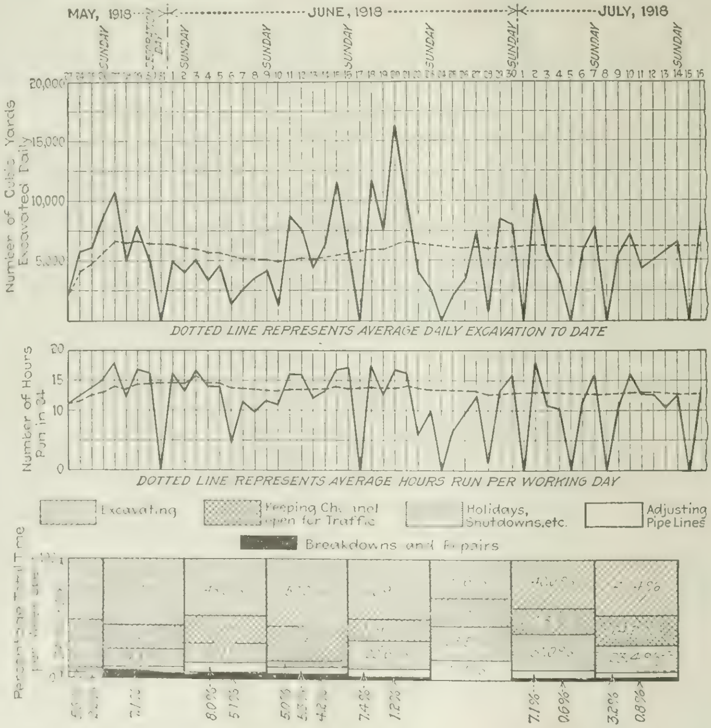
The use of tests as an incentive to good work and as a means of releasing creative energy has been recognized but little. Certain it is that students understand full well how to "get by" examinations as now given. On the other hand, the test of the football field commands their pro found respect, because it is an objective "show-down" in competition with men who are recognized as leaders. The new Army tests are also objective. They open to the schools great possibilities of using their testing machinery as an incentive to spirited work rather than as a sieve for misfits.

6. Perhaps the most striking fact of the War Department's experience with education is that the Federal Government was willing to spend $200,000,000 in one year on education. No such single appropriation for education was ever made in this country before. The reason is very simple. The national need was great, and the schools had proved by their training of soldier mechanics that they could be relied upon to meet the national need. The primary purpose of the training was that each individual might be better equipped, not to realize his own personal ambitions but to serve the nation more effectively. The experience points to the conclusion that the public is ready to spend unlimited funds on education, provided it is obvious to the taxpayers that t h e r e b y community, state, and nation are being effectively served.

Lehigh Valley Visualizes Performance of Dredge with Chart

To help him to visualize construction performances, G. T. Hand, chief engineer of the Lehigh Valley R.R., uses a chart of the type shown. This happens to be a performance record of a 20-in. hydraulic dredge working at Newark, N. J. It began work May 23 with three 8-hour shifts daily, and on the basis of 250,000 yd., the total estimated yardage to be removed, had 87.2% of the work completed June 30.

The chart is made on cross-section tracing cloth, from which blueprints can be made. On the left side, under "General Remarks," is a table, a few days of which are reproduced. On the right most of the same data are shown graphically by a series of diagrams, some of which are here shown. The use of different colors in the percentage diagram makes its meaning clear at a glance.



Date	Day	Cubic Yards Excavated Daily	Kind of Material	No. Hours Worked in 24		Average Yardage per Hour Worked	Total Excavation to Date	Percentage of Total Excavation Completed to Date	
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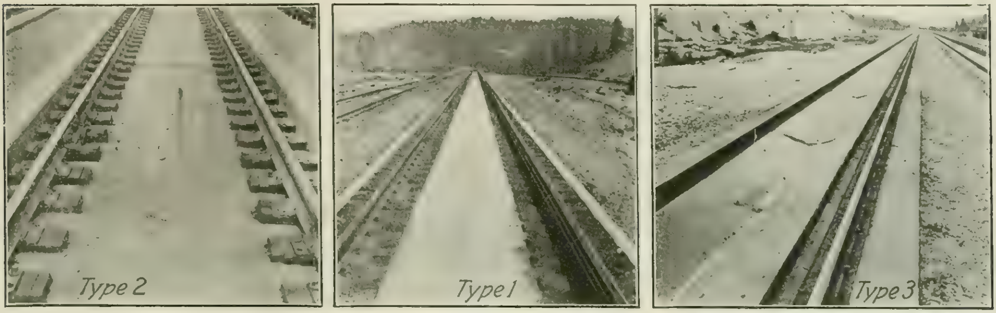
DAILY OUTPUT, TIME AT WORK, PROGRESS OF JOB AND OTHER DATA SHOWN BY BOTH TABLE AND DIAGRAMS

Concrete-Base Track Gives Good Results on Northern Pacific Railway

New Type of Construction Four Years in Actual Service—Concrete Slabs Built on Gravel Roadbed Have Wood Supports for Rails—No Ballast Used—Maintenance Work Not Continuous but Intermittent



NORTHERN PACIFIC RAILWAY IS EXPERIMENTING WITH CONCRETE-SLAB ROADBED DESIGNS

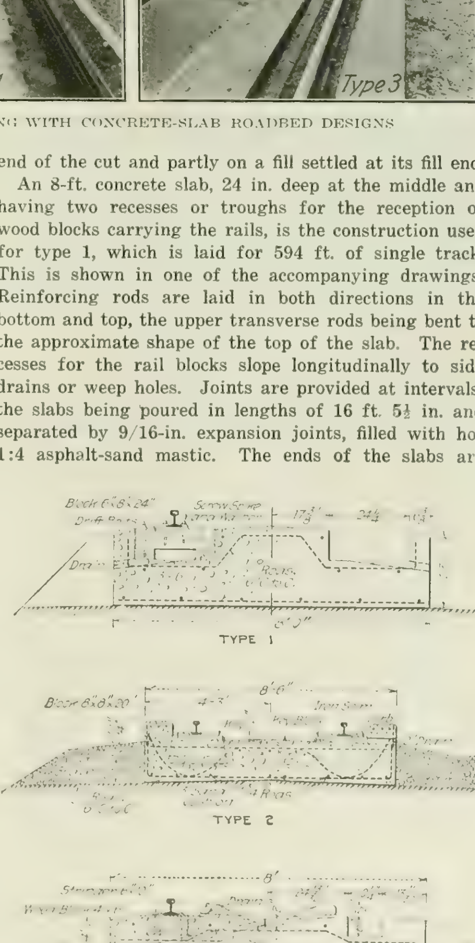
CONCRETE roadbed or base support for railway track on open line, as distinct from its use in tunnels and passenger terminals, has had its most extensive application on the Northern Pacific Ry., where a 2000-ft. stretch of double-track main line with concrete-slab roadbed and no ballast has been in service for four years, with results that are in general satisfactory so far as maintenance and cost are concerned. The experimental concrete-base track is on the line between Tacoma and Tenino, Wash., and was built by company forces in June-September, 1914, during the original construction of the line

This radical departure from the universal type of track and roadbed construction includes three variations of one general design. A continuous single-track concrete slab with wood supports for the rails is the basic feature of this design. Thus, resilience of track and cushioning of the rails are provided in all cases, and there is no placing of rails directly upon a rigid concrete base.

The live load used in designing the slabs was a 26,000-lb. wheel load on two ties, with 100% allowance for impact. Allowable compression and shear in the concrete were assumed as 250 and 50 lb. per square inch, respectively; tension in the reinforcing steel as 12,500 lb. Short transverse wood blocks in the slab form the rail supports in two designs, while the third employs continuous longitudinals or sills. In two designs, also, the slab is so shaped as to form continuous guards or curbs to keep the wheels to the track in case of derailment.

This new type of track construction is located in a long and wide gravel cut. The excavation was finished carefully to grade, so as to avoid backfilling, and after the surface had been well tamped the concrete was placed directly on this roadbed, bottomless forms being used. The material might be classed as fair gravel ballast, although a small proportion of clay led to its being abandoned for ballasting purposes. The settlement has been very slight, except that one slab at the end of the cut and partly on a fill settled at its fill end.

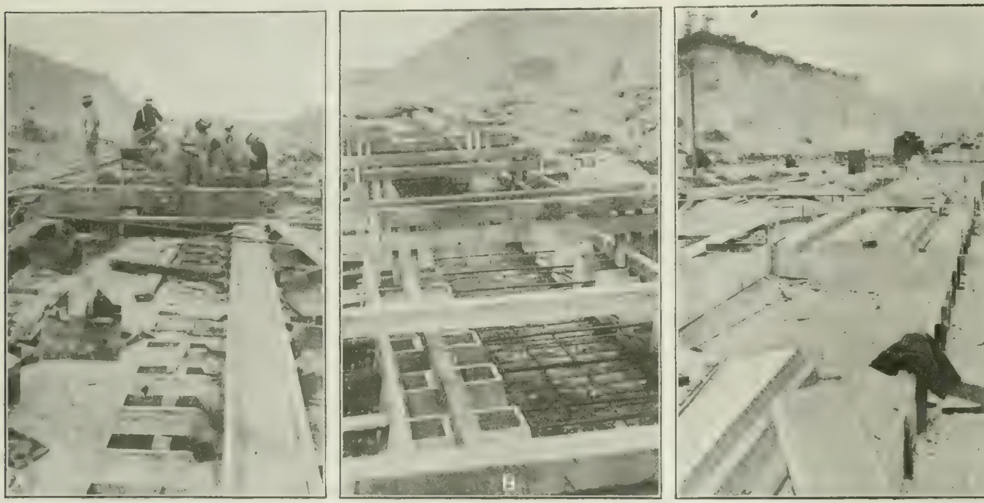
An 8-ft. concrete slab, 24 in. deep at the middle and having two recesses or troughs for the reception of wood blocks carrying the rails, is the construction used for type 1, which is laid for 594 ft. of single track. This is shown in one of the accompanying drawings. Reinforcing rods are laid in both directions in the bottom and top, the upper transverse rods being bent to the approximate shape of the top of the slab. The recesses for the rail blocks slope longitudinally to side drains or weep holes. Joints are provided at intervals, the slabs being poured in lengths of 16 ft. 5½ in. and separated by 9/16-in. expansion joints, filled with hot 1:4 asphalt-sand mastic. The ends of the slabs are



THREE TYPES OF CONCRETE SLABS FOR TRACK CONSTRUCTION ON THE NORTHERN PACIFIC RAILWAY

mortised 6 in. for a width of nearly 3 ft., in order to prevent independent lateral shifting.

Creosoted fir blocks having their tops flush with the top of the slab form the supports for the rails. They do not rest directly on the concrete, however, but each line of blocks is laid on a pair of creosoted fir sills. The purpose of the latter is to afford additional cushioning and anchor the blocks both as to position and as to line and surface. They also allow more convenient replacement than would be the case if the blocks were cast into the concrete slab. Each block is driftbolted to the sills. The blocks are spaced 16¾ in. on centers, except that at the rail joints this spacing is reduced to 11 in. Standard 90-lb. 33-ft. Northern Pacific rails are laid on steel shoulder tie-plates and fastened to the wood blocks by screw spikes with clips which rest on the tie and rail base. The rails are laid with square joints, spliced with four-bolt 24-in. angle bars.



CONSTRUCTION WORK ON CONCRETE SLABS. A. PLACING CONCRETE; IRON POCKET FORMS AT LEFT. B. WOOD FORMS AND STEEL RODS IN PLACE. C. ALTERNATE SLABS ARE POURED

Concrete curbs or parapets on the outer edges of the slab are distinctive features of type 2, as shown in the drawings. This also is laid for 594 ft. of single track. The slab is somewhat wider, 8½ ft., on account of the curbs, but is only 16¾ in. thick at the middle. Its curbs are 8 x 11½ in., with drain holes at intervals. In this case the slab is in lengths of 32 ft. 11 in., with 1-in. expansion joints filled with asphalt mastic. The width of mortise is only 28 in. Separate pockets instead of continuous troughs are provided for the creosoted blocks. Each block rests on a 3-in. cushion bed of sand in the bottom of the pocket and is secured by a wedge or key block driven at its inner end.

Lining and gaging of track are provided for by malleable iron shims set between one end of the block and its pocket. One of these shims is L-shaped, with its top resting on the block and secured by a small nail. In the face of this is a horizontal opening to receive additional shims, as shown in one of the detail drawings. The track construction is similar to that previously described, except that the blocks at the joints have the same 18-in. spacing as the others, while deep bridge plates carry the rail ends over the space between the ties. Pockets have to be made in the surface of the concrete to clear the webs of these plates. Rails are laid to break joint 12 ft. They are laid on hook-shoulder tie-plates, and secured by cut spikes on the inside, while screw spikes fasten the plates to the wood blocks. Gravel ballast is laid along both sides of the slab as a protective covering for the roadbed.

Sand filling is used in the pockets to afford additional cushioning and to provide means of adjusting the track to line and surface in case of settlement of the slabs or wear of the rail. However, it has been decided to use in resurfacing a bitulithic filling, partly because the slabs have reached a final settlement and partly to exclude water from the pocket. Presence of water in these pockets has caused the sand to pump or shift with the movement of the blocks under traffic, so that it will be necessary to resurface this strength of track shortly. Scarcity of labor has delayed this work.

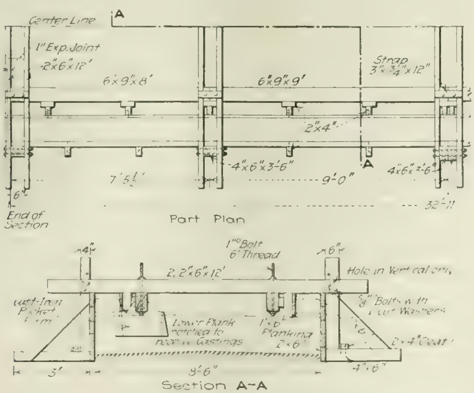
To surface track of this second type, the inside key blocks are removed on a length sufficient for a day's work, and the rails, with tie blocks attached, are jacked up high enough for working. The sand is then removed from the pockets and any water also removed, after which the bitulithic mixture is placed to a depth of about 3 in. and leveled to the grade necessary for a true surface of the track. The blocks and rails are then lowered upon this bed and the keys are replaced. Traffic may be allowed to pass over the track as soon as this is done. The operation may be repeated if necessary, until the track is in proper surface.

Longitudinal timber supports for the rails and inside curbs or guards on the slab are the characteristics of the third and longest of the three experimental stretches of concrete track construction, which extends for 810 ft. of single track. The slab

is 8 ft. wide, dished on top to form a drain between the guard ribs or curbs, and having a depth of 18 in. at the middle. With the guards on the inside, or between the rails, the width of slab can be made less than where they are on the outside, as in the second design described. In this third design the slabs are in lengths of 16 ft. 5½ in., separated by ½-in. expansion joints filled with hot asphaltum. The ends of the slabs are straight and butted together, instead of being mortised.

Creosoted fir timbers 6 x 10 in. form the longitudinal bearings for the rails. To prevent them from shifting or creeping they are fastened at intervals by long lag-screws driven into wood anchor blocks which were embedded in the slab when the concrete was poured.

No tie-plates are used in this case, the rails being laid directly upon the longitudinal timbers. There has been very little wear of the wood under the rails, however, and this does not exceed ⅛ in. in depth. It varies on individual timbers and increases slightly at the joints, but in most cases it amounts simply to compression of the surface fiber. The fastenings are screw spikes whose heads bear directly upon the rail base, no clips being used. To support the rear side of the spike head, and thus afford reinforcement against lateral thrust, a crescent-shaped washer is used, placed with its ends fitting against the rail base. Creeping of the rails upon the longitudinal timbers has been found to occur, although the track is heavily anchored and the timbers themselves do not creep. For this reason it

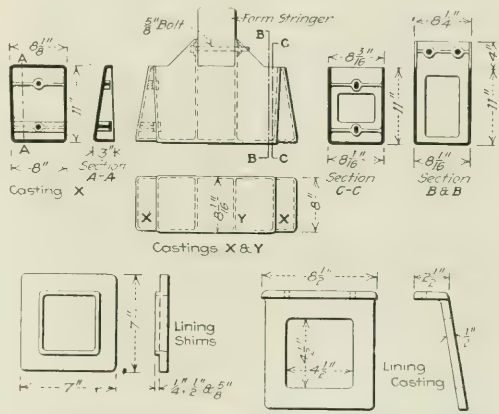


FORMS FOR SLAB OF TYPE 2

has been necessary to cut the longitudinals at intervals and apply rail anchors, which bear against the cut ends and thus prevent movement of the rails.

Preparation for the construction of concrete roadbed for the second design, with the slab laid directly upon the roadbed, consisted in dressing the subgrade to specified shape and placing the side forms. These were braced by outside brackets, as shown in one of the drawings. The side forms were connected at the ends and at intermediate points by transverse members, each consisting of a pair of planks carrying saddles with suspension bolts for a pair of stringers to which the forms for the inside of the curbs were attached. These stringers were placed after the slab reinforcement was in position.

The pockets for the tie blocks were made by means of cast-iron forms, the outer surface of the metal being rough-ground sufficiently to give a surface that would draw readily from the concrete. All surfaces of wood and of castings that would come in contact with concrete were cleaned and soaped before each pouring.



IRON FORMS FOR POCKETS IN SLAB AND IRON SHIMS FOR RAIL BLOCKS

Each pocket form consisted of three parts, the two smaller end pieces being wedge-shaped to give the dovetailed form of the pocket. These parts were fastened together by thumbscrews, and the main or central casting had lugs for a horizontal bolt by which it was fastened to the wood stringer of the top form.

To remove the forms, the nuts on the stringer suspender bolts were run up to allow the raising of the cross pieces 4 in., these pieces then being secured in this new position by bolts through the tall posts of the side forms. After the side blocking of the curb had been removed and the thumbscrews had been released, so as to free the main part of each pocket form, the nuts on the suspender bolts were screwed down carefully. This raised the stringers and pulled the castings vertically out of the slab. The side castings of each block were then taken out, and were attached to the main casting at once to prevent their loss and make the form ready for use again.

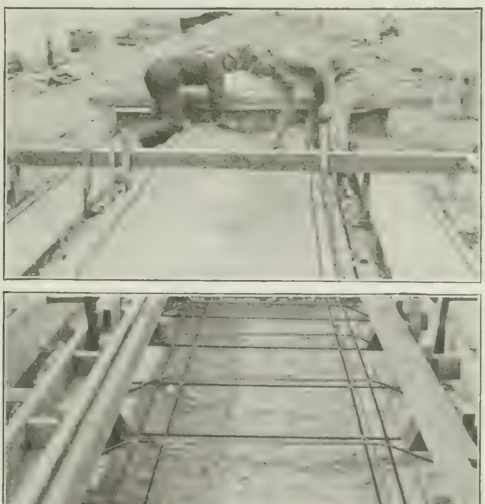
The concrete was a 1:3:5 mix, gravel of ¾-in. to 1½-in. size being used for the coarse aggregate. It was made wet enough to fill out the forms and get a good bond with the reinforcement, but at the same time care was taken to avoid such an excess of water as would interfere with the float-finishing of the top surface. At the rail-joint locations, the concrete between three of the pockets was troweled out to clear the bridge plates, the drain holes being lowered correspondingly. The pocket form castings were withdrawn as soon as the concrete had set sufficiently, and were never allowed to remain in place more than 24 hours. The roadbed was sprinkled to prevent absorption of water from the concrete.

To place the track 3 in. of sand was put in each pocket. The rail blocks were set on this, the key blocks being omitted. Then the plates and rails were placed,

but the rail spikes and screw spikes were omitted. A heavy engine was run back and forth along this track until all the blocks were thoroughly settled into place, relining and resurfacing being done where necessary. Then the inside key blocks were driven. If this did not make the rail blocks tight, the iron lining pieces were placed on the outside. Finally, at each tie-plate the two screw spikes were driven to hold the tie-plate, and a cut spike was driven to hold the rail. The method of resurfacing and of replacing the sand with a bitulithic filling has been noted above.

It is asserted that each of these three types of concrete roadbed and track construction has given satisfactory results, although some minor difficulties have developed. These difficulties have been mainly in regard to creeping of rails. In the light of practical experience, it is understood that certain changes would be introduced in any future construction of the system. No extension is contemplated. The traffic averages six passenger and five freight trains each way daily.

As to the cost, the engineers explain that from the way in which the work was done, in three short pieces, the first cost cannot be taken as applying to construction on a larger scale. The service has been too short for any definite figures as to the labor and cost of maintenance. There is very little difference in the maintenance of the different types, but the type having the rails supported on timber longitudinals maintains the best surface and line. It is said that all of the three



FORM WORK AND FLOAT FINISH FOR ROADBED

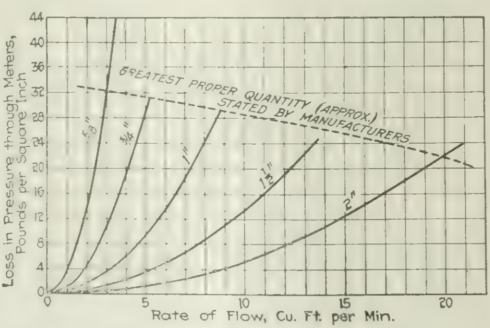
designs of concrete support give a more smooth-riding track than the adjacent tracks having crossties and ballast. The maintenance cost has been very slight so far, probably only 5% of that for the adjacent tracks of ordinary type. From the character of the new construction it is evident that expenses for maintenance and repair are likely to be concentrated at intermittent periods rather than distributed evenly year by year.

This track experiment with concrete base was initiated by W. L. Darling, who was chief engineer at the time the new line was built, in 1914. The designs were prepared by the engineering staff and have not been patented. The service performance of the track has been under the observation of L. M. Perkins, engineer maintenance of way (now corporate engineer) and H. E. Stevens, chief engineer, Northern Pacific Railway.

Water Meters Should be Selected with More Care

Loss of Head Varies Greatly with Different Makes—Right Choice Saves Money—Plumbing Adjustments Help

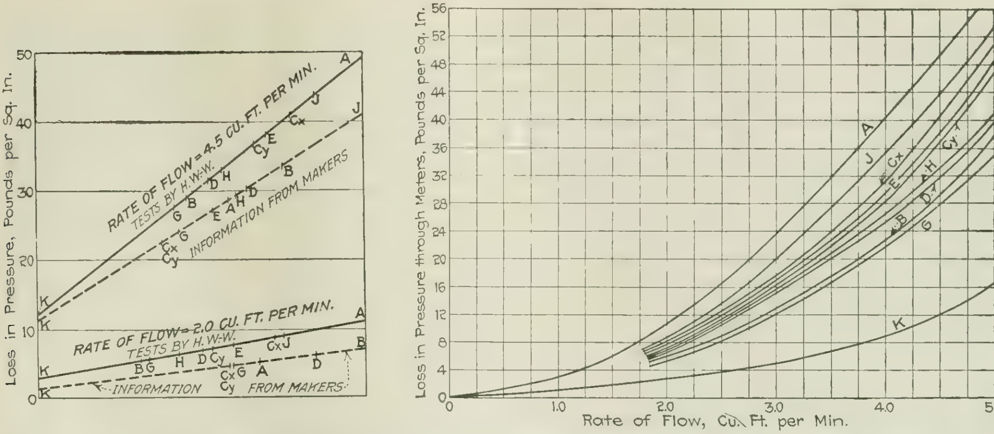
NEED for more care in choosing the sizes and types of water meters to be used under various conditions of service was shown in a paper by Caleb M. Saville, chief engineer of water-works, Hartford, Conn., in a paper read Nov. 14 before the New England Water-Works Association. Numerous diagrams and tables were presented. These were based on studies and actual tests of meters made at Hartford under the direction of Mr. Saville, as well as upon information supplied by meter manufacturers. A considerable part of the paper, and many of the tables and diagrams, dealt with special studies of rates of flow in service pipes, for which an automatic rainfall register was adapted to serve as a recording mechanism, by an electrical connection with the counter of a water meter. The adaptation was made, at Mr. Saville's suggestion, by J. E. Garratt, office engineer of the Hartford water-works. The paper will be published in the *Journal* of the New England Water-Works Association. A sum-



MANUFACTURER'S RATING OF LOSS OF HEAD IN ⅝- TO 2-INCH WATER METERS OF SAME MAKE

mary is given here of the portion of the paper relating to the selection of water meters.

Before taking up his main subject, Mr. Saville called attention to the apparently inevitable increase in the rate of water consumption, which should be taken into account in choosing the size of the meter to be installed. At the same time, Mr. Saville also pointed out, careful design of plumbing, including the choice of fixtures using large quantities of water in a short time, such



LOSS OF HEAD IN ⅝-INCH STANDARD WATER METERS OF VARIOUS STANDARD MAKES

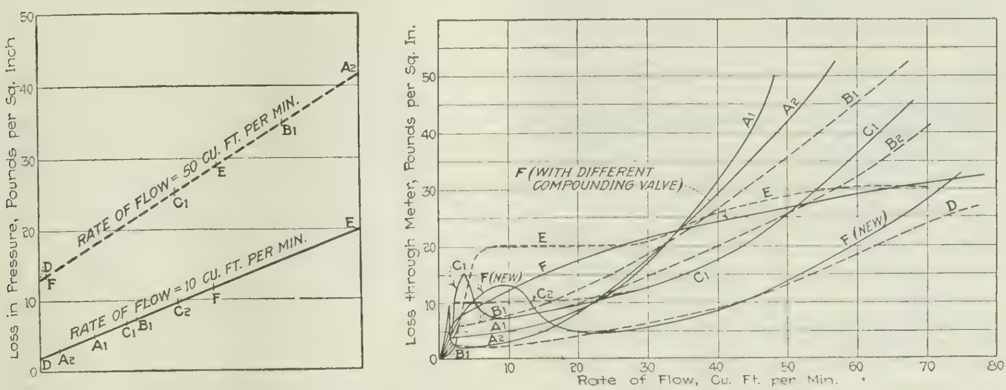
For high and for low constant rates of flow on the left, as tested by makers and by Hartford water-works, and on right, for varying rates of flow, as tested at Hartford

as water closets, and also including the size of service pipes and of large rising pipes leading to the class of fixture indicated, might be far more economical in the longer run than the use of larger meters; that is, he urged in effect that it may be cheaper to reduce loss of head by using larger supply pipes than to effect the same end by putting in larger meters, due to the well known fact that the cost of meters, particularly of the larger sizes, increases out of all proportion to the mere increase in the size of diameter of the meter.

At the beginning of his paper Mr. Saville said:

"So far as accuracy of registration and durability go, there seems little to influence the choice between any of the meters now put on the market by the half dozen or more reputable manufacturers. As regards loss of head, however, meters of different makes now on the market show considerable variation. It easily may be that a smaller meter of one make, therefore of less cost, will do the work as efficiently as a larger and more costly meter of a different make."

Taking the manufacturers' assertion that the proper rate of flow for a 1-in. disk meter is about 8 cu.ft. per minute, and the manufacturers' rating of loss of head per square inch for different makes of meters, it appears that at the rate of discharge mentioned one make of meter loses 19 and another 31 lb. per square inch of pressure. A 1-in. meter of the first make would therefore perform the required service as well as the 1½-in. meter of the other make, at relative costs of $20 and $40. Using similar data and reasoning, a 3-in. compound meter costing $160, of one make, would be just as satisfactory in point of loss of head or volume of water passed with a given loss of head as a 4-in. meter of another make costing $260. Although the difference in cost between ⅝-, ¾- and 1-in. meters is less than between the larger sizes, yet many more meters of the smaller sizes are used than of the larger, so that great economy might result to the water department by choosing the make of meter which gave the lowest loss of head. In addition, Mr. Saville said, "consumers are



LOSS OF HEAD IN VARIOUS MAKES OF 3-INCH COMPOUND WATER METERS

For constant rates of flow on the left, as tested by makers and by Hartford water-works, and on right, for varying rates of flow, as tested at Hartford

much better satisfied with service that gives them the best possible results in the operation of their modern plumbing fixtures."

After presenting and commenting upon the diagrams and tables showing variations in the rate of flow through meters on different classes of service, as determined by connecting a rain-gage recorder with a water-meter counter, as already mentioned, Mr. Saville said:

"The conditions shown above, and the expressed opinions of specialists in water consumption matters, indicate plainly that the time has come when more attention should be given to the design of meters, with a view to greater accuracy on low flows and less friction on the high ones, even if the cost of the meter is increased thereby. Also, it appears that too much 'tolerance' in meter design should not be permitted by water departments, especially where water is filtered or pumped and every unnecessary gallon sent to the distribution system means not only waste of water but increase in the annual cost for maintenance and operation. The compound meter was a long stride toward more accurate accountability on those services where there are intermittent calls for large quantities of water. What now seems to be needed is redesign of present meter mechanism, or a new water-measuring device for use on services now covered by disk meters 2 in. and less in size which will give more accurate measurement of small flows, with less loss of head at the larger rates."

Pre-Assembly System and Efficient Erection Cranes Speed Up Shipbuilding at Ecorse

Pre-Assemoly is Extending Rapidly in Lakes Yards—Reduces Erection Labor on Hull—Thorough Application at Ecorse Helped in Making "Crawl Keys" Record

PRE-ASSEMBLY of ship parts has been developed as a special feature by the Ecorse yard of the Great Lakes Engineering Works. It is given main credit for the remarkable achievement may by the yard recently in launching the 3500-ton ocean-going steamer "Crawl Keys" after 14 working days and completing it in 29. C. E. Baisley, superintendent of the Ecorse yard, said: "We believe that the secret of speed in building ships is to assemble as many parts and as large sections as possible, off the berth. Without this assembly we could not have built a boat in 14 working days."

Efficient ship-erection plant contributes essentially to rapid shipbuilding at Ecorse. The berth layout and the type of crane used result in direct, short-distance travel of the material to the ship—a factor in developing full efficiency of the crane and reducing time loss on the berth.

Originally, pre-assembling of material on the building berth was developed in connection with the building of the ore steamers typical of the Great Lakes fleet. The design of these steamers is especially adapted to this method of construction, and the Ecorse plant was laid out with this end in view and has been operated accordingly since its foundation. Typical ocean vessels, however, are not as well adapted to pre-assembly as lake ships, and therefore on the first of those built for the Emergency Fleet program, the method was not carried as far as it might have been. On the later ships, however, the pre-assembly method has been extended as far as was possible with this type of ship.

Increasing attention is being given to pre-assembly at all the Lake yards. The inevitable assembly of the plate-girder members in the ship's bottom—keelsons and floors—and of web frames and the like, before they are placed in the ship has not heretofore called for any particular system of special facilities; but with great extension of pre-assembly, well planned facilities for it are important. Many of the yards have been hampered, in applying pre-assembly, by lack of storage space for fabricated material and lack of assembly space close to the ship. This condition is being remedied in new berth layouts. At the Wyandotte (Mich.) yard of the American Shipbuilding Co. a special building for the assembly work has just been put in service—a new and radical improvement. The Manitowoc Shipbuilding Co. is erecting a similar shop in its yard at Manitowoc, Wis.

It has been almost universal practice hitherto to use the fabricating shop only for punching, countersinking and rolling, and to carry out all the sub-assembly work on floors, frames, stringers and the like in the open, even on parts of the berth space during the early stages of the ship erection. When the work must be so scattered, and especially when there is no space for finished storage alongside the ship, full development of pre-assembly is discouraged. But since the present shipbuilding rush made it increasingly clear that large advantage could be gained by extending pre-assembly to a maximum, all the yards have worked consistently forward in the direction of increasing the amount of their pre-assembly.

Frames Assembled With Sheer-Strake

At Ecorse the erection-crane arrangement furnishes space for assembly and finished storage at the same time. Mainly due to this condition, the development of pre-assembly at this yard came about quite naturally.

As regularly practiced now at Ecorse, pre-assembly covers the following principal items: Floors, web frames, bulkheads, coal bunkers, poop and forecastle decks, hatch sections, hatch girders, breeching, deck houses, foundations, tunnel, transom, keelsons, stringers, and frames (bolted up in groups with the sheer-strake). Further assembly possibilities depend upon the particular type of ship under construction.

Assembly of sets of frames with the sheer-strake is a distinctive Ecorse procedure. It saves a large amount of labor, both in crane service and in fitting up and bolting on the ship. A length of the upper side plate, or sheer-strake, 24 ft., is assembled with its twelve frames,

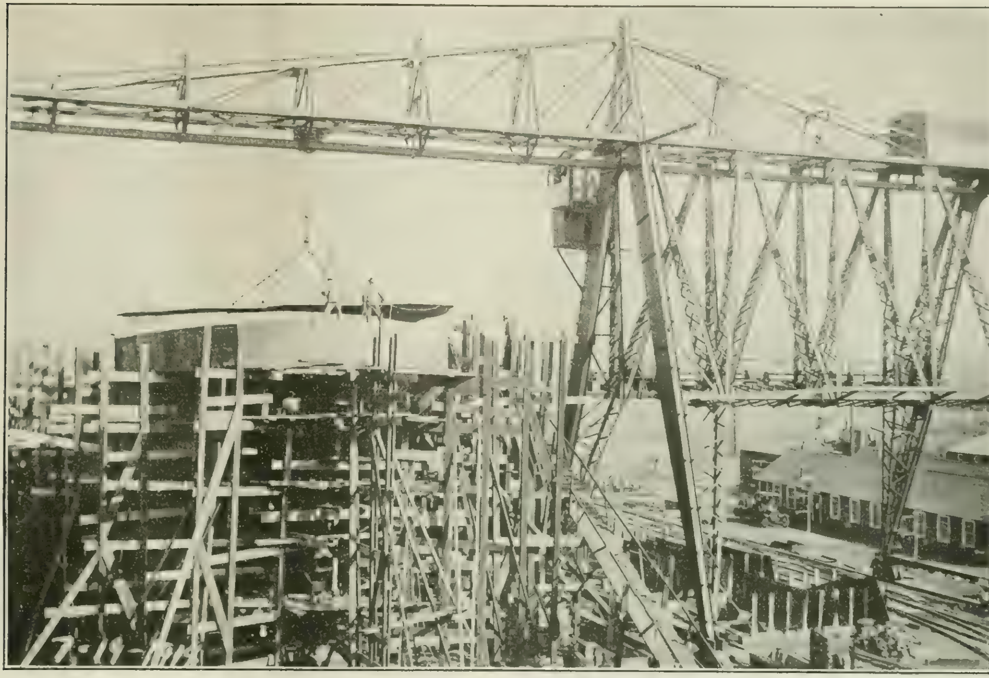


FIG. 1. ASSEMBLY OF LARGE SECTIONS AT ECORSE—POOP DECK BEING SET AS A UNIT

each frame being tacked to the plate by a few bolts. Usually, all the frame sections for the middle body of the ship are made ready in advance, and piled close by the ship (Fig. 2). Only a single handling is required for swinging such a section to place, so that the framing of the ship can be built up rapidly to the stage where plating can proceed. While the process of frame assembly does not reduce the amount of riveting on the ship, it simplifies the erection work to such a degree that it may be considered the outstanding feature of ship erection at Ecorse.

Both speed and economy of shipbuilding are served by pre-assembly. With steel and labor shortages affecting the yard operation and with the shop capacity limited (under single-shift working) to a supply of 400 tons monthly to each berth, the gain in speed is not a vital factor in getting maximum production, but it proves valuable when delays in erection occur on individual berths and must be balanced up. Economy and simplification of the yard system are every-day advantages, however.

Laid out along the sides of slips about 800 ft. long extending into the yard area at right angles to the shore line, the eight shipbuilding berths at Ecorse occupy one full pier and two half piers, down which the ship material is transported from the fabricating shop lying along the head of one of the slips. Side launching is used, as in all the Lakes yards, the berths running parallel to the sides of the piers. Each berth is about 80 ft. wide, and its full width is covered by the cantilever arm of a gantry traveler (Fig. 1), running on a track just back of the berth and parallel to it (longitudinal to the pier). The space between the gantry rails, 60 ft. wide, is used for assembly and finished storage.

An average case of arrangement of material and assembly work alongside the building berth is diagrammed in Fig. 3. A standard-gage track near the rear rail of the gantry track enables locomotive cranes and material cars to reach any part of the berth length, so that a single handling is sufficient to place material in storage directly opposite the point where it is required in the ship, or where it is to be assembled. Plate racks and storage for floors, frames and the like are provided in part of the space between the track rails. The rest of the space is left free for assembly.

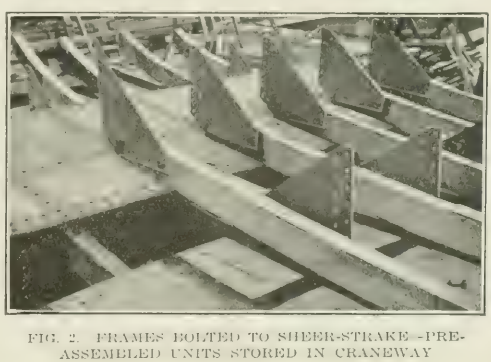


FIG. 2. FRAMES BOLTED TO SHEER-STRAKE—PRE-ASSEMBLED UNITS STORED IN CRANEWAY

Contrasting with the arrangement described, several other Lakes yards of the pier-and-slip type have narrow piers, the berths being separated only by a traveler track or trestle. Ship material must be brought from the head of the pier at the time it is wanted for erection; there is no room for storing fabricated material close to the berth. The Ecorse layout, by providing such storage, reduces the tax on the cranes and equalizes the demand on the fabricating shop, thereby tending to avoid delays in erection. On the other hand, it requires a greater pier width.

Cranes of adequate lifting capacity and speed and in sufficient number are necessary if pre-assembly is to be utilized most fully. For the Ecorse work, cranes of 10 tons capacity are desirable, in the opinion of the yard officials. The heaviest assembled parts in the ships now being built do not exceed about eight tons. Fast crane motions also are important with pre-assembly, because the advance preparation of material enables a greater tonnage of material to be erected for a given amount of berth labor.

Under the demands of rush work in emergency shipbuilding, the need for increased crane equipment has made itself felt quite generally. Until recently the

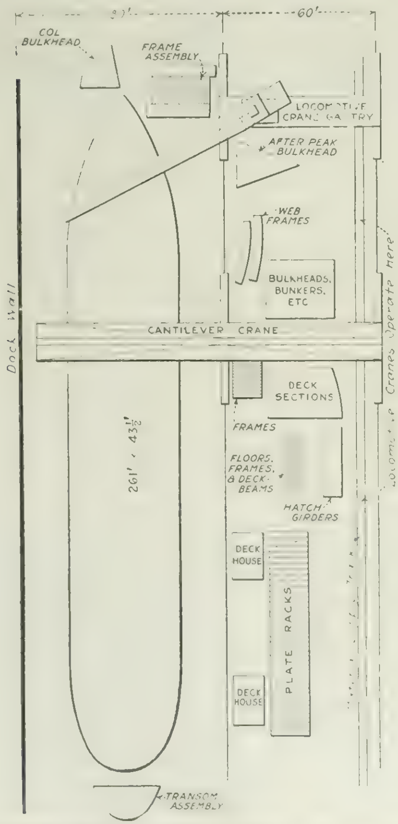


FIG. 3. FABRICATED MATERIAL STORED AND ASSEMBLED IN BAY BETWEEN CRANE TRACKS

Ecorse yard had only the gantry cantilevers shown in Fig. 1, there being one crane per long berth (for 600-ft. ships), now occupied by two of the short berths for ocean-going ships. When it came to be recognized,

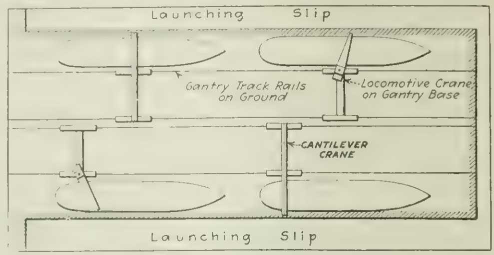


FIG. 4. REVERSED PLACING OF LOCOMOTIVE CRANES ENABLES BOOMS TO REACH ENDS OF PIER

early in the present year, that the crane capacity was inadequate for taking care of the maximum rate of supply of material or for handling it fast enough for the most rapid work on the shipbuilding berths, a second crane was ordered for each runway. The cantilevers had proved entirely satisfactory in their 12 years of service, but for the new machines locomotive cranes mounted on gantry substructures were selected because this was the only type that could be delivered within a reasonable time. The substructures were built by the Russell Wheel & Foundry Co., Detroit; Orton & Steinbrenner locomotive cranes with 75-ft. booms were mounted upon them, at the end facing the berth. The boom can reach over the entire width of the building berth and also over the space covered by the gantry. Covering a wide area by slewing, the crane has distinct advantages for pre-assembling, the management states.

Both the cantilevers and the locomotive cranes have a lifting capacity of seven tons (the cantilevers at 40-ft. reach, the locomotive cranes at 50-ft. reach). The hoisting speed is 80 to 90 ft. per minute, and the travel speed 250 ft. per minute.

The gantry track rails are carried on stringers at the ground level, and do not interfere with the free handling of material. A pair of trolley wires about 8 ft. above the rear rail furnishes 250-volt direct current to a pair of contact-trolley wheels attached to the gantry leg.

At present the output of the Ecorse yard, with eight berths, is two ships per month. This means about four months' normal building time per boat, from keel-laying to launching. What fixes the rate of output of the yard is the general balance of yard facilities, all of which are adjusted to the present production of 20 to 24 ships per year. Expansion of the yard in its various departments has been in progress continuously for the past two years. Further expansion is now going on, chiefly in great enlargement of the fitting-out dock and warehouses and in improvement of the general facilities of the yard.

In common with all lake shipyards, the Ecorse plant was designed primarily for building the larger lake ships, in which each unit has three to four times the tonnage of steel required in the small ocean-going

ships now under construction. On the other hand, the propelling machinery, cabins and other equipment items are little more for the large ship than for the small one. When the yard facilities are applied wholly to the present type of small ship, therefore, and the number of ships corresponding to a given yearly output of fabricated steel is greatly increased, excessive demands are placed on the engine and boiler shops and on all departments of the yard outside of those connected with hull construction. This is the reason underlying the expansion of shop and other facilities at Ecorse as well as at all the other lake yards.

The work on the ocean-going ships being of a new kind, the attainable rate of speed in construction was a matter for gradual development. The record work on the "Crawl Keys" resulted in the attempt to show how far the possibilities of ship erection could be carried.

Ship Built in Fourteen Working Days

Conditions at the Ecorse yard early in July made the attempt at a speed record in shipbuilding appear timely. The plans for such an attempt had been laid some time before. Though the Lakes had been the most active ship producers in the United States for months past, the shipbuilders of the district felt that their work had not received the same recognition as the records in rapid erection made on the Pacific Coast and on the Delaware. Ecorse was two ships ahead of its schedule; a temporary steel shortage had developed, and, while the berth schedule might be disarranged for a time, the total production for the year would not be cut down by centering all effort on one ship. One pair of berths, served by two cranes, was in such condition that both cranes could be concentrated upon one of them.

On July 11 the keel of the "Crawl Keys" was laid. Pre-assembled parts were already largely completed, and the problem in hand was simply that of quickest possible erection. Figs. 5 and 6 show the ship on the second and fifth days. The progress during the first week, while the main structure of the ship was going up, is summarized in the following notes:

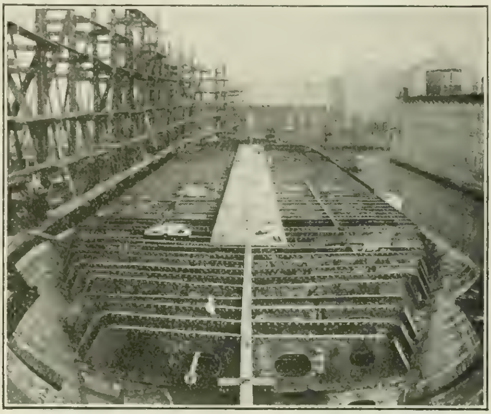
July 11, vertical keel, all floors and the rider plate placed, and transom assembly started adjacent to the stern. July 12, water-side scaffolding erected, stem and stern posts set, margin plate, collision bulkhead, and lowest strake of the side plating bolted up. July 13, part of tank top plating and after-peak bulkhead set. July 15, bunkers and breeching, frames aft, and transoms erected. July 16, engine-room bulkhead, midship and bow frames and sheer strake placed, and tank top completed. July 17, most of deck beams and hatch coamings erected, and shell plating and deck completed, including the pre-assembled poop deck.

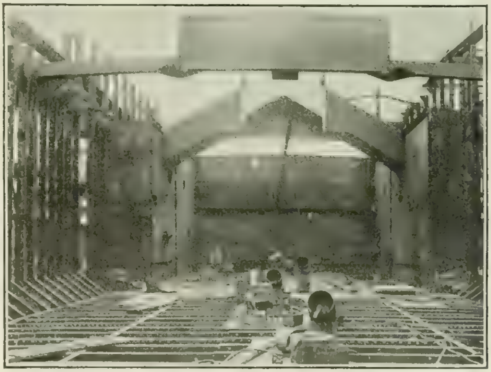
July 11	127 tons	day gang only
July 12	160 tons	dag and night gangs
July 13	56 tons	day and night gangs
July 15	51 tons	day gang only
July 16	140 tons	day and night gangs
July 17	81 tons	day and night gangs
July 18	100 tons	day and night gangs
July 19	117 tons	day and night gangs
July 20	85 tons	day and night gangs
July 22	25 tons	day gang only
July 23	58 tons	day and night gangs
July 24	16 tons	day and night gangs
July 25	5 tons	day and night gangs
July 26	32 tons	day and night gangs
July 27	19 tons	day and night gangs

The tonnage of steel erected during the work is shown by the tabulation in the preceding column.

On July 27 the vessel was launched. By that time 200,000 of the 270,000 rivets in the ship had been driven. This means that 100,000 rivets were driven per week, or 17,000 per day, on the average.

Night shifts were worked regularly, but the night force at no time exceeded half the day force. The greatest number of men at work on the ship while on the stocks was 493, the day before the launching. During the entire building period the day force averaged 320 and the night force 135. Up to 26 riveting gangs worked on the day shift, and seven on the night shift. Though two cranes were available, most of the work was done with the cantilever, as the locomotive crane broke down soon after starting.





FIGS. 5 AND 6. THE "CRAWL KEYS" DURING THE SECOND AND FIFTH DAYS OF ERECTION

Fig. 5—Material placed by one crane in day and a half. Fig. 6—Coal bunkers and bulkhead are five erection units

Fitting out proceeded at the same high-pressure rate as the work on the building-berth. Two days after the launching the boilers were set in the ship (Fig. 7); only 33 days after the keel laying the ship was completed and accepted, and the next day it steamed away in charge of a United States Shipping Board crew.

Two features of the punch shop contribute to over-all efficiency: Usually large raw-steel storage, and frame joggling or offsetting as a substitute for using liners under the plating. None of the other Lakes yards follow the practice of joggling, but at Ecorse it is regular practice. In the view, Fig. 8, the joggled floor flanges may be seen. A single joggling press in the punch shop is able to take care of all the work.

FIG. 7. SHEER LEGS DROPPING BOILER INTO SHIP EIGHTEEN DAYS AFTER KEEL WAS LAID

As the advantage of joggling lies partly in cost saving and partly in a reduction of weight of the vessel, resulting in increase of the cargo-carrying capacity (by 50 to 60 tons in the 3500-ton ship now building), it is worth notice that the Ecorse authorities report no delay or other interference due to joggling. Superintendent Baisley goes so far as to say, "a joggler is the best thing in a shipyard; we wouldn't be without it." A maximum performance of 3000 joggles in eight hours has been made by the machine, but a more usual high figure is 2600. This is on tank-top angles, which can be run through the machine by hand. Channel frames, requiring the use of chain falls while passing through the press, are slower. Three men are required at the machine, but the working costs are said to be well within 10c. per joggle. Liners under the shell plating would cost at present prices about 40c. for material and 10c. to 15c. for fitting and punching, or at least 50c. per liner, as against 10 to 15c., the cost of two joggles.

At the joints of the shell plating, tapered liners are used, as in other Lake yards; no scarfing is done. These liners are usually forged, but at Ecorse they are shaped by rolling in a small pair of eccentric rolls.

Back of the punch shop an area about 150 x 500 ft. is devoted to raw-steel storage. It is spanned by a gantry bridge, traveling parallel with the punch shop. This space is used largely for storage of plates in racks, or material intended for immediate use in the shop. Back of this is an area of five to six acres, every foot of which is reached by locomotive crane, and this is used for general storage of plates and shapes.

The advantage of large storage area is supplemented by direct routing of material through the shop. Plates and shapes pass in a straight line from storage to the loading track at the front of the shop, and thence the fabricated material is transferred by car to any of the berths, going down the track under the ship-erection gantries to be unloaded at the point of use.

A force of 2000 on day shift and about 450 on night shift is the present complement of men at Ecorse. This force is not fully up to requirements, say the officials of the company, and 400 to 600 competent men could be used in addition. There is a limit to the number of inexperienced workers that can be absorbed in a given time, and as men are leaving continuously the work of increasing the force is slow.

No ship erection is done at night, except in special cases like that of the "Crawl Keys." The working time is 10 hours day (7-12, 12:30-5:30) and 12 hours night (6-12, 12:30-6:30).

For riveting 76 gangs are available, or an average of nearly 10 per hull. This means that the hulls which are in their maximum riveting condition have 25 to 30 gangs each, driving about 60,000 rivets per week in each hull. About 15 of the gangs are on night shift, doing usually only pre-assembly riveting. The stock of air tools includes about 120 riveting hammers, 50 to 60 chipping and calking hammers, and about the same number of reamers.

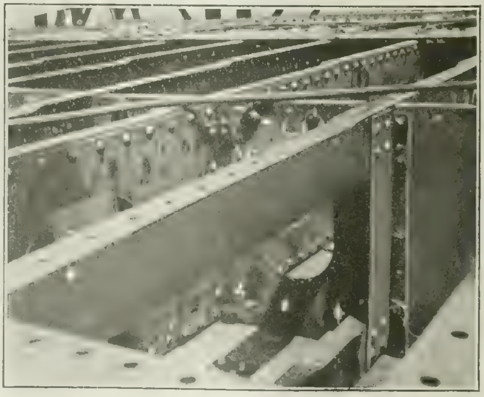


FIG. 8. JOGGLING USED TO REDUCE NUMBER OF LINERS

Air is supplied by 4 two-stage vertical 3000-ft. compressors. Two horizontal machines of 2500 ft. capacity are being added, which will make the total capacity 17,000 cu.ft. of free air per minute—a supply ample for the service required at the present rate of output.

Of the new yard facilities now being built, two items of special note are of interest: A large cafeteria and a new fitting-out dock. The cafeteria, 60 x 270, will be able to feed a large part of the working force.

A timber bulkhead wall 1000 ft. long is being constructed along one side of the yard, forming the side of a wide dredged slip. On the dock will be a crane track of 20-ft. gage, founded on piles, to carry a locomotive crane tower. A 15-ton crane on this tower will handle all the fitting-out except placing boilers and engines. These two items will be cared for as heretofore by the yard shear-legs at the river front.

Waterproofed Floors for Railway Crossings Over Streets

Grade-Crossing Work Makes Severe Demands—Troughing Unsatisfactory—Concrete Slab Floor—Various Methods of Sealing Concrete to Girders

By H. T. Welty

Engineer of Structures, New York Central Railroad, New York

IN RECENT years the waterproofing of the floors of railroad bridges carrying ballasted tracks has received considerable attention from engineers. This is partly due to the increasing numbers of grade-crossing-elimination and track-elevation projects, in which it is necessary to make railroad bridges over city streets as nearly water-tight as possible, and partly to the desirability of protecting from corrosion the steel in the floors, especially in bridges subject to the effect of brine from refrigerator cars.

Prior to about 1905, practically all of the floors of ballasted bridges with which the writer has had experience were of the trough type. The bottoms of the troughs were covered with what was known as "binder," composed of $\frac{1}{4}$-in. gravel or sand mixed with asphalt paving composition or coal-tar pitch, in the proportion of 1 cu.ft. of the former to $1\frac{1}{2}$ gal. of the latter. The binder was sloped up on the sides of the troughs, and down along the bottoms of the troughs to drainage nipples. The ties were placed in the troughs on ballast, the base of the rail generally being $1\frac{1}{2}$ in. to 2 in. above the top of the upper trough cover plates, or sufficient to clear the rivet heads. The troughs were generally about 16 in. wide.

Trough Floor Found Objectionable

This type of floor was very objectionable, because of difficulty in tamping the ties, and in cleaning and painting the insides of the troughs above the binder, and because the floors generally leaked, although the binder generally gave excellent protection to the steel.

About 1906 it was decided to substitute a membrane waterproofing sheet for the binder, as shown in Fig. 1. The trough type of floor was retained, although the design was varied occasionally. So-called saturated burlap was first used for the membrane, this being afterward combined with felt; it was finally discarded in later designs for a membrane consisting entirely of saturated felt, due to the fact that it is practically impossible to saturate burlap, with the result that any moisture which gets to the burlap is drawn into its strands and ultimately rots them. This design was more effective in waterproofing the floors, but was not entirely satisfactory in this respect. Leaks of greater or less magnitude occurred at various points, these being especially noticeable along the webs of the girders.

The other objectionable features of a trough design remained. In fact, a trough floor can hardly be defended except where a very shallow floor depth is necessary.

The desirability of obtaining a smooth surface upon which to lay the waterproofing and the ballasted track led to the use of a floor consisting of transverse I-beams spaced 15 or 16 in. apart and riveted to the girders, with a continuous $\frac{7}{16}$-in. plate deck riveted to the top flanges as shown in Fig. 2, or with a reinforced-concrete deck about 4 in. thick where sufficient floor depth was obtainable, as shown in Fig. 3.

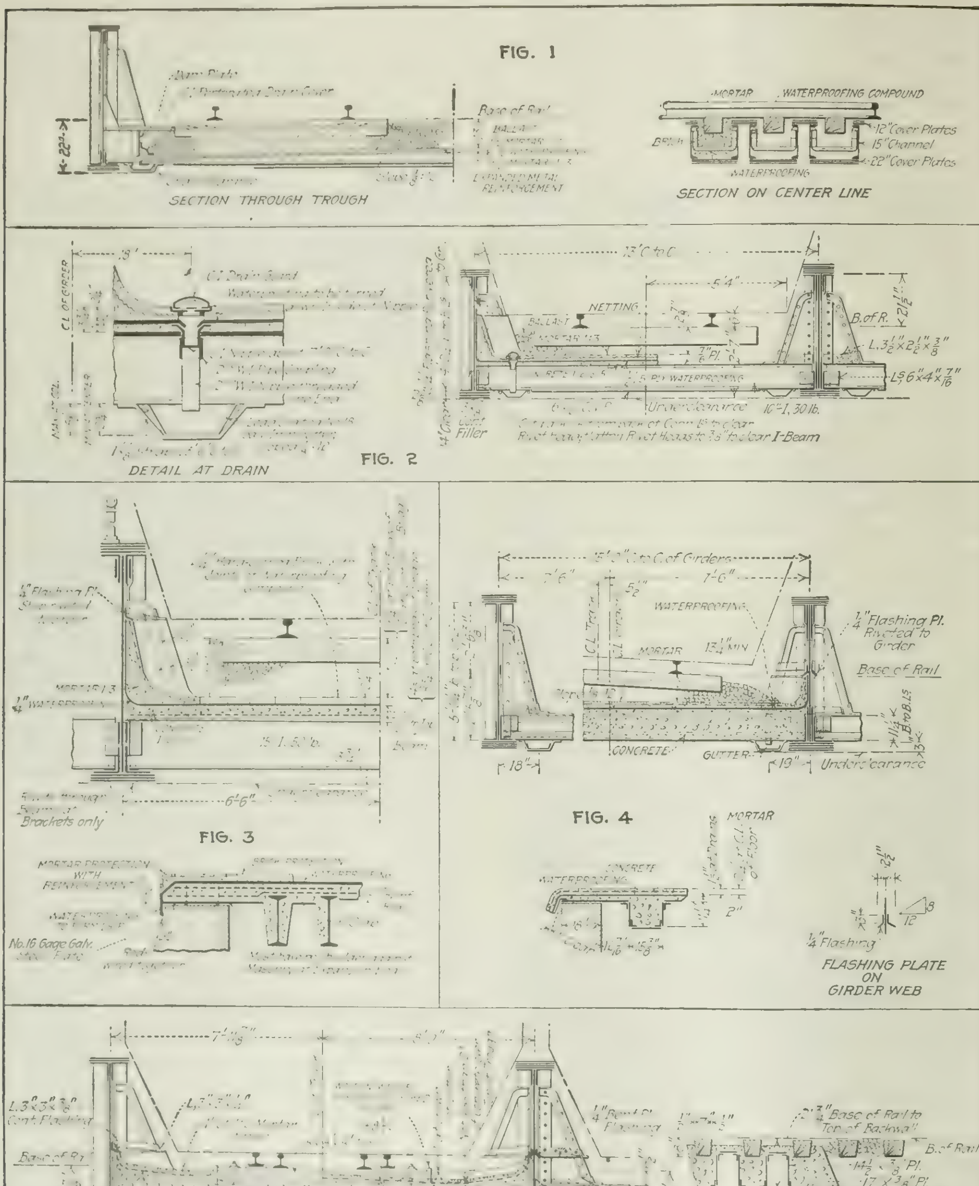
In several instances, where the available floor depth was not sufficient for the designs shown in Figs. 2 and 3, but was greater than that of the ballasted trough design shown in Fig. 1, a trough floor with concrete filling was used, as shown in Fig. 4. This design, while it gave the advantage of a smooth surface to be waterproofed, developed leaks along the girder webs. Such leaks were probably due, partly at least, to the flexibility of the troughs.

These designs produced floors which were much easier to waterproof, were more nearly water-tight, and effectively protected the steel in the floor from corrosion. The waterproofing membrane of the earlier designs of this type consisted of five layers of saturated felt. lapped 2 in. at the joints, the middle layer being usually reinforced with a cotton cloth backing. The waterproofing material used in cementing the various layers of felt was in some cases straight-run coal-tar pitch and in other cases asphalt. The membrane was protected by a $1\frac{1}{2}$-in. to 2-in. slab of mortar, reinforced with wire netting, where the work was done without interference from traffic, or by brick where the work was done under traffic. The waterproofing membrane was carried up the sides of the girders to the top of the rail, and the protection mortar was finished under a flashing course, consisting of bent plates riveted to the webs of the girders.

This type of floor proved fairly satisfactory but was never absolutely water-tight. Some of the objectionable features were as follows:

1. The bent-plate flashing was very expensive and difficult to fabricate in such a manner as to make neat finishes. The difficulties in this regard were especially noticeable where stiffeners and floor brackets were encountered.

2. Deflection of the floor under load has a tendency



EARLY TYPES OF WATERPROOFED SOLID FLOOR FOR RAILWAY BRIDGES OVER STREETS

Fig. 1. Trough floor with membrane waterproofing. Fig. 2. Steel-plate floor. Fig. 3. Reinforced-concrete slab floor. Fig. 4. Trough flooring filled with concrete. Fig. 5. Ties embedded in concrete floor-filling

to separate slightly the concrete and waterproofing from the girders, permitting water to work down the webs of the girders and causing unsightly discoloration on the bottom flanges. Such points seemed generally to be the most pronounced sources of leaks.

3. Where the structure consisted of two or more spans, such as a crossing over a street with columns on the center line of the street or on the curb lines, reverse bending over the supports invariably opened up joints and produced leaks over the columns.

Another type of floor similar in character to the above, and quite extensively used where the spans were not too long, consisted of beams placed longitudinally instead of transversely, thus eliminating the necessity for side girders. As a rule, such a floor is more nearly water-tight than the one with transverse beams and longitudinal girders. In fact, there seems to be no reason why such a floor should not be absolutely water-tight, if proper materials are used for waterproofing, if these materials are properly placed, and if the drainage slope to the nipples is sufficient to carry off the water.

Good Track Obtained Without Ballast

In some cases, where the floor depth obtainable has been too small to permit the use of a floor with a smooth surface, and troughs have been necessary, the expedient of filling the troughs with concrete, embedding the ties in the concrete, thus eliminating ballast, has been used. This design is illustrated in Fig. 5. The ties were creosoted and securely bolted to the concrete filling. No waterproofing, other than filling around the ties with asphalt or pitch, was used. It was thought that the water would flow off the surface of the concrete to the drains with sufficient rapidity to prevent leakage. This proved to be the case, generally, in single-track bridges where it was possible to get good drainage slopes; but in double-track bridges, where the surface of the concrete between tracks was necessarily nearly level, the water did not flow away rapidly and many leaks appeared, the water finding its way down through small cracks in the concrete. This design has been criticized on the ground that tie renewals would be difficult. With creosoted ties, however, renewals should be infrequent and it is thought that the work can be done without great difficulty. Bridges with such floors have been in service for about seven years, and seem to be satisfactory so far as the track is concerned.

Concrete Carried to Top Flange of Girders

The high cost of bent-plate flashing along the webs of the main girders, and the unsatisfactory results obtained with this detail, led to the type of floor shown in Fig. 6. The floor brackets were kept small, and the concrete base upon which the waterproofing was to be laid was carried up to the underside of the top flange of the girders, entirely incasing the brackets and stiffeners, thus providing a perfectly smooth trough the full length of the bridge; this simplified greatly the work of applying the waterproofing. The concrete base along the sides of the girders was reinforced with rods run through holes punched in the girder stiffeners and the floor brackets, and the mortar protection over the waterproofing was carried up flush with the outside edges of the girder top flanges, leaving the top of the flanges exposed.

In one bridge of this type, consisting of five tracks with girders between the tracks, one track was waterproofed with five-ply saturated felt and coal-tar pitch, three tracks with five-ply saturated felt and asphalt, and one track with two-ply saturated cotton drilling and asphalt. Few leaks have been discovered in this bridge, and these are of rather minor importance. After the concrete had set it was found to have shrunk slightly away from the girder flanges, leaving a very small opening into which water finds its way during driving rainstorms and ultimately works down along the girder webs at points where the waterproofing membrane was not carried up tight against the girder flanges. The floor on which the cotton drilling was used showed practically no leaks. This is attributed to the fact that drilling is very pliable and can be thoroughly worked into corners without danger of tearing, thus making a perfectly tight job possible.

Experience With Concrete Extended Over Girders

To overcome the possibility of leakage under the top flange of the girder, the type shown in Fig. 7 was tried. This design is practically the same as that shown in Fig. 6, with the addition of a waterproofing sheet over the top flange, carried down and flashed over the main waterproofing course terminating under the flange. The concrete protection over the girder flange was made about 6 in. thick and was reinforced to prevent cracking.

The first bridge of this type consisted of two spans, which introduced the problem of caring for the reverse bending over the columns. To prevent cracking of the concrete and a possible tearing of the waterproofing over these supports, some flexibility had to be provided. At the same time, it was desired to keep the waterproofing sheet continuous. The concrete base was separated along a plane passing through the center lines of the columns and the abutting ends of the girders, by means of a tar-paper joint. The waterproofing membrane was then given a fold immediately over this joint, which provided a little flexibility. A joint was also provided in the protection mortar over the joint in the concrete base, and this joint was filled with expansion-joint cement. The waterproofing sheet on this bridge consisted of two layers of saturated cotton drilling and asphalt waterproofing compound.

An inspection of the bridge after it had been in service about one year showed no signs of leakage whatever, either along the girders or over the columns, and it is believed that a water-tight bridge has been secured.

The construction shown in Fig. 7, besides giving very efficient waterproofing results, also protects the top flanges of the girders which usually require considerable painting maintenance. The concrete coping formed by the girder capping gives a pleasing appearance to the bridge as seen from the side.

Where the span is long and the girders are deep, it would be rather expensive to adopt this design, because of the excessive weight of the concrete base along the girders. It is thought that in such cases fairly satisfactory results could be obtained by turning the water

proofing membrane into a groove along the webs of the girders, then filling the groove with expansion-joint cement and grooving the top of the protection mortar, filling this groove also with the cement, as shown in Fig. 8. The grooves would be somewhat above the elevation of the top of the rail.

There are, of course, many other types of waterproofed floors of railroad bridges, some of which are simply modifications of those mentioned, and others designed to meet some special condition. One of the latter, designed to meet a shallow-floor-depth requirement without the use of the old trough type, is shown in Fig. 9. This floor, while fairly satisfactory, proved defective so far as waterproofing was concerned. During the first winter in which the bridge was in service the ballast froze solid. When the ballast started to thaw in the spring, water forced its way through shrinkage cracks between the protection concrete and the flanges of the channels forming the top cover plates of the floor-beams and diaphragms, and thus down back of the waterproofing.

Success Depends on Several Factors

In the writer's opinion, the success of a waterproofed bridge floor depends upon the design, the workmanship in laying the waterproofing sheet, and the materials used, the relative importance of each being in the order given. If the design is defective, the result will probably be unsatisfactory, no matter how excellent the workmanship and materials may be. On the other hand, a good design may be spoiled by poor workmanship in applying the waterproofing. With a good design and good workmanship, probably any of the better kinds of waterproofing materials will be satisfactory, although some have inherent qualities, not possessed by others, which tend to produce the results desired.

Based on experience with various types of waterproofed bridge floors and on various kinds of materials, it is the writer's opinion that observance of the following points will be conducive to good results:

Suggestions for Design

Floors should be made as deep as possible, so as to avoid excessive deflection.

Pockets and projections in the surface to be waterproofed, such as are presented by a trough floor, or by floor brackets, stiffeners, etc., should be avoided. In other words, the surface to be waterproofed should be as smooth as possible.

Joints between concrete and steel, such as are formed by finishing the mortar protection against the webs of girders or under the top flanges, should be avoided. The concrete or mortar always shrinks slightly in setting, forming small openings at such joints through which the water finds its way. If such joints are necessary, grooves should be formed and filled with an elastic expansion-joint cement such as is used in sealing joints in vault lights.

The slope of the waterproofed surface should be made sufficient to drain off the water rapidly. A nearly level surface, or one in which pockets have been formed, will hold water which will ultimately find its way through the waterproofing, unless the waterproofing has been perfectly applied. If the span is short and the floor depth sufficient, the water may be drained directly over the backwalls. If this is impracticable, scuppers along each side, draining into gutters and downspouts, will be necessary. Scuppers and drainage nipples should be made of ample size to prevent freezing and thus sealing the openings. Downspouts should be provided with clean-out plugs.

Care should be taken to prevent the seepage of water between the tops of backwalls and the under side of the floor resting on the backwalls. This is generally done by flashing the floor down well below the top of the backwall, and this is generally sufficient if the fill behind the abutments is of porous material. Another design which has been used consists of a line of tile drainpipe back of each abutment at about subgrade elevation, draining into a catchbasin located between tracks and made accessible through a manhole. The catchbasin is drained in the most convenient manner to a sewer, if one is available.

At points of reverse bending, such as those over columns of bridges over streets, a flexible joint should be provided, if possible. In skew bridges this is likely to be difficult, but if it is not done leaks of greater or less size are almost sure to occur.

Important Precautions as to Workmanship

The finished surfaces of the concrete and mortar should be as smooth as possible, with a uniform slope to drains. The concrete should also be made dense.

In heating the waterproofing compound, care should be taken to avoid overheating. This is especially to be observed in the use of coal-tar pitch, which has a high percentage of volatile constituents. Coal-tar pitch which has been very much overheated becomes brittle like glass when cold, and in this condition is worthless as a waterproofing material.

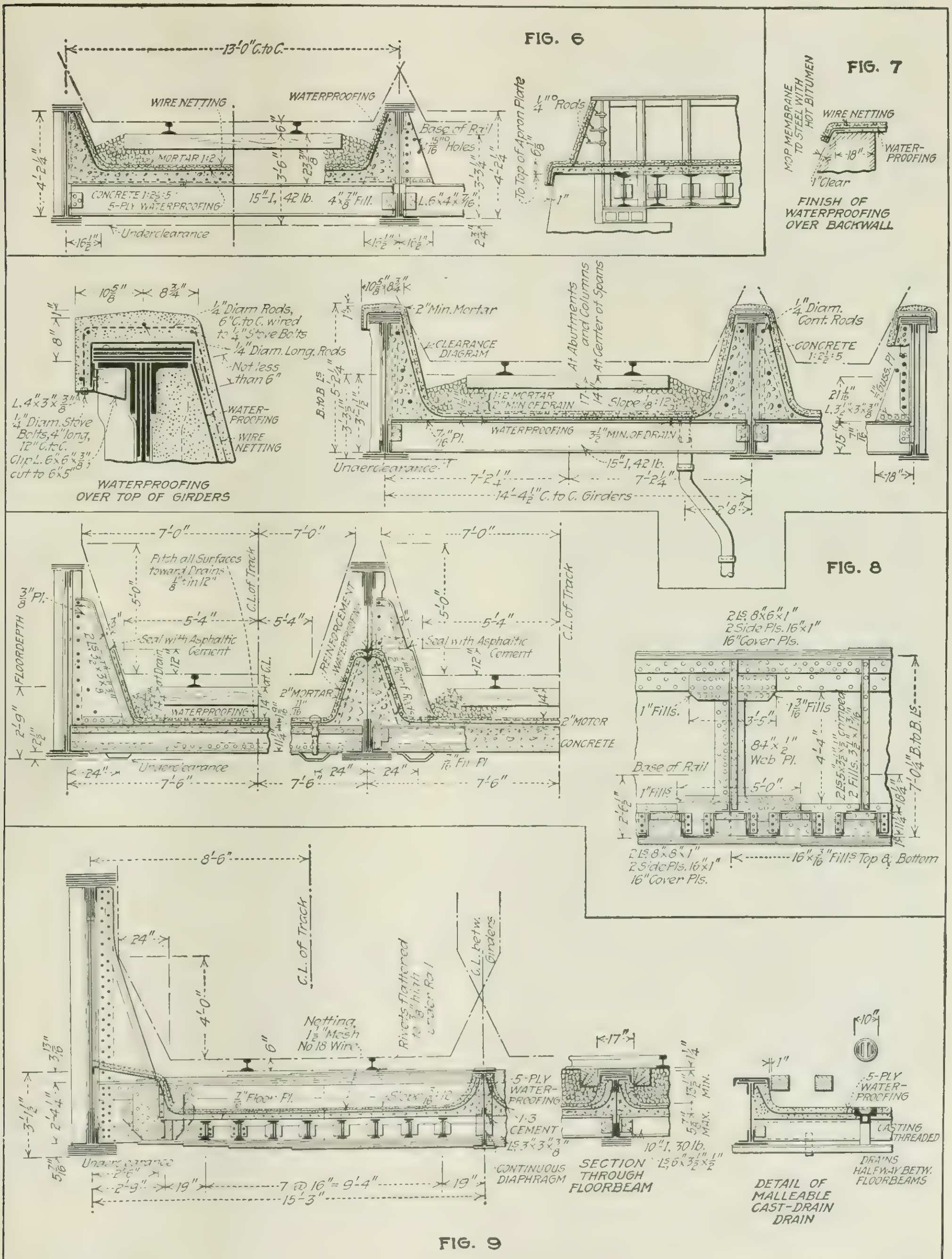
The membrane sheets should be laid perfectly smooth, with all wrinkles pulled out, and should fit snugly into all corners. They should be laid in hot compound, so as to secure a thoroughly cemented blanket. Sufficient compound should be used to cover entirely the surface upon which the membrane is to be laid. Unless the swabbing is carefully done, the surface will be porous, or full of spots not covered by the compound. This is especially true where the compound is applied directly to a concrete surface.

The sheets of membrane should be lapped at least 2 in. at joints, with joints thoroughly cemented, and with the sheets flashing in the direction of the natural flow of the water.

The Waterproofing Materials

The compound should be not only impervious to water, but also unaffected by water, mild acids and brine. It should remain elastic at as low a temperature as possible, and at the same time not flow at a moderately high temperature, such as would result from the direct rays of the sun. It should be perfectly stable, so that deterioration will not occur with age.

The membrane should be one which can be thoroughly saturated, has considerable tensile strength, and is tough and flexible. In the writer's opinion, cotton drilling fills all requirements for a good waterproofing



FOUR RECENT DESIGNS OF SOLID FLOOR USED IN GRADE-CROSSING ELIMINATIONS

Fig. 6. Floor concrete carried up to girder flange. Fig. 7. Waterproofing and concrete extended over top of girders. Fig. 8. Concrete protection kept below top flange and sealed to web. Fig. 9. Special design for a shallow floor

membrane better than any material yet put on the market. This material may be obtained saturated either with asphalt or coal-tar pitch. It is more expensive than felt, but in view of the fact that the cost of waterproofing is usually relatively small as compared with the total cost of a bridge, the excess cost of cotton drilling is warranted by its superior qualities. Good results have been obtained with a two-ply sheet of cotton drilling, whereas five-ply felt is generally used. On this basis the total cost of waterproofing with a membrane of cotton drilling should be little, if any, greater than that of waterproofing in which a membrane of felt is used.

So-called "integral waterproofing" has not been mentioned, as it is thought such material would not be very effective in connection with a structure subject to considerable vibration and possible cracking of the concrete, such as a railroad bridge.

Dumper at Sewalls Point Handles Two Cars at Once

New Facilities of Virginian Railway at Coal Pier Near Norfolk Also Include Cars of 120 Tons Capacity, and a Long Incline

A DOUBLE car dumper, with pier cars of 120 tons capacity and an elevator to raise them to the top of the pier, has been added to the facilities of the coal pier of the Virginian Ry. at Sewalls Point, near Norfolk, Va. They supplement a single dumper, pier cars of 60 tons capacity and a barney incline from the dumper to the top of the pier, installed in 1909, when the pier was built (see *Engineering Record* of Feb. 5, 1910, p. 148) and increase the capacity of the plant from 1500 to 3000 tons per hour. The operation of the pier is the same as before, the pier cars for both dumpers running out to the end of the pier by electric power on the outside track and returning down the inclined center track.

The double car dumper is the first built to overturn two ordinary road cars at a time. It is 94 ft. long between end posts. The car rails are carried on a movable platen which rests on rollers in the bottom of the cradle —or, in fact, two platens, end to end, one for each car. When the cars are on the dumper the platens are moved laterally until the sides of the cars come securely against the side of the cradle for support. When the two cars are of about the same width it is not necessary to uncouple them, but when they are of different widths the two parts of the platen can be operated separately. Eight clamps are operated independently by counterweights which travel in guides at the rear of the machine. They are so spaced that they engage various lengths of cars and are automatically adjustable to any height or width of standard railway car.

The machinery for rotating the cradle is located on top of the main structure, where it is free from dust and accessible for repairs. After the cars have been properly placed on the cradle, the rotating mechanism is started and the cradle with the cars is revolved until the cars are inverted to an angle of 20° with the vertical. The clamps as well as the cradle are counterweighted, this facilitating the return of the cradle to its former position.

Coal dumped from two cars end to end is distributed over a maximum length of about 88 ft. This is much greater than could be gathered in the hopper of a transfer car, which in this case is about 51 ft. In order that all the coal from the road cars shall be properly discharged into the transfer cars without resort to a concentrating chute, which would at once result in an extreme drop of the coal, two steel apron conveyors are provided, each about 8 ft. wide and 34 ft. long, supported horizontally in a portal frame in front of the car dumper. A clear space of about 36 ft. is left between the conveyors, which form a portion of the bottom of a hopper into which the road cars are dumped. The longitudinal center of the conveyor is located directly over the center line of the transfer-car track. With this arrangement all the coal that falls on the conveyors is transferred horizontally and discharged into the transfer cars.

Two 275-hp. motors, designed to work on a direct current of 550 volts, operate the cradle, working through four drums geared by three reductions of cut spur gears.

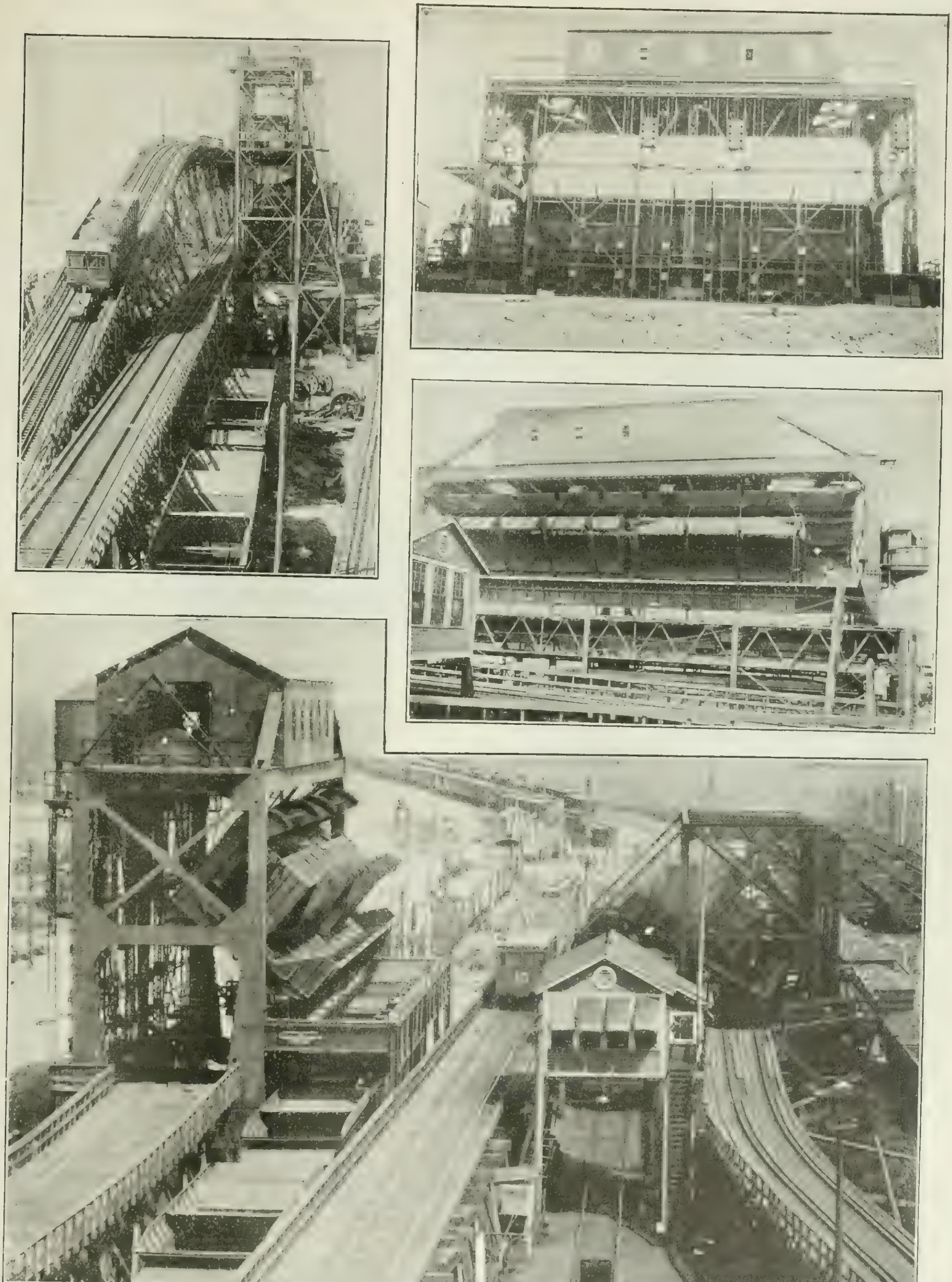
As the cradle is rotated the contents of the car are gradually discharged over the edge of the apron plate, into the receiving hopper which carries the conveyors. This hopper, for a distance of 36 ft., is open at the bottom, and the coal is discharged directly through it into the transfer cars. The conveyors are interlocked with the cradle, so that when the rotation starts the conveyor motor is also started, and the conveyors are in full operation when the first coal falls on them. They are both operated by one 80-hp. motor.

A disappearing barney, which on the return trip, when near the bottom of the incline, follows a low-level track into the barney pit so that cars can be let down by gravity from the load yard before the barney is in position, pushes the road cars up to the dumper. Both the barney and the dumper are operated from a cab at the incoming end of the dumper. All of the speeds and the motions of the dumper are regulated to produce a complete cycle in two minutes.

The dumper will handle at once two cars of 60 tons capacity, or one of the new 110-ton hopper cars of the Virginian, which weighs 160 tons when loaded.

Transfer cars of 120 tons capacity—just double that of those originally installed on the pier—take the coal from the dumper. These cars, as one of the photographs shows, are mounted on two six-wheel equalized trucks, each of which is provided with a driving motor. The driving motors are of 60-hp. capacity, geared for a speed of 12 miles per hour.

The trucks are spaced 50 ft. center to center under the car, the total over-all length of which is about 70 ft., the height 16 ft., and the width 12 ft. The body of the car forms a hopper divided into three compartments, each having a capacity of 40 tons, the three compartments having a combined length at the top of about



TWO GENERAL VIEWS SHOWING OLD AND NEW FACILITIES SIDE BY SIDE, AND TWO OF NEW DUMPER HANDLING TWO ORDINARY ROAD CARS AT ONCE

51 ft. Each of the compartments is provided with a double system of discharge gates at the bottom, through which the coal passes into the pockets to the pier. The gates of each compartment are separately operated by an air cylinder located in the end of the car.

The discharge gates of each compartment are arranged in pairs and hinged to the car body at the sides and in the center, in such a manner as to provide two openings 9 ft. long by 3 ft. 8 in. wide. The operating mechanism is so arranged that the gates are securely locked when closed, and they cannot fall open.

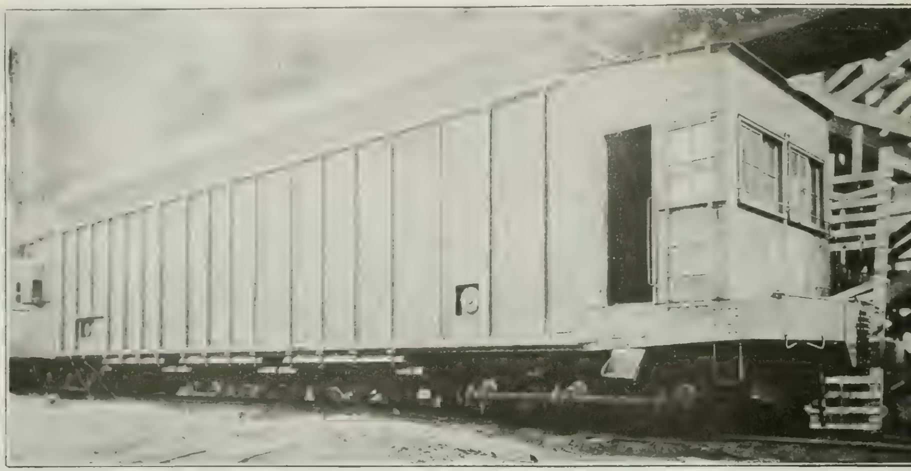
All operations are controlled from one end, although each end is inclosed. The power for operating the cars is supplied from an overhead catenary system. The combined weight of the car and its contents is about 200 tons, making the cars the largest coal transfer cars ever built.

The transfer car elevator raises the pier cars about 67 ft. to the top of the pier. Heavy counterweights are used to counterbalance the weight of the platform and the car; they are so regulated that as much power is required to pull down the empty platform as is required to lift the platform and the loaded car. This arrangement permits the use of smaller motors than would otherwise be necessary.

The elevator is operated by two 450-hp. motors using a direct current at 550 volts. The gearing of the elevator is proportioned to produce a complete cycle in two minutes.

Connecting the frame of the elevator to the pier is a hinged run-off girder, introduced to insure perfect alignment of the rails on the platform and the pier. This girder is hinged to the pier in such a manner as to permit of a vertical movement of the free end amounting to about 2 ft. The free end of the girder rests on brackets on the elevator frame, from which it is lifted by projecting lugs on the platform as it comes to the position of its upper limit. This upper limit of travel is accurately controlled by an electric limit switch, geared to the hoisting mechanism. The power is supplied to the trolley wires in this position, and the transfer car passes out of the elevator, over the hinged run-off girder and out on the pier, where the coal is discharged to the proper pocket. The empty car then returns down the inclined track in the center of the pier structure to the loading track in front of the car dumper, taking its regular turn.

These additions to the equipment of the terminal were installed by the Wellman-Seaver-Morgan Co., Cleveland, which company furnished the original dumper. The work was carried out under the direction of H. Fernstrom, chief engineer of the Virginian Railway.



ONE OF THE LARGEST COAL TRANSFER CARS EVER BUILT—CAPACITY 120 TONS

Corrects Article on Concrete Block Mattresses

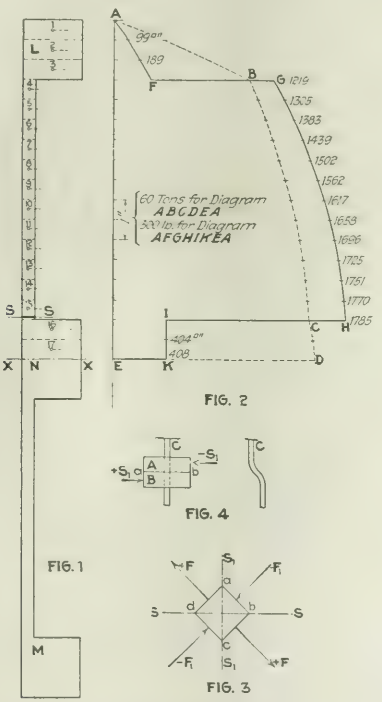
B. Okazaki, author of the article on concrete-block river mattresses in *Engineering News-Record*, Oct. 17, p. 713, calls attention to a typographical error in the text at the top of the second column of p. 714. The sentences beginning at the bottom of the first column on this page should read "In the other types, part of the piles, the cribs or the fascines are very liable to be lost *in toto* from the severe scour or attacks of drift. In the examination of the costs only those works were examined that are constantly subject to severe attack of the current. The first cost and cost of maintenance and repair are considered since the year 1898. Optionally a term of 20 years was adopted as the standard from which to calculate the average of both the first cost and the cost of maintenance and repair per foot run of the river bank under protection." He states that the table showing comparison of costs and repairs of different types should have contained the designating letters A, B, C, D, E and F at the heads of the given columns in order, and that the following sentence should be added: "Works A and B are subject to the same condition of river attack; similarly for works C and D."

Shear in Concrete Ships Critical Point in Design

According to Accepted Theory, the Usual Thin Shell Monolithic with Frame Gives Rise to Dangerous Conditions

By A. C. Janni
Consulting Engineer, Park Row Building, New York City

CONCRETE ships as ordinarily designed have a shell 3 to 5 in. thick, integrally connected, by the concrete and the steel, to the main frames. From the nature of the ship as a hollow beam, this shell must carry practically all of the shear in the structure. It is the purpose of this article to show that unless this integral shell has a prohibitive thickness and an equally prohibitive amount of reinforcement, it will be unable to carry the shearing stresses with-



out cracking, and that danger lies in the fact that any crack so caused will extend progressively, through the grinding action due to subsequent shearing stresses of high frequency.

Fig. 1 represents the theoretical cross-section of a side of a thin-shell 3800-ton concrete ship. This will carry one-half of the whole shear acting upon the ship at this section, which in this case amounts to 600 tons. The expansion L represents the cross-section of a longitudinal member at the top of the hull, the expansion M is that of another longitudinal member just above the bilge curve; the expansion N is a longitudinal shell beam referred to in a later part of the discussion. The dotted curve (Fig. 2) represents the distribution of total shear through the section, as determined by graphical analysis, and the solid curve represents the unit shearing stresses, obtained by dividing the total shear by the cross-sectional area of the true or developed sections, as the case may be.

For the purposes of this investigation the shears on these sections will be transformed to tensile stresses. For instance, consider the section SS which supports, very nearly, the maximum shearing stress (1785 lb. per square inch) and imagine that a cube *abcd*, Fig. 3, having a 1-in. side, be detached from the entire mass in that section. Since the side is 1 in. its diagonal will be 1.41 in., and the horizontal shear, acting along *db*, will be 2517 lb.; that acting along *ac*, of course, will be the same. These stresses may be combined so that they give place to a tensile stress $F = 2517 \times 1.41 \div 2 = 1785$ lb. and a compressive stress F_1 of the same amount, and acting as shown in the figure.

While the cube *abcd* is being stretched in one direction, it is being compressed in the perpendicular direction, by forces of the same amount. This condition is very trying on the material, and it must be taken into account in our investigation, if we wish to reach reliable results.

Assuming as ¼ the value of Poisson's ratio, and assuming the modulus of elasticity of the concrete to be 2,000,000, the shortening of the cube along the direction of F_1 will be $1785 \div 2{,}000{,}000 = 0.00089$ in. Therefore, the corresponding stretching along the direction of F will be $0.00089 \div 4 = 0.000227$ in.; that is, this stretching would be caused by a force along F, and its value would be given by $2{,}000{,}000 \times 0.000227 = 445$ lb. This stress is to be added to F, therefore we may imagine now that the cube *abcd* is only under the action of a tensile stress of 2230 pounds.

How shall the steel be arranged to take its proportion of this tensile stress, which obviously is too great to be borne by the concrete? First assume that the steel be placed diagonally in two directions at 45° angles. With a unit steel stress of 12,000 lb. per square inch, and with the steel taking all the tension, the amount of steel per square inch will be $2230 \div 12{,}000 = 0.186$ sq.in.—that is, 18.6% of the concrete.

As the shear may invert its direction, the cube *abcd* may be stretched along F_1 and shortened along F, so we should add another 18.6% steel in the direction F_1.

But in dealing with concrete ships the assumption that the steel carries the whole tensile strength is not justified. In ordinary buildings this assumption is legitimate, for a crack in the concrete would actually throw the whole stress on the steel, but in ships we cannot have cracks in the hull, especially in the sides of it. If, therefore, we assume to have a crackless concrete, we must assume also that this concrete will deform exactly as the embedded steel does. For the 18.6% of steel and a ratio of $E_s \div E_c$ of 15, then, the tension in the concrete will be 619 lb. and in the steel 9285 lb. For a lower steel proportion the concrete tensile value will be higher and will undoubtedly cause cracks in the concrete. The problem, then, of the diagonal placing of the steel is to get so large a percentage of metal in so thin a shell of concrete.

Let us suppose now that we place the steel in two sets, one vertical and the other horizontal. If, Fig. 4, A and B are two adjacent elements of concrete upon which the internal forces *S-S* act as shown, then along *ab* we shall have shear. In order that the rod C may work it is necessary that the elements of concrete deform. In what consists the work of the rod C?

As the elements A and B and the rod C are not of the same material it is clear that during the shearing action the steel will tend to crush the concrete along the part of it pressing against the steel. As a result of this the rod C will be subjected to a certain amount of shear as well as to a double deflection deformation of very short radius, as shown in Fig. 4. Under shearing stresses, acting with a high frequency and continuously changing sign, the result will be the gradual releasing of the grip that the concrete has on the steel, and this will cause the concrete to carry more and more of shearing stress, until the limit is reached, when it will crack.

Incidentally, this explains the fact that in ordinary reinforced-concrete buildings some of the cracks due to the shear do not appear until after a certain period of time, notwithstanding the fact that during this period the construction has not been subjected to undue loading.

Horizontal Plus Diagonal Steel

If we should combine the horizontal and the diagonal steel in the sides of a hull we might expect a certain improvement in the static conditions of the material, but this improvement is not commensurate at all with the enormous amount of steel required, and does not solve the problem of covering efficiently all this steel by a relatively thin concrete shell.

We must consider that it is the thin shell of concrete which is supposed to bear the brunt of the shearing stress and, by its deforming, transmit it to the steel. This deformation of the concrete is not due to an even compression or tension in a determined direction, for the intensity of stresses as well as their directions change according to the distance between the neutral axis and the element we consider. If we take a cross-section under examination, we see that this, when subjected to shear, is no longer straight, but distorts so that it assumes the shape, familiar to all designers, which resembles an "S." Now, although the steel may somewhat attenuate this deformation, it cannot prevent it altogether, for the steel enters its rôle only through the deformation of the concrete.

An additional inconvenience in this kind of ship is the practical difficulty in the concreting of it. In order to avoid shrinkage cracks caused by the setting of the concrete, the skin of the sides of a hull should not be concreted in one continuous operation. Therefore we must expect construction joints. Dismissing as doubtful the idea that by a careful and painstaking concreting it is possible to obtain a satisfactory concrete bond between a set concrete surface and new concrete, it remains a fact that the hull, as far as shear is concerned, may be considered as already cracked, and as soon as the ship takes the sea the shear will set up a grinding action on the surfaces of the joints in contact, bringing about a progressive enlargement of them. Furthermore, if the joint is vertical the shear acting along this joint will act directly on the reinforcement, quickly destroying the adherence in this region between steel and concrete. During this grinding action the joint will also extend, in the shape of actual cracks, to the bottom of the hull and to the decks.

The type of hull with thick monolithic skin is not worthy of being discussed, because it can readily be seen that the thickness required in the sides of a ship to make it withstand the amount of shear would be quite unpractical.

We can now consider the type of hull, also with monolithic skin, but having inside longitudinal ribs, as well as vertical ones. In Fig. 1 we have shown a certain expansion N which is supposed to be the cross-section of a longitudinal rib. All considerations on this subject may be applied to cases in which more than one rib is used.

By inspection of diagram AFGHIKEA, it is seen that the addition of a horizontal rib brings about a purely local improvement—the improvement in the static conditions of the skin being quite immaterial—as can be deduced from the classical formula giving the shearing stress at any given point of the cross-section.

Therefore, excepting the very limited benefit (almost entirely local) accruing from the adoption of a horizontal rib, we still would have to deal with very important shearing stresses in the resulting panels of the shell. Furthermore, looking at the diagram, we observe that there are two very brusque variations in the value of the shearing stresses, and the question may be raised whether, after all, the adoption of longitudinal ribs does not render the joining sections between panels and ribs more liable to cracks—that is, making the hull more unsafe than before.

Vertical Ribs Do Not Relieve Shear

If we look again at the diagram we see that the adoption of vertical ribs does not affect in the least the action of shear upon the skin of the ship, except in the case, which hardly may be realized in practice, where the shear acts directly and solely on that vertical rib. For the other infinite number of shear applications, the vertical rib would not relieve the skin. Here also, as in the case of the horizontal rib, there is a possibility of cracking, due to the sudden change in the value of shearing stress at the joining section between the panel and the rib.

Finally, a type could be evolved having diagonals inside the shell. These diagonals may be divided into two sets, each of them inclined 45° to the horizontal, so that the sets are perpendicular to each other. If those diagonals were the only structural members between the top and bottom flanges, one set of them would work in compression while the other would work in tension, and the shear would disappear from the web. Unfortunately, conditions there are not such, for, in addition to the diagonals, there is the shell of the ship rigidly connected to the diagonals, and to the top and bottom members. The presence of this shell sets up shearing stresses in the web. It is true that in special conditions of equilibrium those diagonals may be a valuable help to the shell, but the conditions of

equilibrium of a ship cannot be controlled by the desire of the designer.

As a result of these studies, which are given only in brief, it is the conclusion of the author that the successful type of reinforced-concrete ship must be of such a design as to eliminate the shear through the skin of the hull.

It is further believed that a designer should have before him the following considerations: The working stresses in concrete should be so low that strain alternation does not fatigue the material; the working stresses of the steel must be determined as a ratio of those in the concrete, so that the materials may act together. The elastic system should be thought out in such a geometrical shape that shear, at least in all vital points of the system, is eliminated. The makeup of the hull should be such as practically to eliminate all causes of accidental cracks (shrinkage and the like), and the process of concreting should be directed in such a manner that it will accomplish this end.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Norwich the Oldest Civil Engineering Institution in the Country?

Sir—In your issue of Nov. 21, p. 955, Professor Winslow of Norwich University, Northfield, Vt., makes the claim that his institution is the oldest school of engineering in this country. Possibly the matter may be of enough interest for you to spare space for a quotation regarding this matter from the second edition of my "History of Rensselaer Polytechnic Institute":

"During the first quarter of the nineteenth century, however, three schools were established here, for each of which the distinction has been claimed of being the first school created in any English-speaking country for the purpose of teaching science. The earliest was established in Norwich, Vt., in 1819, by Capt. Alden Partridge, a graduate of the United States Military Academy and its superintendent during the years 1815-1817. It was called the American Literary, Scientific, and Military Academy, and it appears ("History of Norwich University," by William A. Ellis) to have been more of a military academy than a school of science. It was evidently modeled after the West Point school. The cadets lived in barracks, and were taken at as early an age as nine years. The curriculum included various languages, English literature, science, as much as was then known of engineering, and many military subjects, including military exercises. The academy was moved from Vermont to Middletown, Conn., in 1825, and was incorporated in that state, but was disbanded in 1829. In the meantime, Captain Partridge had left the academy in 1827, and had opened in Norwich a small preparatory school. When the academy was disbanded in Connecticut, he took its name again for his school, which in 1834 was chartered by the legislature of Vermont as Norwich University, and, in 1866, the university was moved to Northfield, in the same state.

"The second school was incorporated under the name of the Gardiner Lyceum, in Gardiner, Me., in 1822, and opened in 1823 by Benjamin Hale, who was graduated from Bowdoin College in 1818 and who afterwards became president of Hobart College. In his inaugural address, delivered Jan. 1, 1823, he said: 'It is the object of this institution to give instruction in those branches which are most intimately connected with the arts, and to teach them as the foundation of the arts.' 'It is not sufficient for them, as for the general scholar, to be taught the general laws of chemistry; they must be instructed particularly in the chemistry of agriculture and the arts. It is not sufficient for them to be able to repeat and to demonstrate a few of the general laws of mechanics; they must be taught the application of the laws. They must be made acquainted with machines.' The curriculum included various branches of pure mathematics, and natural science, mensuration, surveying, navigation, and theoretical and practical mechanics. The lyceum existed for about ten years. It was discontinued in consequence of the withdrawal of a legislative appropriation.

"The third school, which is the subject of this history, was founded in Troy, N. Y., by Stephen Van Rensselaer, of Albany, N. Y., in 1824. It was called the Rensselaer School, and was originated for the purpose of teaching the 'application of science to the common purposes of life.' Detailed information regarding it, including its early curriculums, will be given in due course in this history, and this reference is made at this time only to give the date of its foundation and its object, in order that a comparison may be made with the two schools previously mentioned.

"The primary object of the Norwich Academy was really not the teaching of applied science. It seems to have been a mixture of boarding-school, military academy, classical school and scientific school. Evidently more applied science, and even engineering, as it was then known, was taught than was taught in the classical colleges of that day. But even if, after all the changes in name and place, Norwich University may be said to be the same school as the American Literary, Scientific, and Military Academy, it is more than doubtful whether it has any right to be called the first school of science to be established in this country. If it has a claim to this distinction, the West Point Military Academy, after which it was modeled, has a greater claim; and this has never been made for it.

"Whatever honor may accrue from being the first school established in this country specifically for the purpose of teaching science belongs, I believe, to the Gardiner Lyceum, which was originated about two years earlier than the Rensselaer School, but which soon ceased to be. The Rensselaer Polytechnic Institute is, therefore, I believe, the first school of science and engineering, which has had a continuous existence, to be established in any English-speaking country."

Engineering schools, since 1819 at least, have not generally been established for the instruction of nine-year-old boys.

After the first edition of my history had been pub-

lished, the late Andrew D. White, in an address delivered at the unveiling of a monument to Benjamin Hale at Hobart College in 1911, called attention to the establishment of the Gardiner Lyceum and claimed that Hale, as its first principal, was the founder of the first technical school of the country. As I know of no other earlier school, I believe his statement to be correct.

The quotation from Hale's inaugural address given above seems to prove his contention. A copy of this address, together with several other pamphlets relating to the Gardiner Lyceum, is in the Bowdoin College library; at least these valuable documents were there several years ago. PALMER C. RICKETTS,

President, Rensselaer Polytechnic Institute.

Troy, N. Y.

Diagram Indicates Where Weak Bridges Should Be Reinforced

Sir—In strengthening old bridges to carry heavier locomotives, the accompanying chart was found to be quite helpful in determining which members should be reinforced.

The full line indicates the live-load capacity of the various members in the bridge, reduced to Cooper's equivalent loading. The dash line represents a 240-ton mikado locomotive followed by a train of heavily loaded coal cars, reduced to Cooper's equivalent loading for the different members of the bridge. The heavy line was drawn at E-55, which is the standard loading used for designing by many railroads.

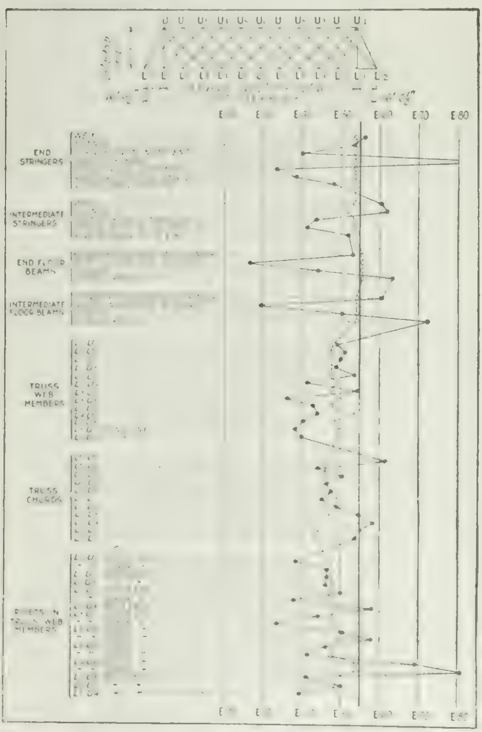


CHART DETERMINES MEMBERS TO BE REINFORCED

The diagram shows at a glance just which members are weak and the degree of weakness, enabling one to designate quickly and intelligently which members or parts should be reinforced. T. A. SMITH,

Structural Engineer, C. R. I. & P. Ry. Company.

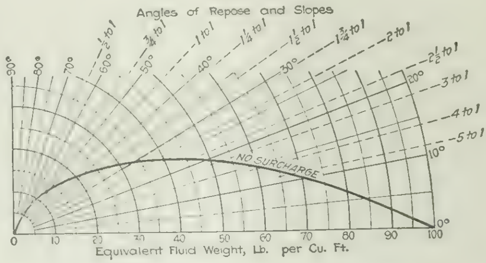
Chicago.

Lateral Pressure of Saturated Earth by Equivalent Fluid Weight

Sir—The writer has read with considerable interest A. G. Husted's article on "Computing the Lateral Pressure of Saturated Earth" in your issue of Sept. 5, p. 441.

Mr. Husted's results are practically the same as those at which the writer has arrived, as given below, though the method of derivation is slightly different in the two cases.

Taking Mr. Husted's example, and referring to the diagram herewith, it is seen that the "equivalent fluid weight" for earth weighing 100 lb. per cubic foot, and with a slope of repose of $1\frac{1}{2}$ to 1, is 28 lb. per cubic foot. Similarly, the "equivalent fluid weight" for earth weighing 70 lb. per cubic foot, and with a slope of repose of $2\frac{1}{2}$ to 1, is $46 \times 70/100 = 32$ lb. per cubic foot. Therefore,



EQUIVALENT FLUID WEIGHT BASED ON EARTH AT 100 POUNDS PER CUBIC FOOT

$$p_a = 28h$$

$$p_b = 46h + (32 + 62.5)h,$$

or, for Mr. Husted's example,

$$p_a \text{ at plane of saturation} = 28 \times 4 = 112 \text{ lb.}$$

$$p_b \text{ at plane of saturation} = (46 \times 4) + (32 + 62.5)0 = 184 \text{ lb.}$$

$$p_b \text{ at bottom} = (46 \times 4) + (32 + 62.5)6 = 751 \text{ lb.}$$

The writer has found this diagram of "equivalent fluid weights" based on Rankine's formula very useful, as it somewhat simplifies the calculations that are necessary.

The curve shown is plotted for a level fill only, but similar curves may easily be constructed for various angles of surcharge. R. D. L. FRENCH.

Montreal, Que.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Table Gives Price of Team Haulage

A PRICE schedule for hauling, shown in the accompanying table, gives the cost of hauling one ton for various distances and at different rates per team per 10-hour day. It is based on an average load of 3750 lb., with team walking at two miles per hour with load and three miles per hour returning. An allowance of 40 min. is made for loading and unloading. This table has been prepared by E. B. Hiatt, county engineer of Madison County, Iowa, who says he has used it to good advantage in determining the cost of hauling materials for concrete work. This year the rate of $7 per team per day is being used.

SCHEDULE OF PRICES FOR HAULING ONE TON BY TEAMS FOR VARYING DISTANCES

Team Rates per Day of Ten Hours

Miles	$5 00	$5 50	$6 00	$6.50	$7 00	$7 50
0 5	$0.288	$0 317	$0.346	$0.375	$0.404	$0 433
1 0	400	.440	480	520	560	600
1 5	511	562	613	.664	715	766
2 0	.622	684	746	.808	871	933
2 5	733	806	880	.953	1 026	1 100
3 0	844	928	1 013	1 097	1.182	1 266
3 5	955	1 051	1 146	1.242	1.337	1 433
4 0	1 066	1 173	1.280	1.386	1.493	1 600
4 5	1.177	1.295	1 413	1.531	1.648	1 766
5 0	1 288	1 417	1.546	1 675	1 804	1 933
5.5	1 400	1 540	1 680	1.820	1 960	2.100
6 0	1 511	1 662	1 813	1.964	2.115	2 266
6 5	1 622	1 784	1 946	2.108	2 271	2.433
7 0	1 733	1 906	2 080	2 253	2 426	2 600
7 5	1 844	2 028	2 213	2.397	2 582	2.766
8 0	1 955	2 151	2 346	2 542	2 737	2 933
8.5	2 066	2 273	2 480	2 686	2 893	3.100
9 0	2 177	2 395	2 613	2 831	3 048	3 266
9 5	2 288	2 517	2 746	2 975	3 204	3.433
10 0	2 400	2 640	2 880	3 120	3.360	3 600
10 5	2 511	2 762	3 013	3.264	3.515	3.766
11 0	2 622	2 884	3 146	3 408	3 671	3.933
11 5	2 733	3 006	3 280	3 553	3.826	4 100
12 0	2 844	3 128	3 413	3 697	3 982	4.266
12 5	2 955	3 251	3 546	3.842	4.137	4.433
13 0	3 066	3.373	3 680	3 986	4 293	4 600
13 5	3.177	3 495	3.813	4 131	4 448	4 766
14 0	3 288	3 617	3 946	4 275	4 604	4 933
14 5	3 400	3 740	4 080	4.420	4 760	5.100
15 0	3 511	3 862	4 213	4 564	4 915	5 266
15 5	3 622	3.984	4 346	4 708	5 071	5 433
16 0	3 733	4 106	4 480	4 853	5 226	5 600
16 5	3 844	4 228	4 613	4 997	5 382	5 766
17 0	3 955	4 351	4 746	5.142	5 537	5 933
17 5	4 066	4 473	4 880	5 286	5 693	6 100
18 0	4 177	4 595	5 013	5 431	5 848	6 266
18 5	4 288	4 717	5 146	5 575	6 004	6 433
19 0	4 400	4 840	5 280	5 720	6 160	6 600

Building Is Erected by Revolving Crane With 100-Foot Boom

A REVOLVING tower crane with a long horizontal boom carrying a trolley hoist has been built specially for the construction of the new high-school building at Galion, Ohio. This crane is shown in the accompanying view. The steel tower is 5 ft. square and 76 ft. high. It turns on a center bearing and is steadied at the top by guy cables fastened to a cap bearing. A lattice boom 100 ft. long is attached to the tower and has a track for the traveling trolley hoist. Cables from the top of the tower carry this boom, and the rear side of the tower is trussed vertically to resist bending stresses due to the loads on the boom.

The crane remains in one position, but is raised as the building progresses. It covers nearly the entire area, wheelbarrows being used to distribute material to parts not reached by the sweep of the boom. Open panels are left in the floors at the tower and will be closed after the crane is dismantled. Steel beams, concreting buckets, timber, stone, skips of brick and other materials are handled by the hoisting trolley, which also serves to set beams, stone, etc., in position.

HORIZONTAL BOOM CARRIES HOISTING TROLLEY

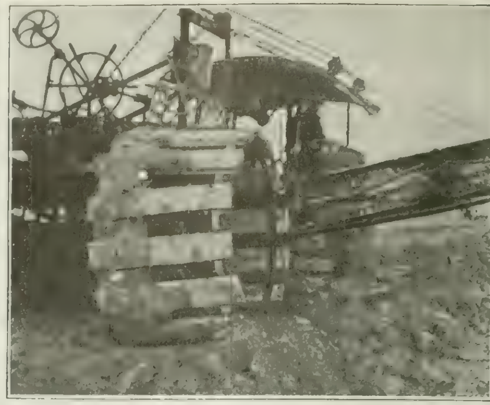
The operations are controlled from a cabin on the tower, just above the heel of the boom. There is an electric motor of 15 hp. for hoisting and another of 5 hp. for traversing the trolley. The hoisting capacity is 10 tons as far as the middle of the boom, and 5 tons at the extreme end.

This crane has been designed and patented by W. L. Willing and C. P. Klein, Bellevue, Ohio. The former is a member of the firm of Willing Bros., contractors for the high school; the latter is a member of the Klein Iron Works Co., which built the crane. A somewhat similar but double-arm crane, designed and used by Willing Bros., and described in *Engineering News* of May 13, 1915, p. 938, had a 130-ft. boom extending 64 ft. on each side of the tower.

Widened Wheels Carry Graders Over Mud

ROAD-BUILDING machinery working on the Great Salt Lake desert had trouble when heavy rains made the silty soil so soft that it would not support either the wheels or the caterpillar tractors. To increase the bearing areas of the machines, pieces of heavy plank were bolted to the tires of the wheels on the graders,

PLANKS INCREASE WIDTH OF CATERPILLAR TRACK



GRADER WHEELS WIDENED TO FORM A SKELETON DRUM

and likewise to the caterpillar tracks of the tractors. For the former an inside ring or false tire carried the outboard ends of the planks, and diagonal brace rods extended from the hubs of the wheels to the planks. For the planks on the caterpillars, however, no outboard support was practicable.

This method was improvised by R. E. Dildree, superintendent for the State Road Commission of Utah. Ira R. Browning is state road engineer.

Small Dump Car Helps Railway Ditching

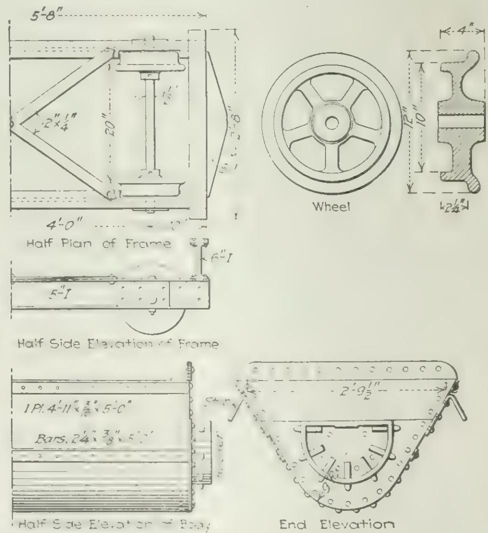
TO FACILITATE the clearing of ditches along railway tracks a ¾-yd. side-dump steel car has been designed and built by the Baltimore & Ohio R. R. The car is operated on a track of 20-in. gage laid directly over the ditch, and is made low and narrow so as to clear trains in narrow cuts. One car can be loaded and handled by two men, but where the work is heavy and requires a long haul two or three cars are coupled

TRAIN USED FOR CLEARING DITCHES ON TRACK TWENTY INCHES WIDE

and are hauled by a home-made motor car, as shown in the view. For this latter plan a larger crew is employed, with two trains, a switch and siding being put in at the end of the track so that one train can be placed for loading while the other is being taken away and dumped.

The dump cars contain a single plate forming the V-shaped shell, which is 5 ft. long, 3 ft. wide at the top and about 25 in. deep.

Rockers on the end plates have projecting lugs or teeth which engage with perforated castings on the end sills, and thus hold the body in position as it dumps. The rockers can be locked to prevent accidental dumping. The frame consists of two end sills resting on side sills, the latter being connected by diagonal bars and



DETAILS OF CONSTRUCTION OF SMALL DUMP CAR FOR DITCHING WORK

reinforced by plates at the holes for the axles. Cast-iron 10-in. wheels are secured to 1½-in. axles by set screws and give a wheelbase of 4 feet.

The design of the car was made under the direction of Earl Stimson, general superintendent of maintenance of way and structures of the Baltimore & Ohio Railroad.

NEWS OF THE WEEK

New York, December 12, 1918

Logan Waller Page

An Appreciation, by John M. Goodell

The sudden death in Chicago on Monday of Logan Waller Page will come as a deep shock, not only to the road builders of the country but also to his wide circle of acquaintances in every walk of life, who have come to admire his unusual executive ability and high character as a public official. Few men in public office in Washington, outside those holding positions of a political nature, have become so widely known and highly respected. The personal loss which is felt by all who have watched the wholehearted way in which he developed a great organization for the public welfare is something that cannot be expressed adequately at this time.

LOGAN WALLER PAGE

He had an ideal training for the work. He was a member of the first class at Harvard which specialized in road engineering. There were but two other members of this class, A. B. Fletcher and A. N. Johnson. The three have since, by their achievements, shown how well justified was the belief of Dr. N. S. Shaler that graduates from such a course were needed in this country. The unusual talents of Mr. Page as an investigator led him to become the geologist of the Massachusetts Highway Commission and director of its road-testing laboratory, the first laboratory of the kind in this country. He introduced here the methods of examining road materials which had been developed in France, and devised improvements of them, so that some years later, when the testing of road materials become a necessary part of the work of the Department of Agriculture, he was naturally selected as the

(Concluded on page 1098)

Reconstruction Problems Studied by Business Men

Atlantic City Meeting Favored Private Control, Coöperation of Labor and Capital, and Increase in Foreign Trade

Five thousand of the biggest business men in the United States got together at Atlantic City last week to formulate a program of industrial readjustment in the post-war period. Meeting first in small groups representing every phase of American industry, they came together later in progressively more inclusive subdivisions up to the last day, when the whole gathering met to consider—and, as it turned out, to approve—32 general resolutions boiled down by a representative committee from several hundred submitted by the major groups. In between there were three general sessions, at which the huge assembly listened with sympathetic and instant response to remarkable addresses by Henry A. Wheeler, Charles M. Schwab, Secretary of Commerce Redfield, James A. Farrell, Paul M. Warburg and John D. Rockefeller, Jr. The superficial result of the congress was the program outlined in the 32 resolutions; the real and more important result was the individual's reaction to the inspiration of the addresses, and the meeting of minds in the minor industrial groups.

The conference, which was called the War Emergency and Reconstruction Congress, was fathered by the Chamber of Commerce of the United States. This body called the meeting, had charge of all the arrangements, and paid the general expenses. It does not, however, assume responsibility for any of the actions of the conference. At the bottom of the progressively representative series of meetings were the war service committees, numbering some 300, which were organized during the past year to assist the War Industries Board. Following these were 35 related groups, embracing industries in the same general field, and finally there were 10 major groups receiving delegates from the related groups and reporting definite resolutions to the general congress. A clearance committee of 15 men, in which were representatives from each of the 10 major groups, was appointed by the president of the Chamber of Commerce to prepare the general resolutions intended to epitomize the hundreds of resolutions from the representative bodies.

Clearance Committee Worked To Collate Collective Thought

Such an organization, so completely subdivided and so extensive in its scope, threatened to be unwieldy, but in fact it functioned remarkably well. Each of the minor groups had its own individual problems of interest only to its own members. At the same time, each had broad views on the reconstruction issues which emerged from the minor groups and from them to the main convention. It was the duty of the clearance committee to take the general views expressed in unworkable multiplicity by the several group resolutions and sense from them the collective thought of the convention. It turned out, however, that the clearance committee disregarded most of the specific resolutions and, with some notable exceptions, confined itself to those which involved definite financial and economic necessities.

It was perhaps too much to hope that the congress would evolve a definite plan of reconstruction. The subject is too varied to permit of reduction to set terms, and too involved to be settled in a few days' conference. Some general principles, fundamental to the conduct of business, were set down as a guide to those intrusted with the national program, and a start was made on a permanent organization of the War Service Committees, which may be the nucleus of a nation-wide industrial organization in this country but which at present is intended to act with the Government should its services be asked in the reconstruction period. Primarily, the

In General Pershing's report of Nov. 20 to the Secretary of War, outlining the history of the American Expeditionary Forces, the commanding officer in France details briefly the remarkable work of the Engineer Corps in keeping pace with the ever-growing demands of the Army in the building of railways, wharves and storehouses. The report was made public Dec. 5. The section relating to the Engineer Corps closes with the following words of commendation:

"While the Engineer Corps has been referred to in another part of this report, it should be further stated that the work has required large vision and high professional skill, and great credit is due their personnel for the high proficiency that they have constantly maintained."

resolutions stand for a better relationship of capital and labor, the return to pre-war conditions of industry, a policy of international good will, and a development of our foreign trade.

Through the whole congress ran the thread of the labor problem as the critical issue of reconstruction. President Wheeler accorded it first place in his preliminary address, Mr. Schwab emphasized it in his warning that in the future labor and capital must share equally in practice as well as in theory, and John D. Rockefeller, Jr., brought it to a climax in the enunciation of his industrial creed, printed elsewhere in this issue. No one could miss the feeling of the delegates; all were agreed that no further progress can be made without close coöperation between these two factors in industry. How that coöperation is to be worked out is still in nebulous form, but the congress adopted a resolution which heartily indorses "in letter and in spirit the principles of the industrial creed so clearly and forcibly stated by John D. Rockefeller, Jr., without approving or rejecting his particular plan or machinery."

Government Ownership Opposed

The congress was overwhelmingly against Government ownership. It recommended that all war restrictions be taken off industry, that the telegraphs, telephones and cables be returned now to private control, that the railways be returned to their owners, but under Federal charter, with such permitted coöperation as will "tend to economies without destroying competition in service." In fact, the watchword of the congress might have been that combination hitherto thought impossible "Competition with coöperation." Just how the advantages of both systems of economics are to be obtained was not explained.

A highly idealistic policy of foreign business relations was laid down. Foreign trade was recognized as a necessity, and its encouragement was advised in definite terms, but at the same time the interdependence of the nations of the world in this rebuilding period was accepted as manifest, and the general sharing of our food, raw materials, financial resources, and shipping "for the common service of all nations" was recommended. Plans were also laid for a committee of business men to go immediately to Paris to look into European conditions and be available for consultation by the American peace delegation.

On those specified problems of reconstruction in which the engineer is interested the resolutions were the weakest. This was undoubtedly due to the submersion of the engineer in the congress. A number of the prominent men in the profession were present, but they were there in an industrial capacity, as parts of organizations whose main functions are commercial, and as such they either did not or could not make any impression on the clearance committee, though they did succeed in getting some strong resolutions through the major groups.

The whole vital subject of construction was passed over in a brief resolution that "the development of public works should properly be resumed." A large merchant marine was recommended, but the method of its control was skilfully avoided. Some action, not specified, was urged on the Federal water-power bill. Public utilities should be made the subject of an investigation. Nothing was done in the matter of further highway construction, though several of the major groups recommended a national system of roads, and one group—that on heat, light and power—passed a resolution against such control. Irrigation, drainage, the use of cut-over lands, housing, and waterway transportation never emerged into the light of the whole congress.

Schwab Resigns from Emergency Fleet Corporation

Charles M. Schwab has resigned as Director General of the Emergency Fleet Corporation. President Wilson notified him by wireless that his resignation had been accepted, and expressed high appreciation of his services. Mr. Schwab, it was stated, is anxious to get back to his private affairs and will retire at once. It is announced that Charles Piez, vice-president and general manager of the corporation, will succeed Mr. Schwab.

Demobilization of S. A. T. C. Proceeding Rapidly

Reports received daily from the universities and colleges of the country indicate that the Students' Army Training Corps is being demobilized at a rapid rate, and that the institutions at which its units have been stationed are returning to a peace basis. Already a great number of institutions are no longer under military supervision, and usual courses of study are being pursued.

Reply to Request for Recognition of Engineers' Services

Under date of Dec. 4, G. H. Sines, chairman of the Federal Board of Railway Wage Adjustment, replied to the letter of Alfred D. Flinn, secretary of the Engineering Council, to Director General of Railroads McAdoo, requesting recognition for the services of engineers, as outlined in *Engineering News-Record* of last week, p. 1048. Mr. Sines' letter follows:

"Referring to your letter of Nov. 20 to the Director General of Railroads, calling attention to wages and working conditions of civil, mechanical and electrical engineers of various ranks and their technical assastants:

"This matter was taken up with the Director General, and this board has been advised that where such positions as those of engineers, assistant engineers, draftsmen and other men of technical training or experience, employed on the staff of the chief engineer of the valuation department or the general staff of the mechanical department, are not reached by the operation of supplements Nos. 7 and 8 to general order No. 27, their cases should receive special treatment at the hands of the Federal managers.

"If any of the employees in the service of railroads under Federal control in whom you may be interested feel that the provisions of wage orders affecting their positions are not being properly applied, it is suggested that they take their cases up with the division of labor in accordance with the provisions of circular No. 3, copy of which is attached for your information and guidance."

Bonds Sold To Push Hetch Hetchy Work at Full Speed

A million dollars' worth of 4½% Hetch Hetchy water-supply bonds were sold at par by the City of San Francisco to the Anglo and London Paris National Bank, which also took an option on the remaining \$8,000,000 now authorized. The \$1,000,000 will be used to carry on work at full speed during the next six or eight months. The \$8,000,000 would cover the construction of the Hetch Hetchy dam and the first section of the aqueduct. Effort will be made to complete the work as far as the Moccasin Creek power development as soon as possible so the 60,000 hp. to be generated there will be made available for the use of the city.

Federal Supervision of State Research Favored

A permanent National Committee of Engineering Experiment Stations was organized at Washington Dec. 9, following a temporary organization in Massachusetts a few days earlier, and about two years of previous consideration. The Washington meeting was attended by some 15 men, mostly presidents or deans of American universities. The chairman was Richard C Maclaurin, president of the Massachusetts Institute of Technology, who was made head of the permanent organization. The committee, it is said, will support the Smith-Howard bill, which in an amended form will be pushed in the present session of Congress. With the proposed amendments the bill would place under the central direction of the United States Bureau of Standards the research work in engineering and agriculture conducted by the various states under Federal aid.

Abandoning Liberty Shipyard

Construction forces of the Liberty shipyard at Alameda, Cal., have been disbanded, and the contractor's office forces have completed their work and left. San Francisco news reports state that the entire project is to be abandoned as a result of the Emergency Fleet Corporation's decision to stop construction.

Founding Marburg Memorial Scholarship

A. S. T. M. Executive Committee Also Decides to Hold Special Memorial Meeting

The executive committee of the American Society for Testing Materials has authorized the founding of an Edgar Marburg Memorial Scholarship in the department of civil engineering of the University of Pennsylvania. Members of the society are invited to subscribe. The committee has also decided to hold a special memorial session commemorative of Dr. Marburg in connection with the next annual meeting of the society. Prominent men who stood in close personal relations with Dr. Marburg will speak.

The minute adopted by the executive committee is as follows:

"In the death of Edgar Marburg, which occurred on June 27, 1918, the American Society for Testing Materials has suffered the irreparable loss of one of its most eminent and distinguished members; its executive officer since its incorporation; a leader in engineering thought and education and in the field of testing materials.

ONE OF SOCIETY'S ORGANIZERS

"He was one of the small group which, in 1898, organized the American Section of the International Association for Testing Materials. In 1902 he was appointed acting secretary of the section. He at once prepared for the executive committee a clear, comprehensive statement of the purposes of a testing society, as he conceived them, which led to the incorporation of the society as an independent body. He was elected secretary and treasurer of the new society, and to him was entrusted the executive direction of its affairs. From then till his death, a period of 16 years, he worked assiduously for the success and advancement of the society. He devoted much time and thought to the work of its technical committees and the standardization of specifications and methods of tests of materials of engineering, and he shaped the policy under which these essential activities of the society are conducted. The marked success which has attended the work and growth of the society, and the interest and pleasures of its annual meetings, have been due in large part to his tireless and painstaking efforts. To his labors he brought great executive and organizing ability, excellent judgment, a clear grasp of the many and varied problems which confronted him, a sympathetic understanding of humanity, tremendous enthusiasm and zeal, and thoroughness in everything he undertook. His high ideals were reflected in every word and act. He was ever jealous of the good name of the society, and sought throughout his leadership to extend its usefulness in every proper field.

"To the officers and members of the executive committee, who were privileged to work intimately with him, his death brings a deep sense of personal loss and grief. His high integrity, his rugged honesty, his openmindedness, and his evident sincerity of purpose endeared him to his associates, and commanded their admiration, respect and devotion.

"The character and personality of Edgar Marburg have indelibly impressed themselves upon the American Society for Testing Materials—an inspiration to the society for all time."

MEMORIAL SESSION AT MEETING

"The executive committee has decided to hold a special memorial session, commemorative of Dr. Marburg, in connection with the next annual meeting of the society, at which prominent men who stood in close personal relation to him will be invited to speak. Announcement of the program and other details of this meeting will be made in a later circular to members.

MARBURG MEMORIAL SCHOLARSHIP

"The executive committee has authorized the founding of an Edgar Marburg Memorial Scholarship in the department of civil engineering at the University of Pennsylvania. It is the earnest belief of the executive committee that the great debt which the society owes to Edgar Marburg makes it peculiarly fitting that a permanent memorial shall be founded by the society, to which he ever gave the best of his efforts and his great abilities. His long and prominent services as an educator in the department of civil engineering at the University of Pennsylvania made it seem most appropriate that this memorial should be in the form of a scholarship in that department, thus associating in a bond of mutual interest the two institutions which owe so much of their success to his labors.

"Provost Edgar F. Smith of the University of Pennsylvania has advised the executive committee that a sum of $5000 is required to found a scholarship in engineering, and has expressed his sincere appreciation of the intention of the society. The executive committee believes that it voices the sentiment of the members of the society in expressing its feeling that this fund of $5000 should be raised by equal contributions of relatively small amount from all of its members, so that it may truly be said that the memorial is a tribute from the society as a body to its honored secretary-treasurer.

"The members of the society are accordingly asked to contribute the amount of $2.50 toward this memorial fund. The accompanying return card should be mailed with the remittance in the inclosed envelope addressed to the assistant secretary. Remittances should be drawn to the order of the American Society for Testing Materials. The executive committee desires that the announcement of the founding of this scholarship shall be made by the university authorities without undue delay, and it is accordingly asked that all contributions shall be in the hands of the assistant secretary not later than Jan. 15, 1919."

Railway Executives Urge Roads' Return

Resolutions Adopted at Meeting in New York for Private Operation of the Lines

At a meeting of the Railway Executives' Advisory Committee in New York City Dec. 4, resolutions were passed advocating restoration of the railroads to private corporations, opposition to Government ownership, acceptance of the principle of "reasonable, responsible and adequate Governmental regulation," adherence during the remaining period of Federal control to a policy of preparing the carriers for the readjustment, and provision by Congress of a system of Governmental regulation, which, while safeguarding the public, will be uniform, businesslike and empowered to deal equitably with wage and labor conditions. Representatives were present from practically all of the big trunk lines of the country.

At the close of the meeting T. De Witt Cuyler, chairman of the executives' committee, issued a statement which, in part, follows:

"Today's meeting showed that the railroad companies want a readjustment which will give the best possible system of transportation to the country. They neither expect nor wish to escape adequate responsible public regulation. They want a relation between rates, wages and dividends which will stimulate business, adequately reward labor and attract the volume of new capital needed for expansion. They want, therefore, regulation which is helpful and constructive, as well as corrective."

Canada Suggests Joint Development of St. Lawrence Power

The Canadian Government is preparing to take up the question of joint development with the United States of the water powers of the St. Lawrence River. A tentative scheme has already been submitted in its broad outlines, which, it is asserted, would, while providing increased navigation facilities, result in the development of enormous additional water power. It is proposed that surplus power generated under this scheme and not required in Canada could be exported to the United States under treaty arrangements providing for its return when needed in Canada. The adoption of the project would entail the practical abandonment of the present canal system, as the result of the creation of a deeper waterway by means of dams. This project is in accordance with the representations made to Washington some months ago, when the application of the St. Lawrence Power Co. was before the International Waterways Commission. It was urged then that instead of permitting a series of unrelated private enterprises to avail themselves of the water power, a comprehensive scheme of development should be carried out under public auspices by the two countries.

Logan Waller Page

(Concluded from page 1095)

Chief of the Division of Tests, which was established by the department in 1900.

From this small beginning as a research bureau in a great department, Mr. Page developed the Office of Public Roads, which I personally consider the greatest single influence in the country in developing an appreciation of the value of good roads to the community and of the importance to the taxpayers of conducting road work in a businesslike manner, with due regard to good engineering practice. In 1905 the Division of Tests was consolidated with another division of the Department of Agriculture into the Office of Public Roads, and Mr. Page was made its director.

Early Work of the Bureau

The early work done by this bureau along technical lines was largely devoted to very close coöperation with the rather limited number of engineers who realized that the enormous sums spent annually in highway improvements were largely wasted through the ignorance of those entrusted with their expenditure. The work which the bureau did in helping these engineers, who were generally without adequate funds for carrying on investigations, was of the greatest value in placing highway engineering on a sound technical basis throughout the country. The enthusiasm of Mr. Page and the warm support given to his work by the successive Secretaries of the Department of Agriculture enabled the scientific and engineering resources at Washington to be utilized with maximum efficiency by road builders throughout the country. At this day, when so many of the state departments have their own laboratories, only those who know the value of the early work of the Office of Public Roads have any appreciation of the importance of its services to the country.

Roads Met With Opposition

The opposition to good road building in many parts of the country was quite active for some years after the Office of Public Roads was formed. There was a feeling that it was unnecessary to spend large sums in the improvement of alignment, the reducing of grades, the betterment of drainage, and the construction of hard-surfaced roads. Several organizations of what we would now call a profiteering nature were formed for the purpose of promoting road improvements. The self-elected officers of them obtained money from the people interested in road improvements in various districts, for the purpose of organizing conventions to discuss road building. This money mostly stayed in the hands of the promoters, and the so-called conventions were a menace to the development of popular interest in rational highway improvements. Mr. Page, accordingly, organized with a number of his friends the American Highway Association, which for some years carried on active educational work for the purpose of interesting influential men in road building. Under his guidance the association succeeded in playing an important rôle in convincing the public that road building should be entrusted to men of experience in such work, and that the financing of road improvements should be put on a sound economic basis. The work of the association was finished a year ago, but the organization during its few years of existence was of such value that the judgment of Mr. Page in organizing such a body was fully justified.

Man of Constructive Imagination

When the Federal-aid road law was passed, in 1916, the good organization which Mr. Page had developed in Washington was demonstrated by the promptness with which national coöperation in road building was undertaken. It was a new departure in public works. Some of the details involving the legal relations of the Federal Government and the states were so novel that it was necessary to feel one's way carefully through an uncharted sea In this difficult work the constructive imagination which was one of Mr. Page's great gifts proved invaluable.

Saw Complications Before They Arose, and Made His Plans

It was my good fortune to be able to see how this characteristic enabled him to sense possible complications long before they arose, and to have his plans ready to meet them. The road builders of the states, harassed by their own difficulties, cannot appreciate as yet the value of the help which Mr. Page rendered them through this gift, which few possess. It is the thing which bothers us on which our attention is fixed; we give little thought to those things which might bother us, but have been brushed from our path by the foresight of another. If there was any one thing that impressed me of late in the work of this gifted public officer, it has been the patient, constant forethought which he showed for the problems of the state highway departments and local road builders, and the innumerable instances of help given to them, of which they have little or no knowledge in most cases.

All States but One Assent To Federal-Aid Road Act

Legislative assent, required by the Federal-aid road act, has now been given by the legislatures of all states except Alabama, according to the annual report of the Office of Public Roads. The Alabama legislature meets only quadrennially, and its next regular session will convene in January, 1919, at which time, it is expected, the necessary legislative assent will be given. The Governor of Alabama has assented on behalf of the state, as authorized by the act, so that coöperation by the state has not been affected adversely.

Engineering Educators Welcome British Mission

Discuss War Lessons for Technical Instructors and Necessity for Broader Training

With the members of the British Educational Mission to the United States as guests and the problems of war and reconstruction up for discussion, the Society for the Promotion of Engineering Education held its 25th anniversary convention at Boston, Mass., Dec. 6-7. The prospect of an early strengthening of relations between educational institutions in the United States and Great Britain was a dominant note in the proceedings, and the sessions were marked by new appreciation of the importance of broadening and deepening the training of the engineer. The desirability of capitalizing some of the benefits of military discipline, for permanent use in character building by undergraduates, was generally recognized. A special session devoted to research united the members and delegates in asking that Federal support be given to a program to aid the United States in maintaining its new place in world leadership, and to facilitate its economic progress.

Favors Specialists in Lecture Rooms

Sir Henry Miers, F. R. S., vice-chancellor of the University of Manchester, spoke of the calling of industrial specialists into the lecture room as a most desirable factor in education. He said that in the north of England the feeling is growing that the student should gain practical experience in industrial works before entering upon the university course proper, and that it is a mistake to attempt to sandwich in works experience except during vacations. He thought too much attention is being given today to the needs of the rank and file of the profession, rather than to training men for the broadest and heaviest responsibilities. The universities in England are trying to get into closer touch with the industries. Firms are introducing scholarships for the purpose of training qualified young men for research. A strong demand for nonvocational training is now being met by the universities. The workers look with suspicion on any training which tends to increase their efficiency of production, but are seeking cultural education. In closing, Dr. Miers emphasized the importance of training engineers in industrial history and social economics. Dr. John Joly, of Trinity College, University of Dublin, emphasized the importance of carrying mathematics farther in engineering schools.

At a dinner Dec. 6 Sir Henry Miers expressed the thought that the mission might be considered as a "bridge across the Atlantic which shall be traversed by a continuous intellectual flow embodied in students and teachers passing between the two countries."

At the session Dec. 7 the opening ad-

dress was upon "The Effect of the War upon Engineering Education in the United States," by Dr. C. R. Mann, of the Joint Committee on Engineering Education. An abstract of Dr. Mann's paper is printed on p. 1069.

TRAINING ENGINEERS FOR THE ARMY

Maj. Gen. William M. Black, Chief of Engineers, U. S. A., outlined the duties of the military engineer in active war service and also under peace conditions, relating with appreciation how the engineering profession responded most patriotically to the country's call in the great war. He said that it was necessary to explain that, valuable as expert knowledge and ability are in war, the highest degree of all-around ability in engineering is demanded for combat service. Maximum versatility and not one-sided specialization is required. The tasks which must be done include, for example, the organization of a line for defense, including the consolidation of trenches, the construction of communication trenches, proper drainage, sanitation, communication, etc. In the rear the engineer is called upon to construct entire villages and cities; thus, a hospital of 25,000 beds required the construction of over 1000 separate buildings, 50 miles of piping, and also electric transmission lines. Long lines of warehouses are essential at the supply depots, all electrically illuminated and supplied with water, sewers, railway yards, piers, etc.

In a brief discussion of General Black's address, Prof. J. C. Olson, of the Rensselaer Polytechnic Institute, contended that the use of the military method in education does not encourage originality or inventive faculties, and maintained that engineering education should not lose sight of the importance of producing technical specialists. The speaker deprecated the production of engineers with too much all-around training. Professor M. I. Pupin, of Columbia University, said that he had found a West Point graduate far ahead of others in usefulness in certain research work, and he felt that military discipline was of great value and that American universities are deficient in the matter of disciplinary emphasis.

TIME TO SUPPORT RESEARCH

That the time has arrived to urge Federal support of research and to plan for its development along comprehensive lines, was the unanimous opinion of a session devoted to this subject, in which President Richard C. Maclaurin, of the Massachusetts Institute of Technology, emphasized the importance of bringing the matter before Congress in a united front. He said that the country should now make adequate provision for science in all its branches, aiming at a great Federal organization comparable to present Government departments. He described the main features of the Smith-Howard bill now before Congress, under which $15,000 per year, and ultimately $30,000, will be appropriated for research in each state, and distributed through the state legislatures. He thought the bill too narrow in its present form, but emphasized the importance of agreeing in order to obtain action at this time.

Professor Pupin suggested that the Smith-Howard bill might well be amended to provide for the distribution of the Federal aid through a committee of five scientific men in each state, to be appointed by the Governor or the state legislature. During the discussion it was pointed out that there are certainly six institutions in this country to which should be granted at least $100,000 a year each for research, in proportion to their facilities and staffs. President Thompson, of Ohio State University, urged the importance of encouraging state aid to research as well as Federal assistance.

At the final session, a general discussion of educational methods emphasized the amazing speed and success of military training under the selective service law, and developed the thoughts that patriotism of peace must succeed patriotism of war among students; that theoretical instruction must fall within the understandable range of practice, and that inventive adaptability to meet immediate problems is not necessarily antagonistic to military training methods.

John D. Rockefeller, Jr.'s Industrial Creed

Principles He Laid Down at the Reconstruction Congress at Atlantic City

1. I believe that labor and capital are partners, not enemies; that their interests are common interests, not opposed, and that neither can attain the fullest measure of prosperity at the expense of the other, but only in association with the other.

2. I believe that the community is an essential party to industry and that it should have adequate representation with the other parties.

3. I believe that the purpose of industry is quite as much to advance social well-being as material well-being and that in the pursuit of that purpose the interests of the community should be carefully considered, the well-being of the employees as respects living and working conditions should be fully guarded, management should be adequately recognized and capital should be justly compensated, and that failure in any of these particulars means loss to all four.

4. I believe that every man is entitled to an opportunity to earn a living, to fair wages, to reasonable hours of work and proper working conditions, to a decent home, to the opportunity to play, to learn, to worship and to love, as well as to toil, and that the responsibility rests as heavily upon industry as upon government or society, to see that these conditions and opportunities prevail.

5. I believe that industry, efficiency and initiative, wherever found, should be encouraged and adequately rewarded, and that indolence, indifference and restriction of production should be discountenanced.

6. I believe that the provision of adequate means of uncovering grievances and promptly adjusting them is of fundamental importance to the successful conduct of industry.

7. I believe that the most potent measure in bringing about industrial harmony and prosperity is adequate representation of the parties in interest; that existing forms of representation should be carefully studied and availed of in so far as they may be found to have merit and are adaptable to the peculiar conditions in the various industries.

8. I believe that the most effective structure of representation is that which is built from the bottom up, which includes all employees, and, starting with the election of representatives in each industrial plant, the formation of joint works' committees, of joint district councils, and annual joint conferences of all the parties in interest in a single industrial corporation, can be extended to include all plants in the same industry, all industries in a community, in a nation, and in the various nations.

9. I believe that the application of right principles never fails to effect right relations; that "the letter killeth and the spirit maketh alive"; that forms are wholly secondary, while attitude and spirit are all-important, and that only as the parties in industry are animated by the spirit of fair play, justice to all and brotherhood, will any plans which they may mutually work out succeed.

10. I believe that that man renders the greatest social service who so cooperates in the organization of industry as to afford to the largest number of men the greatest opportunity for self-development and the enjoyment by every man of those benefits which his own work adds to the wealth of civilization.

Puget Sound Continues Fast Work In Shipbuilding

On its third ship to be launched the Seattle North Pacific Shipbuilding Co., Seattle, Wash., made a record of 81 days from keel-laying to launching, according to the *Emergency Fleet News* of Dec. 5. The vessel was the "Iconium," a 9400-ton ship, launched Nov. 26. The first ship of the yard was launched in 84 days.

Milwaukee Plans $3,100,000 for Public Works in 1919

In anticipation of the necessity of providing employment for men relieved from duty in war industries, the Department of Public Work of Milwaukee, Wis., is considering the advisability of preparing and providing for unusually large expenditures next year. Projects will be submitted to the board of estimate. which prepares the budget

for recommendation to the city council. The projects to be proposed include the following: New bridges, \$500,000; track depression, \$500,000; street work, \$400,000; viaduct repairs and reconstruction, \$350,000; harbor improvements, \$250,000; sewer extensions, \$100,000. Besides the above works, totaling about \$2,100,000, are those contemplated by the school board and the sewerage commission, which have new and deferred works on hand amounting to about \$1,000,000, all of which could be started next year if necessary.

Announce Local Correspondents of Engineering Council

During the past few months some twenty-five men have been selected by the Engineering Council as correspondents. It will be their function to transmit notes on the activities of the Engineering Council to engineers in all branches of the profession in their respective localities, to send information and suggestions appropriate for the attention of the Council, etc. The list of those selected follows:

Anaconda, Mont.	C. D. Demond, Anaconda Copper Mining Co., 704 Main St
Atlanta, Ga	A. M. Schoen, Trust Co. of Georgia Bldg
Buffalo, N. Y.	Edmund B. Neil, Sec., Engineering Society of Buffalo, Pierce-Arrow Motor Car Co.
Butte, Mont.	E. B. Young, Sec., Montana Section, A.I.M.E., 526 Hennessy Bldg
Chicago, Ill	E. S. Nethercut, Sec., Western Society of Engineers, 1735 Monadnock Block.
Cleveland, Ohio	Arthur F. Blaser, Sec., Cleveland Engineering Society, 830 Leader News Bldg
Denver, Colo	Fred J. Rankin, Colorado Public Utilities Commission, State Capitol.
Detroit, Mich.	D. R. Williamson, Sec., Detroit Engineering Society, Detroit Board of Commerce
Duluth, Minn.	W. H. Woodbury, Sec., Engineers' Club of Duluth, 401 Wolvin Bldg
Iowa City, Iowa	John H. Dunlap, Sec., Iowa Engineering Society.
Miami, Gila Co., Ariz.	B. B. Gottsberger, General Manager, Miami Copper Co.
Milwaukee, Wis.	Fred H. Dorner, Sec., Milwaukee Engineering Society, Wells Bldg.
New Orleans, La.	John Klorer, Pres., Louisiana Engineering Society, 8300 Panola St.
Portland, Ore.	George C. Mason, Gasco Bldg.
Reno, Nev	H. M. Rives, Sec.-Treas., Nevada Mine Operators' Association.
Sacramento, Cal	Austin B. Fletcher, State Highway Engineer, Forum Bldg.
Salt Lake City, Utah	Leonard Cahoon, Pres., Utah Society of Engineers, Gallagher Machinery Co.
St. Louis, Mo.	John W. Kerr, Sec., Engineers' Club of St. Louis, 3817 Olive St.
St. Paul, Minn.	George H. Herrold, Sec., Minnesota Joint Engineering Board, Room 78, City Hall
San Francisco, Cal.	Nathan A. Bowers, Sec., San Francisco Engineers' Club, Rialto Bldg.
Seattle, Wash.	Amos Slater, Sec., Associated Engineering Societies of Seattle, 445 Henry Bldg.
Spokane, Wash	Alfred D. Butler, Sec., Spokane Engineering and Technical Association, City Hall.
Trenton, N. J	Joseph F. English, Sec., Trenton Engineers' Club.

It is expected that correspondents will be selected in a few other places in the near future.

Public Health Progress and Some Needed Reforms

Presidential Address Holds Up New Standards—New Jersey Health Board Stagnant

Called to France on the mission announced in *Engineering News-Record*, Nov. 28, 1918, p. 1003, George W. Fuller was unable to present in person his presidential address before the 44th annual meeting of the New Jersey Sanitary Association at Lakewood Dec. 6. The address, which was read by the secretary, was on "Recent Developments in Health Work." In the course of his paper Mr. Fuller said: "It is well for all sanitarians to bear in mind a view which has sprung up in many localities during recent months; that is, that it is frequently of more importance to extend the sewer system of a community than it is to perfect or even to commence the installation of sewage treatment works." In line with this general thought, Mr. Fuller said, later on: "A sound perspective is needed at the present time in revamping the whole question of appropriations made in a sanitary field, with a view to seeing that money is spent in a manner to do the greatest good." A summary, contained in the concluding paragraph follows:

Summary of the Address

"Old-world standards of life for nations and individuals have passed. In the course of our struggle to make the new-world ideas effective, we have learned some lessons which should be utilized as we bring our daily existence back to a normal plane. It is the duty of sanitarians in this state to make our people realize the scope of modern sanitation and see what a defense it is. Great advance in elimination of water-borne diseases has been shown, but education is still needed in our communities to show that these diseases probably cannot be further checked without eliminating insect carriers and securing general municipal cleanliness. Social disease has seriously lowered the strength of our population, and the improvement effected during military service must be carried ahead by civilian agencies. These are tasks for which the engineer and the doctor are to join their functions in harmonious teamwork. Public health work must be balanced, amply financed and well planned to secure a maximum total benefit for every dollar expended. Great, sudden contingencies and local exigencies must be provided for. Municipal sanitarians must keep out of ruts on the one hand; but on the other hand must not develop, in their enthusiasm for excursions into new fields, inertia toward broader and less interesting projects."

Invited to discuss "Some Needed Reforms in Public Health Work," M. N. Baker, of the editorial staff of *Engineering News-Record*, centered his remarks on needed changes in the New Jersey State Department of Health. He said in part: "Only a few days ago a close observer deplored the unprogressiveness of the department. 'It is not even drifting,' he said; "it is stagnant.' My own conviction, based partly upon personal experience as a member of the reorganized board, is that the efficiency of the department would be greatly increased if the board were swept out of existence or restricted to advisory duties, and all the executive functions of the department were centered in a single commissioner, as is the practice now in New York, Pennsylvania, Massachusetts, Maine, Connecticut, Ohio, West Virginia and Oklahoma.

"The statute reorganizing the department is sound in most of its fundamentals. It goes far in separating the legislative and executive functions of the department and in making the director the chief executive officer. But it establishes a considerable division of responsibility. The director has surrendered and the board has assumed powers plainly vested in the director, but the board, like such boards in general, is not properly constituted for quick and efficient executive work. The result is circumlocution, delays, postponements, the killing of initiative, and general discouragement of the bureau chiefs and assistant director, who are the departments life and working force.

"The department lacks a living, growing plan of health protective work, coupled with a real budget. It has lacked the courage, the initiative, the vision to determine what's what in public health work, to establish relative values in terms of costs. Granted full powers to frame and enforce a state-wide health code and to see that local boards enforce the code and the state health laws generally, the department has been slow in drafting the code and slower yet in seeing that local boards do their full duty to their communities and the state."

Urges Reform of Department

Concluding, Mr. Baker urged that the New Jersey State Department of Health be reformed so it may become "a leader in these critical times, doing not alone such direct work as belongs to it, but serving also to point the way in local health administration—which, after all, is the vital thing—leading where local departments need leadership, compelling where without compulsion the public health will not be protected."

A resolution was adopted requesting the legislative committee to take steps to secure an amendment to the state health law confining the State Board of Health to advisory functions and giving the director mandatory power.

The election of officers resulted in the choice for president of Charles J. Fisk, formerly mayor of Plainfield; chairman of the executive council, John H. Gregory, consulting engineer, New York City; secretary, Lieut. Edward Guion, M. R. C., U. S. A., and acting secretary, Dr. C. W. Crankshaw, East Orange, the last two being reëlected.

A. S. M. E. Meeting Stresses Human Problems

Large Part of Discussion at Annual Sessions Devoted to "Engineering of Man-Power"

At the annual meeting of the American Society of Mechanical Engineers, held in New York last week, the sessions which attracted the largest attendance were those devoted to the "Engineering of Man-Power," as the program phrased it. A terse summing up of the situation confronting the engineer was given in an after-luncheon address by Dr. George W. Kirchwey, late dean of the Columbia University Law School. Dr. Kirchwey declared that the engineer, by his development of machinery and his organization of industry, has revolutionized the whole social organization and brought the world face to face with appalling social problems. "You have got us into this mess," said Dr. Kirchwey, "and it is up to you to get us out of it."

The session on the "Engineering of Man-Power" opened with an address by Dr. L. S. Rowe, assistant secretary of the treasury. Dr. Rowe, who is a member of the faculty of the University of Pennsylvania, is well known as one of the leading experts in the United States on conditions in South and Central America. The main topic of his address was the position of the engineer from the United States undertaking work in Spanish-American countries. While giving to the American engineers who have carried out work there high credit for technical ability, ingenuity in overcoming obstacles, and "driving power" in completing work in a minimum time, Dr. Rowe said that observation had convinced him that engineers from the United States very generally failed to cultivate good relations with the native workmen and did not even try to understand their personality and point of view.

In a paper entitled "Standardization and Administration of Wages," Henry C. Kendall and Earl B. Howard discussed the changed relations between employers and labor likely to result from the war. The authors believe that joint boards of employers and employees to deal with the wages and working conditions of an entire industry are likely to become permanent and be adopted in many industries. The authors estimate that these joint boards will eliminate at least three-fourths of the present friction and strife between employers and workmen.

In a paper entitled "Nonfinancial Incentives," R. M. Wolf, manager of the Spanish River Pulp & Paper Mills of Sault Ste. Marie, Ont., described the manner in which he had greatly increased the production of the plants under his care by educating the men in the technical details of their work and then keeping them informed, by up-to-date progress records, of their relative efficiency, week by week, so that they took pride in keeping up and improving their records. In the repair department, by giving the men who carried on the repair work a record showing the cost of the materials which they used, the cost of these materials was reduced more than one-half in the course of two years. This paper brought out active discussion, the purport of which was that while such nonfinancial incentives were excellent, a very much higher degree of efficiency was obtained when the workman was given a financial incentive as well for doing his best.

In a paper on "The Employment of Labor," Dudley R. Kennedy, employment manager of the Hog Island shipyard for the American International Corporation, described the difficulties experienced in maintaining the labor supply on this enormous job. How huge the task was may be judged from Mr. Kennedy's statement that the rate of money expenditure at Hog Island was five times as great as on the Panama Canal.

The vocational instruction carried on by the War Department Committee on Education and Special Training was described by C. R. Dooley, director of the work. The committee was appointed in February, 1918, with instructions to train 90,000 men in the six months from Apr. 15 to Nov. 15, allowing two months as the length of each course of training. There were established 140 vocational schools in educational institutions scattered in all parts of the country, and the work was carried out according to schedule, approximately 100,000 men being trained during that time in some 30 different trades.

Charles Piez, vice-president of the United States Shipping Board's Emergency Fleet Corporation, described the organization which had been developed to conduct that enormous enterprise. The corporation is responsible for a total expenditure of nearly $4,000,000,000, involving the construction of vessels for the American merchant marine aggregating some 15,000,000 tons, dead weight.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan 15-16, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 25-28, New York City.

The American Society for Testing Materials has appointed the following representatives on the American Engineering Standards Committee, in which the society recently voted to participate: A. A. Stevenson, A. W. Gibbs, and J. A. Capp, appointed to serve one, two and three years, respectively.

The Engineers' Club of Trenton, N. J., will hold its annual meeting tonight. Captain Sapelli, of the Italian Commission, will deliver an address on "Italian Participation in the World War," illustrated with lantern slides. The annual report of the board of governors of the club will be received, and officers will be elected for the coming year from the following nominations: President, Charles R. Fairchild; first vice-president, Alfred P. S. Bellis; secretary, Joseph E. English.

The Louisiana Engineering Society was addressed Dec. 9 by William T. Hogg, who spoke on "Suggested Changes in the Operation of the Street-Car System in New Orleans."

The Brooklyn Engineers' Club will hold its annual meeting tonight. The annual report of the board of directors will be received, and election of officers made from the following nominations: President, Frank W. Skinner; vice-president, Herbert B. Morrison; secretary, Joseph Strachan; treasurer, Carroll S. Dunphe. The annual dinner will precede the meeting.

The Detroit Engineering Society held a meeting Dec. 6, at which H. W. Clausen, vice-president of the American Association of Engineers and assistant city engineer of Chicago, delivered a paper on "The Relation of the Engineer to Business and Social Problems." J. H. Herron spoke regarding the joint membership plan between the American Association of Engineers and the Cleveland Engineering Society.

The Engineers' Club of Philadelphia will be addressed by Commander F. G. Coburn, U.S.N., manager of the naval aircraft factory at the navy yard, Philadelphia, on "Airplane Construction," at the weekly luncheon on Dec. 17.

Personal Notes

C. T. HENDERSON has resigned as chief engineer of the Submarine Boat Corporation and has become chief engineer of the Hercules Engineering Corporation, New York City, and president of the Electrolytic Engineering Corporation. Prior to his association with the Submarine Boat Corporation Mr. Henderson was general manager of the Niagara Smelting Corporation, Niagara Falls, N. Y.

D. E. HELVERN, division engineer, Atchison, Topeka & Santa Fé

Ry., with headquarters at Pueblo, has been appointed district manager, northern district, Atchison, Topeka & Santa Fé Ry., succeeding J. A. Gillies, who has been appointed trainmaster at Dodge City, Kan., as noted elsewhere.

F. L. Nicholson, consulting engineer, Virginian Ry., with headquarters at Norfolk, Va., has been appointed chief engineer.

J. A. Gillies, district engineer, northern district, Atchison, Topeka & Santa Fé Ry., has been appointed trainmaster at Dodge City, Kan.

B. Wheelwright, acting signal engineer, Grand Trunk Ry., Canadian lines, with headquarters at Montreal, has been appointed engineer maintenance of way, New England lines, with headquarters at Portland, Me.

C. N. Bainbridge has been appointed engineer of design, Chicago, Milwaukee & St. Paul Ry., with headquarters at Chicago, succeeding H. C. Lothholz, resigned.

G. R. Barry, division engineer, Pennsylvania Lines at Columbus, Ohio, has been transferred to the Chicago division.

C. F. Loweth, chief engineer, Chicago, Milwaukee & St. Paul Ry., with headquarters at Chicago, has been appointed also chief engineer of the Port Townsend & Puget Sound Railway.

J. H. Libberton, division engineer, promotion bureau, Universal Portland Cement Co., has been appointed inspecting engineer and engineer of the promotion bureau, succeeding William M. Kinney, whose appointment as general manager of the Portland Cement Association was noted in *Engineering News-Record* of Dec. 5, p. 1051. Mr. Libberton has been with the company since 1908.

J. L. Campbell, engineer, maintenance of way, El Paso & Southwestern R.R., has been appointed chief engineer. Mr. Campbell entered engineering work in 1888 as deputy county surveyor of El Paso County, Texas, later becoming city engineer of El Paso, after which he was in charge of various location projects on railway systems in Texas, New Mexico and Mexico.

A. T. Mercier, previously assistant district engineer, southern district, and division engineer, San Joaquin division, Southern Pacific Co., has been appointed division superintendent, with headquarters at Portland. In 1904 he entered the service of the Southern Pacific on the Los Angeles division as roadmaster's clerk and transitman, later becoming general foreman and engineer in charge of terminal construction at San Pedro, Cal. In 1909 he became assistant division engineer, Los Angeles division, and was later made district engineer of the southern district. In 1912 he was appointed division engineer of the San Joaquin division.

F. M. Graham, division engineer, Pennsylvania Lines, with headquarters at Chicago, has been appointed supervising engineer, southwest system of the Pennsylvania Lines, with office at Columbus, Ohio.

E. A. Whitman, chief engineer, Minneapolis, St. Paul & Sault Ste. Marie Ry., with offices at Minneapolis, has been appointed also chief engineer, Lake Superior Terminal & Transfer Railroad.

L. L. Hidinger, vice-president of the Morgan Engineering Co., Memphis, Tenn., has been appointed chief engineer of the Little River Drainage District, succeeding the late William A. O'Brien, whose death was noted in *Engineering News-Record* of Oct. 24, p. 781. Mr. Hidinger was graduated from Iowa State College in 1906, after which he became drainage engineer, bureau of drainage investigations, United States Department of Agriculture, in Illinois. Since that time he has been continuously engaged in drainage and reclamation work. In 1910 he became vice-president of the Morgan Engineering Co., and has been in charge of reclamation projects in various parts of the country.

Edward Gagel, chief engineer of the New York, New Haven & Hartford R.R., has been appointed also chief engineer of the Central New England Ry., New York Connecting R.R., Wood River Branch R.R., Union Freight R.R., the Narragansett Pier R.R., the Boston Terminal, the New England Steamship Lines, the Hartford & New York Transportation Line and the New Bedford, Martha's Vineyard & Nantucket Steamship Line.

Charles A. Whitmore, Visalia, Cal., has been appointed on the California State Highway Commission, succeeding Henry J. Widenmann, whose death was noted in *Engineering News-Record* of Oct. 24, p. 781.

Frank H. Fowler, engineer and architect, Seattle, has removed his office to 2006 L. C. Smith Building.

Charles F. Stern, one of the three members of the California Highway Commission, has been appointed state superintendent of banks. Mr. Stern is a graduate of the University of California. He served on the State Board of Education in 1913, and since January, 1914, on the State Highway Commission. His successor has not yet been named.

Archibald W. Campbell, recently deputy minister of railways and canals for the Dominion of Canada, has been appointed a commissioner to investigate and report to the Canadian Government on the question of good-roads construction. Mr. Campbbell was for many years deputy minister of public works for Ontario and was the practical founder of the good-roads movement of that province.

Samuel T. Wagner has resigned as chief engineer of the Philadelphia & Reading Ry. under Federal Manager Charles H. Ewing, to become corporate chief engineer of the Philadelphia & Reading Railway Co., with headquarters at Philadelphia.

Obituary

Logan Waller Page, director of the United States Office of Public Roads and Rural Engineering, died suddenly in Chicago, Dec. 9, while in attendance at the annual meeting of the American Association of State Highway Officials. He was born in Richmond, Va., in 1870, and was a student in engineering at Virginia Polytechnic Institute for two years and at Harvard University for six years. Later, at Harvard, he was in charge of tests of all materials used by the Massachusetts Highway Commission and some for other states and Canada. In 1899 he made an extended study of road building in Europe. A year later, he became chief of the road material laboratory, United States Government, afterwards reorganized as the Division of Tests. In 1904 he became director of the Office of Public Roads, which combined the Division of Tests and the Office of Public Roads Inquiry, in the Department of Agriculture. In 1908, Mr. Page acted as chairman of the commission to represent the United States at the International Road Congress in Paris. An appreciation of his life and work, by John M. Goodell, appears on page 1095.

Carey S. Pratt, formerly bridge engineer for Mercer County, New Jersey, died recently at his home in Trenton, N. J. He attended Ohio State University and in 1892 became deputy county surveyor of Noble County, Indiana. Afterward he served as city engineer of Sidney, Ohio, and later became resident engineer of the Dayton, Springfield & Urbana Electric R.R. and chief engineer of the Springfield & Xenia R.R. In 1902 he became city engineer of Urbana, Ohio, later removing to Trenton, N. J., where he became bridge engineer for the county.

Edward Allen Wickes, president of the Niagara Falls Power Co., died recently in New York City. He was also a director in the Tonawanda Power Co., Cataract Power & Conduit Co., and the Canadian Southern Ry. Company.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Construction Industries Form National Organization

At the convention of representatives of construction industries last week at Atlantic City, a national organization was formed. It has been named "The National Federation of Construction Industries." All war service committees interested in construction industries, and all associations of architects, contractors, engineers, and manufacturers, and dealers in building materials, were invited to send delegates with power to act in planning a policy and program for the future. At the meetings reports were received on the activities of the central war service committee of the building industries, for the creation of which the national federation was originally organized; committees were appointed and reports received. In his remarks at the opening of the meeting, Chairman Ernest T. Trigg stated that the views of leaders in the various branches of the construction industry throughout the country were solicited, and it was the consensus of opinion that a permanent organization was desirable at this time.

The report of the meeting states that nine of the 32 resolutions passed by the conference were of special interest to the construction industries. They were, on removal of restrictions on industries, cancellation of war contracts, disposal of surplus government supplies, relocation of labor, immediate development of public works, extension of port and terminal facilities, development of water power; research connected with forest products, and uniform methods of cost accounting.

Resolutions were also passed advocating the development of foreign commerce and the sending of a committee of American business men to attend the sitting of the peace conference.

Shipbuilding Restraints Lifted by Shipping Board

The war-time restraints on wooden and steel ship construction have been removed by the United States Shipping Board, in so far as the acceptance of contracts for building vessels for private accounts is concerned. In regard to wood construction, the American shipbuilders may now solicit and accept orders and carry forward the work of construction and enter into contracts for the sale of ships, on completion, without restraint. The same action with reference to steel ships is announced, but applying to domestic orders only. The Shipping Board announced that this action is in accordance with the progressive release of business from war-time restrictions, and is not dictated by any special consideration.

Labor Turnover Reduced and Financial Saving Effected by Better Housing

Important Economic and Engineering Problems Discussed at Meeting of National Housing Association

Housing and transportation have been found to be the most important factors in the turnover problem, next to actual labor conditions within the plant. These conclusions were presented in papers read before the convention of the National Housing Association recently held in Boston, and are the results of a nation-wide study of the housing problem. The studies emphasized the engineering phases of building construction, town planning, and urban and suburban transportation, and show that the solution of the problem will result in saving a large amount of money, by the reduction or elimination of labor turnover.

Capt. Boyd Fisher, chief of the employment management division of the War Industries Board, in his paper entitled "Good Housing as a Reducer of Labor Turnover," stated that "it serves a manufacturer's strictly business interests to build houses for his workmen." He added that the proof of this will be found in the record of companies whose labor turnover has been reduced by the provision of sufficient and decent housing accommodations, as against those who have neglected the problem.

Lack of Houses Shown

Captain Fisher briefed the reports of the field agents of the United States Housing Corporation, and brought to light the "deplorable situation in lack of housing that exists throughout the industrial centers of the country." The reports cover the shipbuilding plants of the Atlantic coast, the general manufacturing centers in Ohio and the Central West, industrial centers in the South, the lumber industry in the Northwest, and the agricultural regions of California. Such conditions as men occupying the same bed in three relays, two to eight men quartered in the same room, and families living in cellars and garrets, are exposed. The reports state that "employers interviewed without exception consider that housing shortage is a very important, if not the principal, cause of high turnover." In one plant employing many hundreds of men the turnover was found to be over 30% per month, and the company estimated that by solving the housing problem it would save $200,000 a year.

The actual working out of good housing conditions, as compared with poor housing, is illustrated in the blast-furnace section of Pennsylvania. One company had two blast furnaces about 20 miles apart, between which was the blast furnace of a rival company. The housing facilities of the first company are considered superior to that of the other, and it was found that for a number of years the second company has had to pay all its men a higher rate per day for the same number of hours.

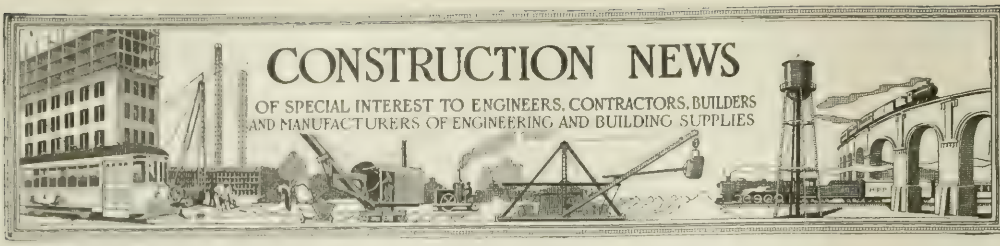
In a paper entitled "Housing and Reconstruction," Thomas Adams, town planning adviser to the Conservation Commission of Canada, pointed out that the provision of houses, as part of a policy of reconstruction, has still to be begun in this country and in Canada. Evidence presented before certain investigating committees of Congress brought out that the increase of war-time output in shipyards and munition plants was due to the increased efficiency and contentment of the workers brought about by better housing.

Good Housing as Necessary Now as in War Times

If it is true that good housing was needed to win the war, Mr. Adams asked, is it not equally true that good housing is needed to win or maintain the victory of peace? The war-housing problem, he stated, has passed into history so far as housing purely war workers is concerned, but there still remains the problem of making up for the shortage of houses caused by the high prices of labor, materials and money. Bad housing conditions are not caused by scarcity of houses so much as by defective Government and false economic ideals, because, even in peace times, with an excess supply of houses, slum conditions persist.

Mr. Adams gave an exposition of England's purposes and plans in spending $600,000,000 on new houses, and pointed out that the density of house building in England will be governed by town-planning schemes, fixing a certain number of houses to the acre and assuring that land purchases, local transit, and house building will proceed side by side, involving extensive work by the engineer.

Apparently having in mind both United States and Canada, Mr. Adams suggested appropriations by the Federal Government to aid state and provincial Governments in improving housing conditions, and further Federal help for highway improvement and for the development of land for housing purposes.



PROPOSALS

For Proposals Advertised See Pages 52 to 54 inclusive

WATER-WORKS

Bids Close — See Eng. News-Record

Dec. 17 Boonton, N. J. .... Dec. 12
Jan. 2 Galesburg, Ill. .... Dec. 12
Adv. Dec. 5 and 12.
Jan. 10 Houston, Tex. .... Dec. 12

SEWERS

Dec. 19 Long Island City, N. Y.... Dec. 12

BRIDGES

Dec. 19 Marianna, Fla. .... Nov. 21
Dec. 20 Petersboro, Ont. .... Nov. 28
Jan. 2 New Brunswick, N. J. ...... Dec. 12
Adv. Dec. 12.
Jan. 6 Tulsa, Okla. .... Dec. 12
Adv. Dec. 12.

STREETS AND ROADS

Dec. 16 Pocahontas, Ark. .... Dec. 12
Dec. 16 Dickens, Tex. .... Dec. 12
Dec. 16 Louisiana .... Dec. 12
Dec. 18 Pascagoula, Miss. .... Dec. 16
Dec. 19 Williamson, W. Va........ Nov. 28
Dec. 20 Marion, S. C. .... Dec. 5
Dec. 27 Pittsburgh, Pa. .... Dec. 5
Dec. 29 Great Bend, Kan. .... Dec. 5
Jan. 6 Tulsa, Okla. .... Dec. 12
Adv. Dec. 12.
Jan. 15 Blytheville, Ark. .... Dec. 5

EXCAVATION AND DREDGING

Dec. 16 Kirksville, Mo. .... Dec. 12
Dec. 17 Wilkesbarre, Pa. .... Dec. 5
Adv. Dec. 5 and 12.
Dec. 17 Olivia, Minn. .... Dec. 5
Dec. 17 El Centro, Cal. .... Dec. 12
Dec. 19 Walnut Ridge, Ark. .... Dec. 12
Dec. 23 Caruthersville, Mo......... Dec. 12
Adv. Dec. 5 and 12.
Jan. 3 Brownsville, Tenn. .... Dec. 12
Jan. 3 Terra Ceia, N. C. .... Dec. 12
Adv. Dec. 12.
Jan. 7 Albany, N. Y. .... Dec. 12
Adv. Dec. 12.
Jan. 9 Bridge Junction, Ark. .... Dec. 12
Feb. 3 Madisonville, Ky. .... Dec. 12
Adv. Dec. 5 and 12.

INDUSTRIAL WORKS

Dec. 16 Detroit, Mich. .... Dec. 12

BUILDINGS

Feb. 3 St. Paul, Minn. .... Oct. 31

Bids Close — See Eng. News-Record

FEDERAL GOVERNMENT WORK

Dec. 16 Electric Traveling Cranes —Spec. 3627—Alexandria, Va. .... Nov. 28
Dec. 16 Radial Towers—Spec. 3600 —Monroe, N. C. .... Dec. 5
Dec. 16 Freight Station—Spec. 3651 —Indianhead, Md. .... Dec. 5
Dec. 16 Sterilizing Equipment — Spec. 3674—Wards Island, N. Y. .... Dec. 12
Dec. 16 Fence and Gates — Spec. 3668—Bellevue, D. C...... Dec. 12
Dec. 18 Fuel Storage Tank, etc. — Detroit, Mich. .... Dec. 12
Adv. Dec. 5 and 12.
Dec. 19 Plumbing—Cleveland, O. .. Nov. 28
Dec. 20 Sewer Pipe — Key West, Fla. .... Dec. 12
Dec. 23 Pier and Bulkhead — Spec. 3663—Alexandria, Va. .... Dec. 5
Dec. 23 Septic Tank—Spec. 3664— Miami, Fla. .... Dec. 5
Dec. 23 Tanks—Spec. 3414—Rockaway, N. Y. .... Dec. 12
Adv. Dec. 5 and 12.
Dec. 23 Extension to Heating System and Power Plant — Spec. 3666 — Paris Island, S. C. .... Dec. 12
Dec. 23 Altering Marine Barracks — Spec. 3514 — Ft. Mifflin, Pa. .... Dec. 12
Dec. 23 Annex to Dispensary—Spec. 2588—Indianhead, Md..... Dec. 12
Dec. 23 Officers Quarters — Spec. 3677 — South Charleston, W. Va. .... Dec. 12
Dec. 23 Kitchen and Mess Hall Equipment — Spec. 3684 — Philadelphia, Pa. .... Dec. 12
Dec. 23 Boiler House, Heating and Drainage Systems, etc. — Spec. 3612 — Chatham, Mass. .... Dec. 12
Dec. 23 Extending Pneumatic Tube System — Spec. 3658 — Hampton Roads, Va. .... Dec. 12
Dec. 23 Wood Pier and Approach— Spec. 3491—Yorktown, Va. Dec. 12
Dec. 30 Shop and Industrial Buildings—Spec. 3675—Galveston, Tex .... Dec. 5
Dec. 30 Radio Building, Garage, Barracks, etc.—Spec. 3683 —Monroe, N. C. .... Dec. 12
Dec. 30 Additional Buildings—Spec. 3686—Cape May, N. J. .. Dec. 12
Dec. 30 Cranes—Spec. 3681—Washington, D. C. .... Dec. 12
Dec. 30 Boilers—Detroit, Mich..... Dec. 12
Adv. Dec. 12.
Jan. 2 Lavatory Annexes—Washington, D. C. .... Dec. 12
Jan. 3 Post Office—Park City, Utah Dec. 5
Jan. 3 Post Office—Newburyport, Mass. .... Dec. 5
Jan. 3 Post Office—Mt. Carmel, Ill. .... Dec. 5
Jan. 6 Post Office — Bakersfield, Cal. .... Dec. 5
Jan. 6 Post Office — Lancaster, S. C. .... Dec. 5
Jan. 6 Post Office—Caribou, Me... Dec. 5
Jan. 7 Post Office — Woodbury, N. J. .... Dec. 5
Jan. 7 Post Office—Fremont, O.... Dec. 5
Jan. 7 Post Office and Court House —Alexandria, La. .... Dec. 5
Jan. 8 Post Office—Prescott, Ark... Dec. 5
Jan. 8 Post Office—Cody, Wyo. ...... Dec. 5
Jan. 8 Post Office — Waterloo, N. Y. .... Dec. 5
Jan. 9 Post Office—Orange, Tex... Dec. 5
Jan. 9 Post Office — State College, Pa. .... Dec. 5
Jan. 9 Post Office and Court House —Durango, Colo. .... Dec. 5
Jan. 10 Post Office — Front Royal, Va. .... Dec. 5
Jan. 10 Post Office—Vineland, N. J.. Dec. 5
Jan. 13 Post Office—West Point, Ga. Dec. 5
Jan. 13 Post Office and Custom House—Ft. Fairfield, Me.... Dec. 5
Jan. 13 Post Office and Court House —Globe, Ariz. .... Dec. 5
Jan. 14 Post Office — Southbridge, Mass. .... Dec. 5
Jan. 14 Post Office—Cherokee, Ia... Dec. 5
Jan. 14 Post Office—McKees Rocks, Pa. .... Dec. 5
Jan. 15 Post Office — Long Island City, N. Y. .... Dec. 5
Jan. 15 Post Office—Kenton, O. .... Dec. 5
Jan. 15 Post Office — Bellefourche, S. D. .... Dec. 5
Jan. 15 Post Office — Winchester, Mass. .... Dec. 5
Jan. 16 Post Office—Eldorado, Kan. Dec. 5
Jan. 16 Post Office—Shawnee, Okla. Dec. 5
Jan. 17 Post Office—Franklin, Pa... Dec. 5
Jan. 17 Post Office—Cohoes, N. Y... Dec. 5
Jan. 17 Post Office—Buffalo, Wyo... Dec. 5
Jan. 20 Post Office — Harrisonville, Mo. .... Dec. 5
Jan. 20 Post Office—Owego, N. Y... Dec. 5
Jan. 20 Post Office—Sunbury, Pa... Dec. 5
Jan. 20 Post Office—Decatur, Ala... Dec. 5

MISCELLANEOUS

Dec. 16 Lumber—West Springfield, Mass. .... Dec. 5
Dec. 18 Auto Eductor, Steam Roller, etc.—Brooklyn, N. Y...... Dec. 12
Dec. 18 Steam Roller—New York, N. Y. .... Dec. 12
Dec. 18 Coal Trestle—Binghamton, N. Y. .... Dec. 12
Adv. Dec. 5 and 12.
Dec. 20 Semi Trailers — Brooklyn, N. Y. .... Dec. 12
Dec. 20 Extending Bulkhead — Brooklyn, N. Y. .... Dec. 12
Dec. 23 Elevated Railway—Philadelphia, Pa. .... Dec. 5
Dec. 23 Shaft—New York, N. Y. .. Dec. 12
Dec. 27 Electrical Equipment—Jersey City, N. J. .... Dec. 12

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Water-Works

PROPOSED WORK

N. J., Trenton—City plans to lay 10 in. iron water mains in various streets. About $20,000. H. C. Gregory, City Hall, engr.

Wis., Milwaukee—Bd. Pub. Wks. soon lets contract building water pipe tunnel under Menomonee River, from West Water St. to Reed St. and 2 shafts; also laying connecting water pipe line. P. Braman, deputy comr.

Kan., Logan—City election soon to vote $15,000 bonds to improve water-works and electric light plant.

Tex., Houston—E. E. Sands, city engr., soon receives bids improving water works system. Plans include 7 deep wells, deep well pumps, motors and electric generators. About $160,000. Noted Dec. 5.

Engineering News-Record

Devoted to Civil Engineering and Contracting
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THE old Christmas spirit has been dimmed for four years. Our hearts have been heavy with the woe of war. This year how different! The great sorrow is lifted. Enduring peace, a hope before, is an accomplishment now.

¶ With the conflict over and the future bright, most heartily do we extend to our readers the season's greetings—a Happy Christmas and a New Year filled with all the good things of body and spirit.

¶ And while on Christmas day we glow with happiness, our hearts go forth in gratitude to those overseas, brother and Ally alike, who have lived to glory in victory or who, no less triumphant, have made the supreme sacrifice. Our hearts, too, join those in sympathy and love whose Christmas day will have a shadow, in the memory of sons who will not return. They, no less than the brave men who have fought the good fight, have made it possible for us to work out our futures in peace and happiness.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

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E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

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Good Roads Vote Decisive All Over Illinois

NOT often has a bond issue for good roads been so handled from the educational standpoint that the issue has been carried in practically every county of a state. The official count in Illinois shows that every one of the 102 counties rolled up an actual majority, only two falling slightly below a constitutional majority, half the highest vote for members of the legislature. Of these two counties, one has a very small mileage of the proposed routes, and the other had a strong political leader unconvinced of the merits of the project. Candidates who were against the bond issue were almost invariably defeated. This augurs well for Minnesota with its proposed $100,000,000 project, if only a proper educational campaign is started far enough in advance and is conducted on nonpartisan lines.

Prejudice or Incompetence

DURING the season of 1918, just closed, the New York State Canals carried less freight than they did in 1917. Doubtless, more elaborate figures and some explanations will later be given out by the United States Railroad Administration, which now controls the canal, but deductions from the bare statement of fact cannot be escaped. If, in spite of the difficulties in procuring boats and some deficiencies in the depth of the canal, a Federal administration with plenary powers of freight allocation and rate control could not send more tonnage over a modern barge canal than was carried last year over the narrow and shallow waters of the century-old Erie Canal, then one of two things is so: Either that administration is woefully incompetent, or it has prejudices against inland waterway navigation.

Problems in Determining a State Highway System

MR. HIRST'S paper, of which the second and concluding part appears in this issue, is so comprehensive a review of a problem that is now critical in all states—the determination of a state highway system—that we strongly urge its reading, not merely upon engineers and contractors engaged in highway work, but on all who have any connection with engineering and construction work. Large policies in engineering matters are determined to a considerable extent by the attitude of the public, and this every engineer and contractor is in a position to influence. Many points in Mr. Hirst's paper might be discussed, but particular emphasis should be laid upon his strong plea that a state upon designating a route as part of the state system should undertake its maintenance even before any new work on it is done. The past practice has been to take over the routes only after a new pavement has been laid. Mr. Hirst argues, with good reason, that immediate control of all routes designated as parts of a state highway system is a desirable policy. Local communities always neglect routes when they know that they are to be taken over by state authorities, while maintenance of even inadequate surfaces results in economy in haulage cost as compared with traffic over neglected roads. Mr. Hirst contends that the results in Wisconsin fully justify the adoption of the policy. We believe that engineers generally will agree with his point of view. Maintenance of existing surfaces is a good forerunner to the laying of roads of improved types.

Guarding Against Influenza Recrudescence

INFLUENZA is again on the increase. Everyone responsible for men and women gathered together in office, camp or shop should be forehanded with plans to meet a possible outbreak of the disease, and alert to forestall its spread. Concise directions to this end may be obtained from the United States Public Health Service, Washington, D. C., and from any of the more progressive state and local boards of health of the country. For the individual, greatest safety lies in keeping beyond the range of droplet infection from influenza victims who are giving out the specific germs by coughing, sneezing or talking. Inoculation against the disease and mask wearing are at least worth considering. Patients should be isolated, and bedside disinfection practiced. The chances are that before the winter passes those over forty years of age, who so largely escaped last fall, will be attacked. Finally, it should be remembered that regardless of influenza sequelæ the next few months will doubtless show many other cases of pneumonia, which is a communicable disease to be guarded against by the same general methods as apply to influenza.

Working Under Divided Responsibility

NEW attacks made on the Hog Island shipyard in the Senate evidence either a lack of subjects for debate or inability to get the proper perspective of this abnormally big enterprise. Undoubtedly, this effect of size is at least a factor in the matter; it is hard for statesmen to realize how far beyond all precedent was the task assigned by the Emergency Fleet Corporation to the Hog Island plant. Unfortunately, attacks such as these operate to delay and disorganize the work—which is still under the same driving pressure for speed as at

the start. Yet one good result might come out of the matter if Congress should enter into a real study of the enterprise; the evils of divided responsibility might be laid bare. When the history of the Fleet Corporation's work comes to be written, the remarkable agency-yard system will surely call for a chapter of its own. Under this system as practically applied, authority and responsibility are divided, the former residing in the Fleet Corporation while the latter rests on the agent. Spirit, energy, speed, cannot be expected in these premises. Notwithstanding this obvious fact, the agency yards have made wonderful performances, but until the Emergency Fleet Corporation renders account of its stewardship in the administration of these yards the country will not be in a position to judge where the credit and where the blame should be placed.

German Bureaucrats and Water Engineer Piefke

READERS of Dante's "Inferno" will remember the remarkable mental ingenuity of the author in devising punishments suited to the earthly sins of those who were undergoing punishment. The subject is recalled by the experience of a victim of German bureaucracy a quarter century ago, brought to light by George W. Fuller in an address from which extracts are printed on p. 1121. Piefke was an apostle of water filtration at a time when German officialdom, extending to even the Kaiser himself, it is said, was forcing the use of ground water instead of filtered surface water. This great water engineer, worried in his advancing years over titles and degrees, as the letter now given out by Mr. Fuller shows, was finally taken away from the congenial task of operating water filters and made recorder of ground-water statistics. Thus did the German iron hand equal both Dante and Gilbert and Sullivan in "making the punishment fit the crime."

Selection of Secretary of New Contractors' Association

NO ASSOCIATION of business or professional or trade interests is organized merely by naming its directing officials and codifying its purposes. Complete organization is a far more comprehensive series of processes and developments. It involves the selection and coördination of a working force; the creation of an active membership and a financial reserve; the practical application to its industry of a definite plan of service. To insure these accomplishments there must be the highest quality of management. Success of the Associated General Contractors of America, nominally organized four weeks ago in Chicago, will depend upon securing a good manager of the association. Specifically, success will depend upon securing a good secretary—a good working manager. Granting every credit deserved by president, vice-president and directors, still, they play a smaller part than does the secretary. The title of the office is unfortunate; it smacks too much of the desk worker and the keeper of records. A successful working secretary for an active business association is less the traditional secretary than he is the managing director of a business enterprise. Cognizance of this fact must stand solidly behind the choice of secretary for the new contractors' organization and behind the determination of the secretary's compensation.

The Decision as to Future Railway Control

PRESIDENT WILSON has referred to Congress for decision one of the most momentous questions that has ever confronted that body: Are the railways of the United States, which were taken over for operation by the Government during the war, to be returned to the owning companies—with reëstablishment, so far as possible, of pre-war conditions; is the experiment of Government operation to be continued for a term of years, as Director General McAdoo recommends; or is some middle course, as yet uncharted, to be followed?

From the numerous expressions of public opinion which have appeared since the President's message brought the railway question to the fore, it is easy to find substantial agreement on two points: That the railways should not be returned to the pre-war status, and that business men, at least, are generally opposed to the transfer of the railways to public ownership.

It seems worth while to enumerate some of the chief points in which, if the roads are returned to the companies, conditions are likely to be different from what they have been in the past.

In the first place, we have probably seen the end of competition in the railway business. Of course, direct competition in rates was practically ended years ago; but such competition in service as existed the experience of the war has shown to be more wasteful than beneficial to the public. This competition was responsible for more fast passenger trains and more frequent fast-freight service than were really needed, an expensive corps of agents to solicit traffic, and needless duplication of terminal facilities and offices. Now that the Government has demonstrated the public benefit of eliminating these and other wastes due to competition, it is not likely in future to enforce laws which have in the past kept the railway companies from agreeing among themselves to prevent such wastes.

In the second place, there is general agreement that Government control of the railway business must continue and must be made more thorough. When we come to the question what that control is to be and how it is to be exercised, the agreement disappears. It sounds well to say that Government control should in future be unified and effective and should be so exercised as to restore the financial status and credit of the companies; but is there any real likelihood of such changes in the existing methods of Government control? "Unified control" may be taken to mean that the present dual control by both Federal and state authorities should cease; but there appears to be no method short of an amendment to the Federal constitution by which the states could relinquish their control of intra-state traffic. Such an amendment would have hard sledding. State legislatures will be loath to yield their power over railways, which carries with it the power to protect a state's commercial cities against rival traffic centers in other states.

The Federal control of the railway business, if the roads go back to the companies, is certain to be much more complete. The Interstate Commerce Commission is already on record as urging that if the roads are returned to the companies no new railway construction or extensions shall be allowed except by Government au-

thorization. Such restrictions have been for years in force in several states, and will probably be made nation-wide. Similarly, the supervision over railway financing already established in several states is likely to be made a Federal matter, now that the war experience has made a precedent. The domination of Wall Street influence in railway management is distrusted by the public; and its distrust is justified by such scandals as those of the New Haven and the St. Louis & San Francisco—to mention only two out of many. There will surely be, therefore, a much more rigid Government control of railway company financing, if the roads are turned back to the companies.

In the third place, there looms up the railway labor question. The railway employees' organizations are here to stay. Nobody doubts that. History was made when they won their battle and dictated their terms of settlement in the fall of 1916. They are going to have a very large voice in determining their own wages and working conditions. The methods by which the railway companies have controlled the labor situation in the past are not going to succeed in the future. In short, whether the companies operate the roads again or Government operation prevails, the final decision on railway wages will be made by some Federal board.

The public is now paying something like $750,000,000 a year in increased fares and freights to enable the railways to pay out this amount in increased wages to employees. Probably this is a just and fair increase in view of the changed value of the dollar; but the question is, How far will extend the power of railway labor to exercise its control at the expense of the public?

A railway officer of long experience remarked a half dozen years ago: "I once thought I earned my salary by using my technical knowledge and executive ability to run the lines under my control economically and safely; but I have now become a mere clerk to execute the orders of others. The railway organizations dictate what wages shall be paid and the conditions under which the men shall work. I have to hire the men they furnish and can discipline or discharge only as they approve. The Federal and state commissions prescribe what train service I shall furnish, what rates I shall charge for passengers and freight, how I shall keep my books and records, what measures I shall use to secure safety at every point, from the spikes in the track to the hand-holds on a freight car. I go through my daily routine; but as for any opportunity of exercising executive ability, originality or initiative, there is little to choose between me and the office boy."

There are many strong arguments in favor of operation of the railways by private companies, but many of these arguments are based on conditions which have prevailed in the past and which have offered opportunity for the men of enterprise and ability who have developed our railways to an efficiency undreamed of a generation ago. Undoubtedly, we need, as much as ever, such men in the railway business; but the serious question to consider is whether, with competition eliminated, with public control exercised at every point, and with railway labor in a position to dictate its own terms, both incentive and opportunity for creating efficiency in railway operation are not largely removed.

There are unquestionably powerful arguments against operation of railways by the Government. They are familiar to our readers. Perhaps Director General McAdoo had these in mind when he expressed his belief that the five-year trial of Government operation which he recommends would not result in its adoption as a permanent policy.

Replacing Distrust in Contractors by Confidence

CONTRACTORS should see to it through their new national organization, said General Marshall in addressing the first national convention of the body in Chicago last month, that never again should a contract be drawn within the four corners of which could be written the contractor's bankruptcy. The significance of this statement did not escape those present, everyone of whom undoubtedly had suffered from the kind of contract to which the general referred. But even contractors do not always appreciate the full extent of the evil consequences of one-sided contract agreements. The agreement which assumes on its face that one of the contracting parties does not intend to perform his part, if it can be avoided, does more than work a hardship on the individual who accepts such conditions. It lets into the contracting field men with whom it is safe to deal only on the assumption that they must be watched. Worse; it lets in men whose intentions are honest, but whose competence is doubtful. In other words, so long as no contractor is deemed worthy of confidence, so long as private owners and public bodies choose to assume that it is necessary to spy on any contractor they may select, to plan and supervise his work, and to perform things within the province of the contractor—to make sure that they are done as desired—so long will owners be willing to entrust their work to the lowest bidder regardless of ability, and so long will experience and real capacity to handle work go without proper reward.

Individually, a single contractor may build up a reputation for capability which will keep him well supplied with work for owners who have confidence in him. But at the present time work for private owners offers the only opportunity of this sort, and as a relatively small part of the total work is in the hands of large operators whose construction goes on year after year, the opportunity for establishing such a clientèle is further limited. The average owner does not build extensively as often as once in a decade, and comes into the market for contractors' services prepared to take things as he finds them and to treat the contractor as incompetent and dishonest because he finds the public doing likewise.

Collectively, contractors can eradicate this distrust, and replace it with confidence on all work, within a short space of time. Having a national organization, they can make an early beginning by getting the members to leave alone that work on which the owners offer agreements which do not repose confidence in the contractor. With the strength of such an organization behind the movement, a natural separation between the real contractor and the man who ought not to be in the business will result. The competent men will join the na-

tional organization and back it, in order to have a chance to handle the kind of work on which ability is recognized and paid for. The public and other owners who cannot or will not evaluate ability and experience in letting work will find no one of reputation offering to undertake their projects. The final result will be the elimination of those who ought not to be in the field, and the recognition by the public and all other owners that skill and capacity must be paid for in construction work, just as in other lines of business.

National Highway System Gets Strong Backing

LAST week the Highway Congress at Chicago fully bore out the predictions that it would serve to crystallize the highway sentiment of the country. After attending the meetings no one could doubt that the country at large, as represented by delegates from practically every state, was determined that our present highway systems should be completed by the adoption of a national system under the auspices of the Federal Government.

The congress itself declared in favor of a national system of highways to be built, maintained and controlled by the Federal Government, the system to be in charge of a national highway commission which would not only assume the new activities but take over all Federal highway functions.

The American Association of State Highway Officials, on the other hand, while one of the joint sponsors for the congress, did not accept the resolutions of the larger body, though its resolutions differ only in detail. Like the congress, the association advocated increased appropriations by the Federal Government, and favored a Federal highway system. The point of departure came in connection with the expenditure of funds. While the congress asked for a system built and maintained exclusively by the national Government, the officials favored the making of all expenditures under the Federal-aid plan, the routes in the Federal system being selected by the various states and connected at the state lines by the Federal department in cases where connections are not made by adjoining states.

With reference to the machinery of control by the Federal Government, the departure again was in detail. The congress declared unreservedly for a national highway commission. The officials' association, in its own meetings, recognized the inadequacy of the present machinery, and directed its executive committee to formulate and submit to the various state departments for their consideration a bill providing "for a Federal body or officer with adequate power and funds to administer all Federal and Federal-aid laws."

The differences of opinion—far from weakening the main proposals, those for additional Federal funds for highway work and the construction of a national highway system—tend rather to emphasize the unity of all highway interests on these broad matters. But the unanimity, nationally, goes even farther than the action at Chicago indicates. The Bureau of Public Roads brought to Chicago a bill proposing greatly increased highway expenditures by the Federal Government (totaling $425,000,000 in four years) under the Federal-aid plan, while it is now well known that in addition to this bill the bureau also carefully studied, drew up and considered a bill for a national highway system to be built and maintained solely by Federal funds. Even though the latter bill has apparently been rejected in favor of a measure for additional Federal-aid funds, it indicates clearly the drift; the Bureau of Public Roads, the most conservative body in the country on highway policy, never before was willing to give consideration to a policy of national highway building.

The so-called Page bill, brought to Chicago, which provides for increased Federal-aid money, has already been introduced by Senator Swanson, while a measure in accord with resolutions of the Highway Congress will undoubtedly be introduced in the very near future. Unless Congress sees fit to fly against the sentiment of the country, one or other of these measures will become law. It is our earnest hope that that which provides for the establishment of a national highway commission and a system of roads built and maintained exclusively with Federal funds will prevail. We refer to an article elsewhere in this issue, by the editor of *Engineering News-Record*, for arguments in favor of this plan.

Should the other measure, however, be adopted, it is inevitable, in our judgment, that before long the scheme will be changed. We cannot conceive that Congress will allow so large a sum as $425,000,000 to be expended upon a system that shall be determined by the individual states, for such determination is sure to result in an illogical system. However, if the state authorities give up their initative to the extent required to produce a defensible system of highway routes, they and the people of their states will not be long willing to pay half of the cost for that which is determined with sole reference to the nation's good rather than to that of the citizens of the individual state.

As to the method of Federal control, we feel that that, too, can have but one satisfactory solution—an independent body divorced from departments with alien interests. No other scheme is adequate to deal with the highway problems of the present day. In this respect, also, the departure of the state highway officials in their resolutions from those of the congress strengthens the latter's proposal rather than weakens it. The officials recognized clearly the inadequacy of the present administration, and directed their executive committee to draw up a bill conferring adequate powers.

From every point of view, therefore, the Highway Congress at Chicago has written highway history. That it was a correct interpretation of the views of the country is evidenced by the indorsement of the major propositions by a body which chose to dissent upon details. Undoubtedly, the energy and enthusiasm shown at Chicago will be carried through the various channels represented—highway associations, chambers of commerce and various civic bodies—to the members of Congress. With the Secretary of Agriculture, and even the President, favoring additional highway appropriations, open-minded as to the plan under which the moneys shall be spent, we are sure to have legislation in a very short time that will inaugurate a Federal system of roads adequate to the highway transportation demands of the present day.

Regulation of Speed, Weight, Width and Height of Motor Trucks Discussed

They Are Essential Transportation Agencies, and While Regulation Is Necessary It Should Not Restrict Their Expansion—Table of Proposed Dimensions, Speeds, Weights and Fees Presented

By George M. Graham

Chairman National Motor-Truck Committee of the National Automobile Chamber of Commerce

(From paper read before the Joint Highway Congress, Chicago, Dec. 12, 1918)

I ASK your consideration for my client, the motor truck. He is charged at divers times and places with wreaking damage untold upon our highways. He has cracked open the surface, he has pitted deep ruts, he has broken cavernous holes into which the rains have beaten, and collapse has followed. This is the bad side, but there are extenuating circumstances. It is admitted that he has done notable things for the country, performing almost incredible service in speeding up our war program. He has brought the manufacturer nearer his market, the farmer nearer his consumer, the finished war order nearer a shipping point. He has facilitated rapid filling of orders, brought in raw material, supplied the equivalent of man-power lost by withdrawal of soldiers, made less serious the shortage of horses, and restored in organizations gaps occasioned by deficiencies of labor, material and transportation.

Through rural motor-truck express farmers, produce growers and dairymen are reaching their markets. Fertile soil, formerly isolated, has been brought into access to the markets.

Motor trucks have been doing railroad work on short hauls. Public utilities companies, such as oil purveyors, telephone and telegraph companies and express companies, would operate under serious handicaps but for the assistance of the motor trucks. This is what my client has done on the good side.

Justice for the Motor Truck

But there are those who would banish him, because he has damaged roads which were never suited to his use. He has not offended maliciously. His misdeeds have proceeded from the fact that he has height, width, weight and speed, particularly weight and speed. We admit that he has these attributes. He could not very well get along without them, but in spite of the trouble in which they have involved him, we believe that this is an ideal time to define the place for the truck and to ask justice in his behalf.

We believe the truck as much sinned against as sinning. Out of 2,500,000 miles of highways in the United States not more than 10% are improved, and many of these are of most mediocre quality. The unfitness of the road has not only resulted in damage to the highways but has also militated against the efficiency of the truck, as has been shown by many tests.

There is no riddle about building roads that can withstand truck traffic. This is proved by Wayne County, Michigan. There are 10,000 trucks licensed in Wayne County. These contribute an enormous amount of heavy traffic. Much of the war material from up-state cities, such as heavily laden trucks, tractors, ambulances, etc., from Flint, Pontiac and nearby cities, goes through Detroit on this cross-country trip to the seaboard. Despite this abnormal traffic, Wayne County roads are in good condition. They stay right because they are built right.

Three Sides to the Controversy

There are three main parties in the controversy with respect to motor trucks and their relation to the highways.

First, there are extremists who argue that all the truck has achieved for civilization does not compensate for its damage to the highways. Their only panacea is ruthlessly to legislate the power vehicle from the highways, penalize its operation with impossible license fees, and ignore all the blessings to be gained from a new system of transportation which has taken its place with railroads and steamships.

Second come those of us who stand to defend the motor truck, who are willing that it should bear a proper financial penalty for such damage as it does to the roads, and who are willing to deal in a spirit of compromise with the question of weight and speed, so as to make these factors as little harmful to the road as may be.

Between these radicals is a third class, which stands for compromise. These concede the place of the truck and believe that roads should be built adequate for it. But they insist that, until better roads are obtainable, the present highways must be protected, even though in the process it becomes necessary to impose restrictions on trucks.

My presentation will, therefore, direct itself to drawing into closest possible accord the three viewpoints.

Highways the Servant of Transportation

As a basic proposition we beg to submit that highways should be the servant of transportation, not its master. The truck has made its place. It has proved its adaptability to modern transportation problems. Civilization will lose unless means be found for its expanding application. Restrictions, prejudices and petty objections must not be permitted to stand in its way, for it presents possibilities that are too great to be sidetracked for temporary considerations.

Those who admit no place for the truck stand opposed to the spirit of the times. They are putting themselves in opposition to cabinet officers, the Railroad Administration, the Food Administration, the War Industries Board, the National Highways Council, the Electric Railways' War Board, the Army, the United States Senate, and even the President of the United States, all of whom have approved of and coöperated with the efforts of the Highways Transport Committee to divert all possible traffic to the highways. Secretary Redfield has

definitely stated that legislation restricting the size of motor trucks is a menace to the development of highways transportation, and constitutes an economic error.

Those legislators who vote against trucks feeling that they are serving the interest of the farmer, should be reminded that actually they are working against the pocketbook of the farmer. It is a fact not yet generally known that haulage of farm product by motor truck is cheaper than haulage by team, as shown by the following table presented by Frank Andrews of the Bureau of Crop Estimates, of the Department of Agriculture:

COST OF HAULAGE PER TON MILE

	Horse and team	Truck
Wheat	$0.30	$0.15
Corn	0.33	0.15
Cotton	0.48	0.16

Must Protect Present Roads

For those who ask that trucks be not permitted to ruin present roads pending the time when money, labor and material can be raised to build new ones, we can have only highest respect. They are striving to guard that which is. We feel sure that they will be our allies against legislation that is unfair. We meet them in a spirit of coöperation.

As manufacturers we know that we must build trucks to weight, speed and the size that will do least harm to present roads. The foremost men of the industry, recognizing the difficulties involved, have given close thought to the question of dimensions. Frequent meetings have been held in Washington to discuss the subject in detail. Compromises and adjustments have been made, and we are now in agreement on a bill which we should like to see enacted into law by all the legislatures of the United States.

It was high time for such concerted action, and we wish to propose a combination of necessary fundamentals, equitable legislation, efficient administration and proper construction.

It is entirely possible that after the war short-line railroads will be a thing of the past, not only because the motor truck can deliver goods over short hauls in quicker time and at a reduced shipping rate, but because it saves labor and time by delivering goods to the consignee's door. Add to this the fact that there is no initial expense in putting a line of motor trucks in operation outside of the original cost of the trucks, as compared with the high cost of track building and railroad equipment.

Lack of Repair, Not Trucks, Responsible For Condition of Roads

I should like to raise the question of how far trucks are responsible for the present damaged condition of the roads. Are they unjustly accused in this respect? It is conceded that roads were never in worse shape, that many highways formerly famed for their perfection are now battered and filled with ruts and holes. But is this up to the trucks? A foremost expert on road building and maintenance makes the statement:

"Since the war started we have not been able to make repairs. Labor has been lacking, and there have been embargoes on road-building material. Where formerly in the spring we would have quickly filled the holes and patched the ruts, we have been unable to do so. Therefore, the roads have been permitted to remain smashed up. Once our maintenance system is restored, we shall be able to do away with a lot of the present trouble. But for the lack of this repair the present agitation against trucks never would have arisen."

In our investigation we have found the opinion almost general that most of the damage is done in the spring. Then the frost is still in the ground, and as it thaws the mixture becomes almost like jelly. The impact of the passing vehicle with the top crust of the road, unsupported as the latter is by any adequate foundation, results in more damage than could be inflicted in all the other months of the year put together. We admit this fact unhesitatingly. We have in our bill proposed a remedy for it in the shape of an embargo by which, on proper notice, any road can be closed to traffic by the local highway authorities for any vehicle weighing more than 10,000 lb. Such embargoes cannot cover more than 45 days in any one year.

Proposed Dimensions For Trucks

Height and width are not the major problems with which we must deal. They can speedily be eliminated. We have fixed on 12½ ft. as the utmost distance between the road and the summit of the body, and 8 ft. as the greatest width of the body. We do not think these figures should be exceeded, and would cheerfully bow to laws so decreeing. Thus we readily dispose of height and width, but when we come to weight and speed we have much more to contend with.

It is not to be denied that the heavily weighted truck, running on solid tires and at high speed, causes damage. But it is not to be forgotten that both this weight and speed serve a highly practical purpose—the cost of carrying the load decreases in proportion to the number of tons carried.

As a general proposition it may be stated that as the size of the truck increases the cost of operation in relation to carrying capacity decreases. There are four principal reasons for this: (1) The cost of manufacture of a truck does not increase in proportion to the carrying capacity; (2) the so-called fixed charge, or overhead of operation, does not increase in proportion to carrying capacity; (3) the actual operation cost does not increase in proportion to carrying capacity; (4) the weight of the truck itself does not increase in proportion to carrying capacity.

From an economic standpoint this is most important. Truck owners have a right to operate their trucks to the highest limit of economy and efficiency. They should be permitted to run the heaviest possible truck made necessary by their haulage problems, and roads should be made equal to the burden as speedily as possible. To take any other position is to legislate directly against an increasing army of motor-truck users.

There are not less than 550,000 trucks in use in the United States. It has been estimated that farmers alone will apply to the highways 2,000,000 more trucks within the next 10 years. The possibilities in all other lines of activity are so many and so varied that the whole subject of truck legislation must be approached with justice and vision.

Our plan for a uniform truck law calls for permission

to operate a vehicle whose gross load is 28,000 lb. It also provides that the highway commissioner can reduce this limit to 24,000 lb., where it can be shown that the roads will not stand more than this weight. He also has the option of increasing above 28,000 lb., where highly improved roads make this possible.

The accompanying table provides for license fees, three kinds of speed according to section traversed, maximum weight and the load per inch width of tire. With the considerations of license fees I have not to do. Another speaker will discuss those. The load per inch width of tire was, after due consideration, fixed at 800 lb. throughout, whether solid or pneumatic tires be used. The speed and fees vary as the total load.

An examination of the weight of vehicles made by some 40 manufacturers shows that within the 4000-lb. class will fall vehicles rated to carry ½-ton and ¾-ton loads; 8000-lb. class, 1- and 1½-ton loads; 12,000-lb. class, 2-ton loads; 16,000-lb. class, 3- and 3½-ton loads; 20,000-lb. class, 4- and 4½-ton loads; 24,000-lb class, 5-ton loads, and within the 28,000-lb. class, 6- and 7-ton loads.

Overloading Made A Misdemeanor

If it be said that the maximum weight should be put to as low a point as possible in order to deal with probable overloading, attention should be directed to the penalty prescribed in the bill—a penalty made the more easy of infliction since the bill provides for a plate placed on the truck, said plate to show gross weight of vehicle and load. Any truck carrying more than this weight becomes liable to the penalty.

Therefore, the question becomes one of proper administration.

Truck Economical in Use of Steel

The war has made opposition to waste a national policy. It should, therefore, be remembered that the motor truck is highly economical in its consumption of steel, as compared to its carrying capacity. The steel required for the average railroad freight car is 25 tons; for the average locomotive and its tender 150 more tons must be allotted. A two-ton motor truck requires 1½ tons.

The ton-mileage of a freight car per day is 800, forty tons average load and 20 miles per day. An easy average for the two-ton motor truck is 200 ton-miles, two-ton load and 100 miles per day. Therefore, the four 2-ton trucks can do more work per day than one freight car. Trucks also deliver direct from shipper to consignee.

To build 50,000 steel freight cars and the 1250 locomotives to draw them will require 1,437,000 tons of steel. Only 300,000 tons of steel are necessary to build 200,000

DIMENSIONS, WEIGHTS, SPEEDS AND FEES SUGGESTED FOR PROPOSED UNIFORM TRAFFIC LAW

Character of Vehicle			License Fees		—Maximum Speeds—			
Reference Letter	Type of Tires, Etc.	Maximum Weight of Vehicle and Load	Covering all Charges, Including Property Taxes	Covering All Charges Except Property Taxes	In Open Country* Miles	Through Suburban Sections, Villages and Towns, Miles	In Thickly Built up Parts of Cities and Towns, Miles	Load per Inch Width of Tire, Measured between Flanges, Lb
				Per Horsepower				
A	Passenger or light commercial, pneumatic tires	6,000	$0 60	$0 40	30	20	15	800
				Per Annum				
B	Other pneumatic tired	6,000	30 00	15.00	25	20	15	800
B	Other pneumatic tired	8,000	45 00	22 50	25	20	15	800
B	Other pneumatic tired	12,000	60 00	30 00	25	20	15	800
B	Other pneumatic tired	16,000	75 00	37 50	25	20	15	800
B	Other pneumatic tired	20,000	90 00	45 00	25	20	15	800
B	Other pneumatic tired	24,000	105 00	52 50	25	20	15	800
B	Other pneumatic tired	28,000	120 00	60 00	25	20	15	800
C	Having solid rubber tires	4,000	40 00	20 00	25	20	15	800
C	Having solid rubber tires	8,000	60 00	30 00	20	18	12	800
C	Having solid rubber tires	12,000	80 00	40 00	18	15	12	800
C	Having solid rubber tires	16,000	100 00	50 00	16	15	12	800
C	Having solid rubber tires	20,000	120 00	60 00	15	15	12	800
C	Having solid rubber tires	24,000	140 00	70 00	15	15	12	800
C	Having solid rubber tires	28,000	160 00	80 00	15	15	12	800
				Per Horsepower				
D	Commercial passenger	6,000	1 60	80	30	20	15	800
				Per Annum				
D	Commercial passenger	7,000	40 00	20 00	30	20	12	800
D	Commercial passenger	8,000	50 00	25 00	25	20	12	800
E	Motorcycles		10 00	5 00	30	20	15	
E	Motorcycles, side car		6 00	3 00				
F	Trailers or semi-trailers, with solid rubber tires	4,000	20.00	10 00				800
F	Trailers or semi-trailers, with solid rubber tires	8,000	30 00	15 00				800
F	Trailers or semi-trailers with solid rubber tires	12,000	40 00	20 00				800
F	Trailers or semi-trailers with solid rubber tires	16,000	50 00	25 00				800
F	Trailers or semi-trailers with solid rubber tires	20,000	60 00	30 00				800
F	Trailers or semi-trailers with solid rubber tires	24,000	70 00	35 00				800
F	Trailers or semi-trailers with solid rubber tires	28,000	80 00	40 00				800
F	Same with iron tires				Double the above rate for Class E.			
F	Same with pneumatic tires				Three-quarters of the above rate for Class F.			
G	Traction engines, tractors, etc., not loaded		30 00	25 00				
H	Electric				Two-thirds of the fee charged gasoline vehicles of equal weight.			
I	Animal drawn			1 00	For one horse or its equal, 800 lb			
I	Animal drawn			2 00	For two horses or their equal, 800 lb.			
I	Animal drawn			4 00	For four horses or their equal, 800 lb.			
I	Animal drawn			6 00	For six horses or their equal, 800 lb.			
I	Animal drawn			8 00	For 8 horses or their equal, 800 lb.			
I	Animal drawn			12 00	For 12 horses or their equal, 800 lb.			
J	Publicly owned				No charge maximum speed, maximum weight and load per inch width of tire to govern each similar class of vehicle, as prescribed in Classes A, B, C, F and K.			
K	Registration tags or markers issued to manufacturers and dealers in motor vehicles or trailers			25 00	For first two sets—$12 for each additional set			
L	Registration tags or markers issued to manufacturers and dealers in motorcycles			20 00	For first two sets—$5 for each additional set.			
M	Chauffeurs' licenses			2 00				
M	Operators' licenses			2 00	For operators, good until revoked.			
N	Duplicate licenses			50	For each duplicate set.			

* Greater speeds may be attained for distances not to exceed ¼ mile, in order to permit one vehicle to pass another

two-ton trucks capable of doing the same amount of work. There is a saving of 1,137,000 tons of steel.

Considered from the standpoint of national wealth and prosperity, does not this saving, plus the time saving in favor of motor trucks, make insignificant the cost of repairing possible damage to the roads?

An Ideal Plan

As a temporary measure, the ideal plan would seem to be to build improved roads on the shortest routes connecting important centers, and then to protect these roads from washouts, cave-ins and obstructions caused by snow and ice.

As far as possible, traffic should then be centralized temporarily on such designated routes, thereby eliminating the necessity of sending trucks over side roads, before they have been properly rebuilt for such traffic. Such well organized motor-truck highways, by obtaining the shortest routes and skirting the congested districts, would be valuable savers of time.

There are three principal methods of finance by which may be obtained roads that will afford the truck its full chance of service to the public: (1) Direct taxation on part of the state; (2) enlarged Federal aid, based on the probability that the war's end will see the United States Government owning a large number of motor trucks, which will be applied to peace uses in the various departments. There is already keen Governmental interest in respect to the highways situation, and there are better chances of assistance here than ever before; (3) there never was so great a warrant [state?] for bond issues as now. Previously, projects of bond issues for highways construction met the objection that future generations should not be taxed with the burden of financing new constructions. This reason does not hold valid now. The present generation has done its duty by posterity. It has borne not only the burden of death and suffering from the war, but also assumed more than its share of the financial obligation. Therefore, it is only equity that generations to come should pay their share for inaugurating adequate road systems now. Results in Illinois and Pennsylvania would indicate that the public is coming to this same viewpoint.

When we obtain roads suited to truck traffic, license fees should always be maintained at such figures as will permit the maintenance of the highways without further burden to the public.

I submit you the case of my client. I hope you will not be unduly severe on him for such damage as he has wrought. We ask you to coöperate with us in our effort to make the road fit the truck and the truck fit the road, for the permanent benefit of us all.

A Suggested National Highway Policy and Plan

Phenomenal Growth of Interstate Motor Traffic, Favorable Attitude of Government and People, and Magnitude of Problem Make Suggestion Timely

By E. J. Mehren
Editor of Engineering News-Record

(Paper read before Joint Highway Congress at Chicago, Dec. 11, 1918).

TEN years ago the highways of this country were subjected to a traffic scarcely different from that which they had borne in Revolutionary days. In fact, the traffic was not much different from that which the Romans had imposed on their roads nineteen centuries ago. Indeed, highway transportation has changed to a greater extent in the past 10 years than it did in all the nineteen hundred years preceding. The motor vehicle is responsible for this revolution in conveyance, and to it is due the stress to which our roads are subjected.

Growth of Motor-Vehicle Traffic

A decade ago the automobile was in its infancy. Today 5,500,000 motor vehicles are in service, and of these it is estimated that 500,000 are commercial cars, ranging from the light delivery wagons to heavy trucks. Figures have not been compiled as to the number of passenger miles totaled in automobiles every year, nor as to the ton-mileage of freight hauled. H. W. Perry, secretary of the Commercial Vehicle and Good Roads Committee of the National Automobile Chamber of Commerce, made an estimate in 1916, however, that gives ground for an interesting comparison. There were in use then 3,000,000 passenger automobiles. Allowing an average of 5000 miles per year per car, and assuming an average number of passengers per car as three, he obtained a passenger mileage per year of 45,000,000,000. Since that time the number of passenger automobiles in use has increased to 5,000,000, and, even if we discount Mr. Perry's figures heavily and accept, with the larger number of cars in use, his total of passenger miles, 45,000,000,000, we still find that the figure exceeds that for the railways of the United States in the year 1916, which was 34,000,000,000 passenger-miles. In the same estimate, published in *Engineering Record* of Jan. 20, 1917, p. 112, Mr. Perry concludes that the commercial motor vehicles of the country performed a service of 3,750,000,000 ton-miles when there were 250,000 commercial vehicles in use. He assumed an average of 50 miles per day, 300 working days per year, and two tons per load, with half the mileage traveled loaded. This appears to be a very liberal estimate, but if his figure is twice as large as the facts, the traffic would now, with a doubling of the number of commercial cars, have caught up to his estimate, and surely a freight traffic of 3,750,000,000 tons is not a negligible item.

It is not now possible to ascertain what percentage of this passenger and freight mileage was carried over rural roads and what portion over city streets. The figures are quoted merely to give an idea of the magnitude of the instrumentality—the motor vehicle—which has introduced the new and troublesome factor into highway construction and maintenance, and has raised highways into one of the foremost of national problems.

Another measure of the new importance of highway transportation is indicated by the total annual expenditure for highway work. The Bureau of Public Roads gives the cash expenditure on highways for the year 1915 as $267,000,000. This already large sum is sure to be rapidly increased because of the attitude on highway improvement in every part of the country. It is hardly necessary to call attention to the fact that the two $50,000,000 bond issues authorized in New York State have now been followed by a $50,000,000 authorization in Pennsylvania, and a $60,000,000 authorization in Illinois.

The Government's Attitude

The figures, then, as to the number of motor vehicles in use, and the expenditures on highways, confirm our opinion as to the importance of the highway transportation problem. If we seek further confirmation we can find it in the attitude of the Federal Government. The Bureau of Public Roads, which surely cannot be charged with anything but the utmost conservatism, was established in 1893. Its appropriations have grown year by year to a total of $400,000 annually, exclusive of that portion of the Federal-aid funds which is used for administration purposes. In other words, the United States Government, following an exceedingly conservative policy, has gradually increased its expenditures for purely advisory and experimental work to $400,000 per annum.

But this is not all. In July, 1916, the Federal-aid law, carrying a total appropriation of $85,000,000, to be expended over a period of five years, was passed. This law, marking a great stride forward in our highway policy and constituting the first step toward a national highway system, is in itself merely the culmination of a movement that has been going on for a quarter of a century. We determined years ago that township administration of roads was unsatisfactory even for horse-drawn traffic, and county supervision of highways was inaugurated. But even county administration proved inadequate, and in order to meet the new demands of traffic state after state has taken over supervision of its main trunk lines. In some states the commonwealth's money is contributed to aid county work, while in others the state builds and maintains with its own funds the main highway routes. From that stage of our development, state control, the logical step was assistance by the Federal Government to the states themselves.

The question now comes whether another step should not be taken, in order that we may round out and complete our highway development. I need not tell highway builders and highway users that sentiment has been growing all over the country in favor of the construction and maintenance by the Federal Government of a highway system that shall transcend state bounds and that shall do nationally what state control has done within state borders—place the through routes under a single competent authority.

Secretary of Agriculture Advocates Increased Federal-Aid

It is opportune here to quote no less important a man than the Secretary of Agriculture, who supervises generally the Government's work in highway matters. In a statement given to the press Nov. 27, he discusses the highway funds available from state and Federal appropriations, and then adds these significant words: "Still, it seems to me that we should take a further step; it would be in the public interest to make available larger appropriations from the Federal treasury, to be used separately or in conjunction with state and local support."

Let me call your attention to the very significant word "separately" in this statement of the Secretary. A system built and maintained separately by the Federal Government means a national system of highways. Note that the Secretary does not commit himself to that system. He does, however, place it on a par with the Federal-aid plan.

This is the first statement from the executive department of the Federal Government that it is prepared to consider the expenditure of Federal funds for a system of highways to be built and maintained solely at Federal expense. Furthermore, Secretary Houston says in his statement that he has taken up his suggestions with the President, the Secretary of War and the Postmaster General, and that they agree with him that the appropriation of additional moneys is advisable. I have it on good authority that the Secretary discussed not merely additional revenues, but the possibility of their expenditure for a national system, and found that the President and his fellow cabinet members were not opposed thereto. And I say this, even though a recent letter from the President to Secretary Houston discussing additional expenditures referred only to the Federal-aid plan.

Lessons Taught by the War

In indicating their openmindedness with respect to the building of national highways, the officers of the administration indicate that, in common with the public, they have learned the lessons which the war has taught regarding the place of the highways in the transportation system of the nation. Personally, I am glad that the statement of Secretary Houston has come at this time, for it gives support to that which I had proposed three months ago to present to you today—a plea for the adoption by the United States Government of a new policy in highway work, a plea for a further and completing step in our highway progress—namely, the selection, construction and maintenance by the Federal Government of a national highway system that shall fully embrace the entire country, that shall serve every state, that shall tie the nation together by a network of highways more effective in its place than even the rail lines which form our secondary system of transportation.

The step proposed is an important one. What are the reasons for the building of a national highway system? I contend that the policy should be inaugurated for (1) economic reasons; (2) spiritual reasons; (3) military reasons, and (4) because of the example it would afford for all classes of highway construction. Let me say here that the people of this country will not find it necessary to make a close study of the various factors as we, with a deep interest in highways, shall naturally make. There is something sure and solid in sweeps of public opinion that proceed slowly and in which each step is logical, following upon its prede-

cessor. I have taken the trouble to inquire as to the attitude of the people from coast to coast with reference to a national highway system, and find that the war injected the necessary crystallizing element to convince the people of this country, far and wide, that highway systems cramped by state lines are insufficient for the demands of the present day. And when the people at large favor a policy, particularly when it is not radical, but is a logical development from an existing situation, we may feel sure that its realization is not far distant.

The economic grounds which justify the inauguration of a national highway system are based upon the extent to which motor-truck traffic has developed. We had evidence of its importance last winter, when many industries were kept in service because they were able to get essential materials and coal by motor truck after the railroad system had broken down.

Motor-Truck Traffic Over Rural Roads

Moreover, the economic importance of highways is indicated by the extent of the motor traffic running over the rural roads.

As an instance of the extent of this truck traffic, it is of interest to know that the Return Loads Bureau of the New York Merchants' Association lists no less than 661 motor trucks which are registered to go over either specified routes or are available for carriage anywhere. The established motor-truck routes cover no less than 1721 miles of highway, including such runs as from New York to Boston, New York to Syracuse, New York to Scranton and New York to Washington. There are, of course, in addition, many routes ranging up to 100 miles in length, and simply scores of systems which reach the suburban towns in Connecticut, Long Island, Westchester County and northern New Jersey. These are not included in the 1721-mile total just mentioned. What the total number of trucks is that radiate from New York and run on rural highways has not been recorded. If 661 are registered, however, it is safe to say that three or four times that number are engaged in traffic over rural routes.

In connection with this trucking in the neighborhood of New York, it is important to note the extent to which the registered vehicles cut across state lines. The established routes go into or across the States of Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware and Maryland and the District of Columbia. In other words, the motor truck, not to speak of the passenger car, has become an instrument of interstate commerce of no mean proportions.

Furthermore, consider the inequities that are possible under the present system of obliging the states to bear the burden of their highway developments, save as they may get some assistance under the Federal-aid law. The traffic between New York and Philadelphia has grown to be of tremendous proportions. For a great part of its length, the New York-Philadelphia route lies across the State of New Jersey. The heaviest share of the highway portion of the trucking cost comes out of the pockets of the New Jersey taxpayers.

What is said of the motor-trucking situation at New York can be repeated, of course, for all of the large cities of the country, whether they be situated on the Atlantic or the Pacific, near the Canadian border or on the Gulf. Motor trucking over rural routes has become a very considerable factor in the lives of all large communities, and not infrequently enters very heavily into interstate commerce.

In further reference to the interstate character of motor trucking I need merely ask you to revert momentarily to the remarkable address by the Hon. James I. Blakslee, fourth assistant postmaster general, at this morning's session. He has parcel-post routes in service at the present time across state lines, and is planning a very considerable extension of the system. What the benefits of such parcel-post routes are to rural communities in bringing goods to their doors, and in furnishing quick and regular transportation of their products to the cities; and again, what these routes mean to city dwellers in bringing them quickly and cheaply the products of the farm, I leave to his very graphic description and to your own knowledge of the present terrific transportation and middlemen's charges on fresh farm products. I can see no single movement that will so reduce the cost of living as the rapid extension of the parcel-post routes which Mr. Blakslee is now operating, and which he has planned. In fact, we could find adequate justification for a national highway system as a means for allowing him to proceed with his magnificent work, even if there were no other argument in its favor.

The Passenger Car in Interstate Traffic

The spiritual justification that I claim for a national system of highways is based on the extent to which passenger-car traffic has developed between the various states. There was a time when the passenger car was considered an agency for recreation only. We now see it in a different light, and realize that it is an important instrument of business.

Nevertheless, I am willing to claim justification for a very heavy expenditure by the Federal Government for highway construction solely on the basis of passenger-car travel for recreational purposes. On Labor Day of this year I stood just below Colonel Cody's grave, in the Denver Rocky Mountain Park, and watched hundreds of cars pass by on the road beneath. The majority of them carried Colorado licenses, but a goodly number showed the tags of Wyoming, Utah, Kansas, Nebraska, New Mexico and other trans-Mississippi states. I maintain that each of the cars that had come from another state into Colorado carried back men and women who were better citizens of our common Union, who had a better appreciation of the glory of our country and who were more firmly convinced than ever before that for the maintenance and defense of this nation, no sacrifice is too great. "Not by bread alone does man live." Spiritual forces are still the mainsprings of all great endeavor, and hold this nation together no less certainly than they did in the Revolutionary War or in the great war. We have had a wonderful demonstration during this war of the unity of our people. That unity was fostered and secured by the various agencies of transportation and intelligence which have wiped out sectional lines, and taught the East and the West that they are one, the North and the South that their aims are common. I am willing to dispute with any man who maintains that this spiritual unity in the United States is not worth spending money to secure.

What the extent of passenger automobile traffic is from state to state there is no means of knowing. Here and there, though, are figures which give some indication of its extent. There are, for example, the statistics of private-car travel in Yellowstone Park. No less than 17,000 persons traveled through the park in the season of 1918 in private automobiles. Naturally, the greatest number of these came in cars bearing the tags of states which border the park—Idaho, Montana and Wyoming. But 456 traveled in Colorado cars, 1854 in Utah cars, 648 in Washington, 152 in Illinois, 235 in Iowa, 300 in Kansas, 101 in Michigan, 224 in Minnesota, 206 in Missouri, 529 in Nebraska, 90 in Ohio and 61 in New York.

Additional light on the extent of interstate touring is shown by the activities of the Touring Bureau of the American Automobile Association in Washington, D. C. Between Sept. 15 and Nov. 26, of this year, no less than 400 autoists stopped at that office and inquired as to the best route to Florida. In the summer, the same office advises, an average of 20 persons per day inquire regarding routes to New England points, and four regarding routes to the Pacific coast. Where one person makes inquiry, 20 rely on guide books. These figures are for only one point, the City of Washington. Automobile clubs in every large city can bear similar testimony to the extent of interstate touring.

Reverting to my previous statement that it is worth the expenditure of considerable money by the Government to encourage touring, let me call your attention to the fact that the expenditures by the Government on the national parks for the fiscal year ending in June, 1918, amounted to somewhat more than $800,000. This department of the Government is spreading the slogan "See America First," and hopes by acquainting our people with the extent and wonders of our country to keep much of our tourists' money at home, promote healthful recreation, intensify faith in our country and develop a better appreciation of the value of citizenship.

Military Uses of Highways

The third reason I assert as justification for a national highway system is that of military necessity. The War Department has refused to designate any highways as military highways, but we have the testimony of leading Army officers that every highway connecting large centers is a military highway, in effect, during war times. All of the trunk lines leading into the big munition centers last year were military highways in effect, even though not so declared. We most sincerely hope that out of the peace conference shortly to be held in Paris there may come a league of nations, but even if there is that fortunate result, it will still be necessary for us to be prepared. No one will contend that even if a league of nations is formed, we shall abolish our War Department. And if we do not abolish it we cannot afford to neglect the most essential means of transport for fighters—the highway system.

We had an excellent demonstration of the possibilities of highways in war time when 18,000 Army motor trucks ran over our highways during the war, from the Great Lakes to the Atlantic seaboard. These routes, to be effective, must be under a single control, in order that the construction and maintenance may always be adequate to the demands of military traffic.

In addition to the benefits already emphasized, the building and maintenance of a national highway system will furnish an object lesson to the citizens of every state in the Union. It is true that under the Federal-aid system there is excellent opportunity for influence by the Federal Government upon highway construction and maintenance, but initiative lies with the states, and their views have great weight. Under the national system, however, the Federal Government would be unhampered in the selection of roadway surfacing, in the method of maintenance and in the control of traffic. In all of these respects the standards would be the highest warranted by present-day traffic conditions, and such routes, crossing every state in the Union, and coming under the personal observation of thousands of citizens, would set a standard for state and county road work and for traffic control that would be of inestimable value in the development of adequate local highway systems.

For these reasons, then—the extensive development of interstate highway transportation both of goods and passengers, and the ensuing spiritual and economic benefits to our country, as well as for the value of the example given—it is the speaker's judgment that it is both desirable and necessary that the Federal Government round out its highway policy by undertaking a national highway system which shall give us in a reasonable time Government-built, Government-maintained and Government-controlled trunk highways, consisting of all strategic routes and providing intercommunication between all the states.

Would Federal-Aid Extension Suffice?

Some will argue that there is no need for this additional step in Federal highway policy, but that everything desired can be accomplished under the Federal-aid plan. The best answer to such an objection is to canvass the opinions of the state highway engineers throughout the country. That I have taken the trouble to do, and I can assure you that the opinion is overwhelming that the Federal-aid system is inadequate to secure the building and proper maintenance of through trunk routes of a single high standard, conformable to the traffic that must be borne. Naturally, and very properly, each state is obligated to its citizens to spend its highway funds to the maximum benefit of the people of the state. Consequently, in selecting their Federal-aid projects, they will choose the routes that will be of greatest advantage under local conditions, and will not be interested in spending funds for links of less local importance. State highway engineers from all over the country tell of the futility of efforts of adjoining states to connect up their systems.

Let it be clearly understood, too, that in advocating the building of a national highway system the speaker does not believe that the present Federal-aid road plan should be abandoned. On the contrary, it is his belief that the expenditures under the Federal-aid plan should be materially increased. If we are justified in spending $100,000,000 a year in the building of a national highway system, we are at the same time assured of a generous return, economically and spiritually, from an expenditure of $25,000,000 annually under the Federal-aid plan.

Americans, when they see a real need, do not look for

precedents. Nevertheless, let me remind you that the countries of the old world have long had national highway systems. What the national road system did for France in the war need not be repeated in these days when the war memories are still fresh. But Spain and Italy, Austria and the individual kingdoms and principalities of Germany had state road systems. In all cases these were superimposed on the very excellent systems of the minor civil divisions. England has a state-aid system, but the flexibility of her thinking on the highway problem was shown during the war by the fact that the War Office appropriated money for the maintenance of highways subjected to heavy use by War-Office traffic.

Plan for National System

Manifestly, without very complete study it is not possible to indicate the routes that should be included in a national highway system. There needs to be a very careful survey for the determination of routes which will be of the greatest benefit to the country as a whole. In my judgment, however, the policy at the outset should include at least two highways per state, one approximately longitudinal (or east and west) and one approximately transverse (north and south). A rough study of a system so laid out will show that there would need to be five routes east and west, and ten north and south. Such a system would total somewhat less than 50,000 miles, or approximately 2% of the total road mileage of the country.

If the cost is figured at $25,000 per mile, which is liberal considering the condition of the roads which would be taken over, the total cost would be $1,250,000,000. This is a large sum, but in view of the heavy appropriations which we have made during the past two years for destructive purposes, and considering that the States of New York, Pennsylvania and Illinois alone have either bonded themselves or have voted to bond themselves for $210,000,000 for the construction of state systems, the sum is not unreasonable. If the money were appropriated at the rate of $100,000,000 a year, the total appropriation would have to extend over 12½ years. Surely, this is not a heavy strain upon the resources of a country which has raised over $15,000,000,000 in Liberty Loans in 18 months' time. Moreover, this expenditure is distinctly of a type that adds to the economic wealth of the country, by lessening transportation costs and increasing property values.

How shall the national highway system here proposed be administered? There is but one plan, in my judgment, adequate to the national importance of the highway problem, and that is through a national highway commission. In the past our Federal road bureau has been buried as a subordinate office in a great Governmental department, whose chief interest lies in another direction. It would be as logical for me to advocate the abolition of all state highway commissions and the putting of their work under the respective state departments of agriculture, as to advocate the continuance of the Bureau of Public Roads under the Department of Agriculture. Why have we separate and independent highway commissions in the various states, and not subordinate bureaus? Simply because the highway problem is of such importance as to demand the broad-gaged consideration and handling that only the dignity of a separate major arm of government can secure.

Let me quote you from the Good Roads' Year Book for 1917, p. 41: In the section on state highway department legislation, prepared under the direction of R. Walton Moore, chairman of the Committee on Legislation of the American Highway Association, we find this statement:

"In some states the (highway) department is managed by a single commissioner, and in others by a board of commissioners. The advantage of concentrating authority in a single commissioner is that a good administrator can accomplish more than a mediocre board, and it may not be so difficult to obtain a good administrator as it is to obtain a harmonious, energetic and capable board. On the other hand, a board composed in part of state officials and in part of civilians, including professors of engineering in state colleges, is perhaps more likely to be free from individual predilection, in closer touch with public opinion in different parts of the state, and apt to take a broad view of problems because relieved of direct responsibility for detail."

I submit that for a national system of highways we need, above all, that close touch with public opinion in different parts of the country and that broad view of problems coming from relief from direct responsibility for detail, which the Good Roads' Year Book so aptly says are advantages of the commission form of highway control.

Some will say that Congress will not appoint a highway commission. I submit that Congress will be glad to do that which the people of this country really want. In four years Congress has created no less than four important boards or commissions for peace-time purposes, and no end of boards for war-time purposes.

Of the peace-time boards there have been established in four years the Federal Reserve Board, the Federal Trade Commission, the United States Tariff Commission and the Federal Board for Vocational Education. The Tariff Commission was created as recently as September, 1916, and the Federal Board for Vocational Education in February, 1917.

What was the reason for the creation of each of these boards, or commissions? In every case it was because the problems had grown to be of such a magnitude that their broad-gaged consideration and administration could no longer be trusted for efficient handling to administration departments. In the opinion of Congress, the country could be better served by placing these functions in the hands of independent bodies than by leaving tariff considerations and trade matters to the Bureau of Commerce or vocational education to the Bureau of Education of the Department of the Interior.

Broad-Gaged Consideration Only From Separate National Highway Board

I submit that the highway problem has now come into the same class, and that it is of such national importance that broad-gaged consideration can be secured only by putting the problem in the hands of a separate board.

Some have argued that the creation of a national highway commission is dangerous because it will increase the centralization of control in Washington. That argument was strongly advanced in a meeting in

this city only yesterday, but would the speaker suggest the abandonment of our Federal judiciary system and the concentration of all legal matters in state courts? He would answer, "No; state courts for state cases, Federal courts for national cases." Would he abrogate the Sherman and the Clayton laws, abolish the Federal trade commission and confine all corporation legislation to the states? He would answer, "No; state laws for state corporate matters, national laws and national administration for those corporate matters which transcend state lines and are national in character." Would he advocate the abolition of the Interstate Commerce Commission and the control of all railroad matters by 48 state railroad commissions? He would say, "No; state railroad commissions for state railroad problems, interstate commerce commissions for national railroad problems." I think, too, that he would admit that there are highway problems which transcend state lines and are truly national in character. Following the logic of our Government's development, I contend that we should have state highway commissions for state highway problems and a national highway commission for national highway problems.

To sum up, then, I come to you with a plea that the United States Government shall take the final step in rounding out the highway system of the country, by superimposing upon our excellent county and state systems a national highway system, to be built, maintained and controlled by the national Government itself. In its effect upon the farmer, in its effect upon the cost of living, in its influence on national morale, no single transportation agency is as important as the highways, and I urge that the Federal Government, as the only agency capable of building and administering an adequate system, embark on this great project. It will return in increased property values, and in lower transportation costs, all that is invested in it, and it will contribute very materially to the further welding together of all the people of the country.

License Fees for Motor Vehicles and Drivers

Those Benefited Should Pay for Highways—Theory of Marginal Utility Indicates That Public Should Pay First Cost, While User Should Pay Maintenance

By H. Eltinge Breed

First Deputy Commissioner of Highways, New York State

(Paper read before the Joint Highway Congress, Chicago, Ill., Dec. 12, 1918)

After comparing the opposing theories that the entire cost of highway construction and maintenance should be paid by the user, on the one hand, and the general public, on the other, Mr. Breed, considering the advantages and disadvantages of both systems, takes intermediate ground. The cost of highway construction is great—so is the immediate benefit to the public. The cost of highway maintenance is great—so also is the damage done to the road by motor vehicles. The public and the user should each pay up to the margin of direct benefit to each, and the author believes that these margins are reached when the public pays for construction and the user pays for maintenance.—Editor.

THOSE who benefit from an improvement should be the ones to pay for it. Like many another obvious truth, that easy-sounding statement conceals the kernel of our perplexity. *Who* benefits by improved highways, and in what proportion? The question involves the economics of taxation; the various answers to it are as radically opposed.

They run the gamut from those who would place the entire cost of highway construction and maintenance upon the direct users of the roads, to those who would exempt them and make the general public foot the total bill. In between are the various degrees of compromise, all of them advocating, in different ratio, some tax on the public and some on the vehicles. To prepare the way for this middle group, let us briefly consider the arguments of the two extremes. Many of them appear in replies to a questionnaire that I sent to a number of state highway officials and to representatives of automobile associations and industries.

The strong plea for exempting the direct users of roads and placing the entire cost upon the public is, of course, that the public is ultimately the great beneficiary.

I may never own a car, or ride in one, but when my child is taken critically ill, his life may depend upon the condition of the good road over which the doctor can speed to him. Shall I hesitate to pay my share?

I may never have letters to send or goods to export, yet inevitably the life of my household and business depends upon the receipt of supplies from without. Shall I not help pay for the route over which they travel?

Even though I may never use the public schools I gladly pay the school tax, because through education it enhances the life of the community, and hence my own welfare.

I pay for police and fire protection, though personally I may never need either, and I don't demand that people whose houses burn up, or who have burglars arrested, shall pay a special fee. Should I not be willing, as one of the public, to pay for the public benefits derived from good roads, especially as I am bound to receive from them not only a share in the general good but direct personal advantages?

The argument sounds convincing. It is ably supported by George Diehl of the American Automobile Association.

An interesting suggestion for application of the entire tax upon the public is made by Ellis Dutton. Land bordering the highway, whose value is directly increased by it, shall carry the greatest burden of expense; contiguous lands and the general public should pay less, proportioned, as far as possible, upon the benefits they receive. Says Mr. Dutton: "In every case where streets or roads are paved the increased value of the property is more than the cost of the improvement. Shouldn't these benefited lands pay for the paving . . . and in less proportion contiguous lands and the general public?"

But, as in the case of so many other convincing arguments, there is a practical difficulty—not insuperable perhaps, but considerable. The traffic demands for and upon highways are greater than the taxpaying power of the public can sustain. More and more traffic—an increase in New York State of 390% in motor vehicles in the past seven years—more need for new routes and good maintenance; higher and higher taxes, until the point is reached where the increased cost of the roads does not yield the taxpayers a commensurate return in public benefits. The gain accrues to private pocketbooks. Thence we swing to the opposite extreme that says that the motor vehicles using the roads and directly profiting from them should be the ones to pay for them. I purposely omit horse-drawn traffic here, as being an increasingly negligible factor upon our highways.

Putting Entire Cost on the Motor Vehicl

Illinois is the chief exponent of taxing motor traffic for the entire cost of the highways.

The arguments advanced by Mr. Bradt of Illinois in favor of their arrangements are:

1. The practical difficulties of raising money through a general public tax. The political party in power, particularly in election year, is so anxious to keep down taxes that it is loath to secure funds for absolutely necessary work. The tax burden in Illinois is already very heavy.

2. The greatest benefits from the roads accrue to the direct users of them. Motorists gain directly through the lower cost of running on good roads. Hence, the user should pay.

3. The public really pays a share through the increased cost of service and commodities received over these highways.

On the strength of these arguments, Illinois has authorized bonds for $60,000,000 for highway improvement, all of which will be paid from automobile, dealers', motorcycle and chauffeurs' license fees, the greater part being derived from automobile fees. The system to be built from this sum will cover 4800 miles, and, it is estimated, will carry 40 to 50% of the total state traffic. It comprises, however, only 5% of the total road mileage. The other 95% will have to be maintained and improved through general taxation.

So even the state that has gone farthest in taxing vehicles for highway purposes has stopped short of the ultimate, by 95% in mileage and 50% in traffic.

The practical objections to putting the whole cost of the highways upon motor-car users are obvious. In the first place, even if it were practicable, it wouldn't work —which isn't quite so much of a bull as it sounds. It wouldn't work because all cars engaged in any kind of public service—by far the greater and more destructive number when you include the motor trucks—would immediately charge the expense of the fee to the cost of their service, increasing the price to the consumer, so that the public would be paying just the same, only a little more so, for the benefits it receives via the highway route. Indirect taxation may tickle the palate, but it's fundamentally bad for financial digestion. The relatively small number of car owners who do not perform any public service for which they charge would bear the brunt of disproportionately high taxation. This immediately raises the question of how far we believe in class taxation. Is it, or is it not, justifiable?

Moreover, I don't believe it is generally practicable to raise highway funds exclusively through taxation of vehicles. It would tend to limit the number of vehicles, and the fewer of these the more each one would have to pay, until the limit that any one could endure would be reached. Then the roads would have to suffer —less new construction, poorer maintenance—until the public, realizing that the loss of good roads was costing far more than the taxes necessary to sustain them, would rise and demand that they be continued.

Theory of Marginal Utility as a Working Basis

It is really the theory of marginal utility that adjusts the difference between the two extremes, and offers us a working basis. The public is willing to pay up to the margin where the utility it receives from the road compensates the money outlay in taxes. Beyond that it cannot economically go. But so great is the destruction of the roads under heavy traffic that taxes on this basis will not meet the entire cost of maintenance and desirable new construction. The difference must probably be met by a tax on vehicles. Now, the vehicles are willing to pay up to the margin where the tax levied upon them is commensurate with the especial value that they, as direct users, receive from the road, in distinction from the non-direct-using public. Believing, therefore, that both classes of beneficiaries should contribute toward the support of highways, it remains to adjust the balance between them.

The point of marginal utility for the public seems to be reached at paying for the construction of new roads. The cost of these is great; so is the immediate benefit derived by the public. More exactly than such balances can usually be made, the point of marginal utility for the vehicles seems to be reached at paying for maintenance. The cost of maintenance is great; so also is the damage done by motor vehicles to roads for which the public has paid. I make these two statements, *a priori*, from a study of cost data and of the means taken by the different states to raise the necessary funds for highway purposes. They are, of course, open to dispute. I offer them as a hypothesis, because motor-truck fees must be considered in relation to the objects for which they will be used.

If we consider the fees in relation to maintenance, Connecticut offers us some interesting experience. Mr. Bennett, the commissioner there, is working on the the-

ory that the income from motor fees should approach the outgo for maintenance. Here are the schedules of Connecticut's heaviest revenue producers in fees: For passenger cars, 50c. per horsepower per annum; for commercial vehicles up to 1000 lb., $11 per annum; one ton, $15 per annum; then an increase of $5 per half ton to the three-ton weight, $35; then an increase of $10 per half ton to the five-ton weight, $75; then an increase of $12.50 per half ton to the seven-ton weight, $125; 7½ tons, $150 per annum; eight tons, $200 per annum; then for each additional ton or a fraction over a ton, $100; each motor cycle, $2; each chauffeur or operator, $2.

Here are the schedules of New York's heaviest revenue producers in fees: Passenger cars, 25 hp., $5 per annum; 25 to 35 hp., $10 per annum; 35 to 50 hp., $15; 50 hp. or more, $25.

For commercial vehicles, two tons or less, $10 per annum; then an increase of $5 a ton up to 14 tons, which is $70; for each ton over 14, $10 per ton; for trailers of two tons or less, $5 per annum; two to five tons, $10; five to seven tons, $15; seven to 10 tons, $20; 10 to 14 tons, $30, and $5 for each ton above 14.

For passenger omnibuses:

Passengers	
Up to 5	$15.00
Not less than 6 nor more than 7	24.50
Not less than 8 nor more than 10	30.50
Not less than 11 nor more than 16	43.00
Not less than 17 nor more than 20	52.00
Not less than 21 nor more than 22	55.00
Not less than 23 nor more than 26	61.50
Not less than 27 nor more than 30	67.50

And an additional $2 for each passenger over thirty.

Motor cycles, $2.50; chauffeurs, $5 first year—$3 for license, $2 for examination; renewal, $2.

According to motor-car owners with whom I have talked, these fees are paid willingly, both as a matter of abstract justice in repairing the damage done by the vehicles themselves, and as a matter of personal interest to the motorist. Through the payment of fees for maintenance of good roads, they assure themselves that they will lower operating expenses, decrease hazards and curtail delays.

Wisdom in Choice of Pavement and Efficiency of Maintenance Necessary

But here is an important point in considering motor-car fees in relation to maintenance. *The cost of maintenance depends upon the efficiency of your highway department.* Put in incompetents or grafters, and the fees will either go beyond bounds or the maintenance will fall short. The general public is not yet educated to knowledge of and insistence upon the best use of the taxes it pays. It is all up to the motor-car users and industries to see that the money for highway purposes be expended by honest men of proved ability. Whether they like to or not, they must concern themselves in politics to the extent of securing good highway men in state service, for the success of their business depends upon the success of the roads, and the success of the roads depends upon highway administration.

For instance, for years Mr. Bennett has been building in Connecticut durable types of pavement with maintenance charges of $100 to $200 per mile per year—a very different proposition from laying water-bound macadam with a maintenance of $1000 a mile or upward a year under heavy traffic. If motor-vehicle fees are to cover maintenance, wisdom must be shown in laying permanent types of pavement for heavy traffic, so that repairs will be kept at a minimum.

The maintenance itself must be well advised and executed. Millions of dollars can be squandered on poor materials or on work delayed or done at the wrong time. The proverbial stitch saves nine. The motorist must insist that repairs be promptly made, so that his fee is used to the limit of advantage. In justice to himself, he can't shunt off the responsibility upon some unknown official.

In New York state motor fees are a trifle lower than those in Connecticut. For the past two years they have almost covered the cost of maintenance. Last year fees aggregated $4,284,114; maintenance was $4,939,916. For the nine months of this fiscal year, which ended Nov. 1, fees were $4,571,852.75, while maintenance was over $54,000 less. Maintenance is high now because almost all our earlier roads, built to sustain traffic up to three tons, are protesting against traffic 10 times that wieght. The maintenance includes many complete resurfacing jobs done with durable pavements. As we build better roads, maintenance should decrease, even with increase of traffic. Motor-vehicle fees can then be lowered.

Limitation of Truck Capacity Necessary

Another important point to consider in relation of motor-truck fees to maintenance is limitation of damage that any one vehicle may do to your pavement. It is manifestly unfair to expect all motorists to pay for the destruction done by a few excessively heavy trucks—as unfair as to expect the public to pay $50,000 a mile for new roads to sustain such trucks. There must be an arbitrary limit of load for which we can design our roads. Otherwise, as fast as they are built, roads will attract to themselves traffic heavier than they are designed to bear. The road and the load will be forever outstripping each other, with great economic loss both of the original investment in the road and in the appallingly high maintenance. In addition to regulation of weight of load, there must also be regulation of other destructive factors, such as width and kind of tires, spring, speed, etc. If, after our roads are built in accordance with these regulations, it seems in course of time desirable to put much heavier loads upon them, we may well consider the suggestion made by Mr. Whinery (see *Engineering News-Record* of July 18, p. 142), that we lay narrow-gage tracks on either side of our pavement to carry the heavy trucks.

With these regulations, it is obviously only fair to proportion the fee to the vehicle in accordance with its probable requirements upon maintenance funds. It would not be fair to tax the little two-passenger "flivver" the same amount as the 12-ton truck.

Nelson P. Lewis, chief engineer for the Board of Estimate and Apportionment, New York City, says: "The plan of grading the annual fee in proportion to the gross weight and carrying capacity is rational, and it might well go further and make the total width of the vehicle, where such width exceeds 7 ft., an element in the determination of this fee."

The fees should undoubtedly be graduated in accord-

ance with the destructive factors to the road of the vehicle in question. Such a gradation is now made in many states. I purposely refrain from bombarding your ears with masses of figures.

A graduated scale of motor-vehicle fees to cover the cost of highway maintenance necessitated by the cars themselves would not, I believe, fall too heavily upon anyone. There are, of course, objections to it, but it seems to me the fairest adjustment yet made in taxation between the vehicle and the highway, the motorist and the public.

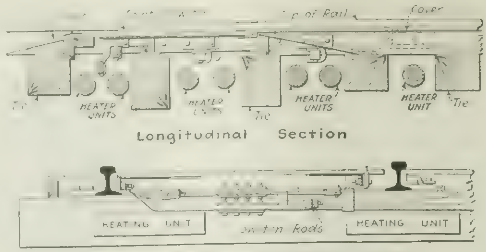
Electric Heaters Keep Track Switches Clear of Snow and Ice

CLOGGING of track switches by snow and ice has been prevented, on the New York Central R.R., by the installation of electric heating devices. On the electrically-operated suburban lines at New York there are 107 turnouts and seven double-slip switches thus equipped, all taking current from the third-rail conductor. There are two heated switches also at Utica and Albany, N. Y., where the line is not electrified. The accompanying view shows one of the heated switches on a third-rail suburban line. The device may be used without the covers, which serve to prevent diffusion of the heat.

The avoidance of delays and interruptions to traffic at busy points is of much more importance than the cost of keeping the track clear. Detentions at junctions and at points of detour and change of power become cumulative when switches operate slowly, as in time of snow and severe cold, so that in the rush hours suburban traffic may be badly deranged unless means are taken to keep the switch operation as nearly normal as possible. This was accomplished last winter by the use of the heaters.

In ordinary storms these devices were found to be completely effective in themselves, no men being required to keep the switches clear. Deep snow aided the efficiency, as more mist and steam arose to prevent freezing on the slide plates and other parts of the switches. On one occasion, when there was not much snow, and a high wind was blowing parallel with the tracks, men were required to help in keeping the switches clear.

Short heater units placed between the ties and directly under the rails, as shown in the drawing, are wired together and connected to any convenient circuit of either direct or alternating current. Each unit is enclosed in a 20-in. length of 3½-in. pipe. When a storm begins the current is turned on, heating the ground and the rails. In laboratory tests the heater was maintained at about 275 deg. F. above atmospheric temperature.

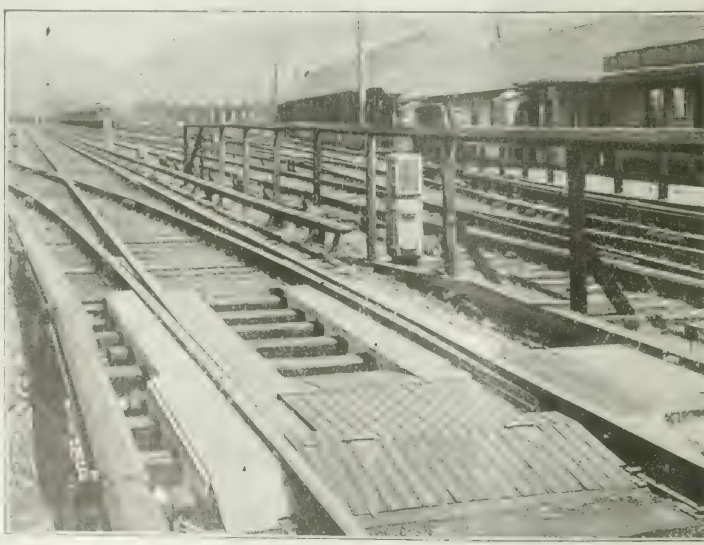


SWITCH HAS ELECTRIC HEATERS WITH COVERING TO RETAIN HEAT

This electric track-heating device is being handled commercially by the Q. & C. Co., New York. It is the invention of Francis Boardman, division engineer of the New York electric division of the New York Central Railroad.

Safety Isles Removed by Traffic Officials

The safety isles in Fifth Ave., at 42nd and 43rd Sts., New York City, have been removed at the suggestion of Special Deputy Police Commissioner John A. Harriss, in charge of traffic, because investigation showed that few pedestrians used them. Instead, they stepped out into the traffic area beyond the lines, and thus left passage room for but one line of vehicles. Besides this interference with traffic, the isles were also found to cause obstructions to large parades. It is said that the system recently introduced at 42nd St. and Fifth Ave., where a line of white marble slabs, extending from curb line to curb line, indicates to the pedestrians the safe area within which he may cross the avenue, will be extended.



HEATER UNITS UNDER THE RAILS PROTECT SWITCH FROM SNOW

German Militarism and Bureaucracy Deplored 27 Years Ago

Remarkable Human Document from Engineer of Berlin Water Filters, Victim of Conditions, Then Growing Worse

ILLUSTRATING "the odious burdens which have been cast off" from individuals as well as nations by the winning of the war, George W. Fuller, consulting engineer, New York City, brought into his recent address as retiring president of the New Jersey Sanitary Association a letter dated Berlin, Jan. 6, 1892, written to him by C. Piefke. The larger part of this letter, and comments by Mr. Fuller, follow:

"Esteemed and dear Mr. Fuller:

"My best thanks for the kind transmission of the 23rd annual report of the State Board of Health of Massachusetts. On a preliminary perusal I have seen with pleasure that you belong to the most industrious co-workers. I shall not fail to study thoroughly the voluminous papers and further to utilize them on appropriate occasions.

"Give also Mr. Allen Hazen my most obliging thanks. Besides, I must beg his pardon on account of my sin of omission, of which in my correspondence I have been guilty. But the last year does not belong to the happiest of my life, and many circumstances have combined to produce in me a certain mental fatigue from which I am suffering partly even today.

"Here in Germany conditions have changed to be very uncomfortable. Militarism and bureaucracy are spreading over our very existence, and despite all effort no success rewards him who does not occupy a high rank within this hierarchy. Then comes the unfortunate passion for titles among Germans in general, so that an individual is not esteemed according to his personal worth, but his social position.

Vain Struggle Against Conditions

"Nothing therefore remains but to pay regard to this national fault, if you do not wish to give up competition. As this is not my intention, I must rise to a deed which I am in fact struggling against, because it appears ridiculous to me, but the necessity of which daily becomes clearer. To you, my dear young friend, I shall delegate this matter.

"First of all, I must endeavor to acquire the title of doctor (in science) so that in this country I may receive the concession for scientific work. As a man of years I do not care to submit to a painful examination, as suits young people. My pride forbids this. But I am gladly ready to write a dissertation and am in possession of suitable material. It relates to a process devised by me for treating ground water containing iron.

"The article could be composed within a few weeks; it is only necessary for me to sit down and write it. What do you think if I should hand it to the Institute [Massachusetts Institute of Technology—EDITOR] in Boston with a request for a degree? Since you have always shown me how gratefully you remember the small favors that were once shown you here, I am hoping that you will be pleased to take up this matter, so far as your coöperation is practicable. Therefore, you will have the kindness to ascertain what my undertaking would cost, if it is feasible, and what other formalities are to be fulfilled.

"Further, I have yet the wish to secure a more intimate intercourse with the esteemed Institute to which you belong, particularly in a way that I could help pursue the aims held in view. America is today the only civilized country where no restraint is placed upon the pleasure of working, either through antiquated regulations or through the rights of privileged classes. (Signed) C. PIEFKE."

Mr. Fuller went on to say:

"Piefke, with whom the writer studied in 1890, was then the engineer in charge of the Stralauer filter plant of the Berlin water-works. He was one of the earliest and best investigators of filtration practice, and was an active participant in the strenuous discussions upon the relative hygienic and economic aspects of ground water and filtered surface water-supplies. The medical men and engineers had many wordy conflicts that were not wholly quieted by the performance of the Altona water filters at the time of the cholera epidemic in Hamburg, or by the success attending steps to remove iron and manganese from ground water. The latter years of Piefke's life were spent very unhappily—deprived of his water-works position in Berlin and assigned practically to be a recorder of ground water statistics for the Berlin district.

World Is Now Safer, But Sadder

"If, 27 years ago, humble origin, beyond the confines of Prussia, was so distinct a handicap for a man of very unusual technical ability in various directions, how the oppression must have grown with the rising tide of militarism, bureaucracy and caste! How welcome must be the change and how human are the swings to unwise radicalism which we are witnessing! Today the world is safer but sadder than it was a few short years ago. But accomplishments have been wrought with terrific sacrifices. It remains for those who have not made the supreme sacrifice now to see to it that the appalling losses of life and property will not have been made in vain.

"Fortunately, in America we do not need to worry about holding ajar such newly opened gates to personal ability. Here the doors against opportunity are permanently off the hinges. But, nevertheless, no one will deny that great improvements for the well-being of our population are possible, or that the conduct of this war presents some immediate lessons to that end for every profession."

Large Saving in Army Camp Coal Contract

Substitution of bituminous coal and coke for anthracite at 31 posts, camps, cantonments and stations south of Washington and west of Pittsburgh, with a saving of about $300,000 a year in cost of coal and $200,000 in transportation for the fiscal year 1919, was announced recently by the War Department. About 33,000,000 ton-miles of transportation will thus be made available for other purposes. Some 200,000 tons of anthracite coal was called for originally. Change was made to bituminous coal and coke as a result of investigations by the fuel and forage division of the Quartermaster Corps.

Ship-Design and Quantity-Production Methods of Newark Bay Yard

Project for Factory-Style Shipbuilding Based on Enlisting a New Labor Supply and Using Commercial Steel—Methods Dictated by Delay in Ship Orders—Bridge Shops Fabricate Straight Parts

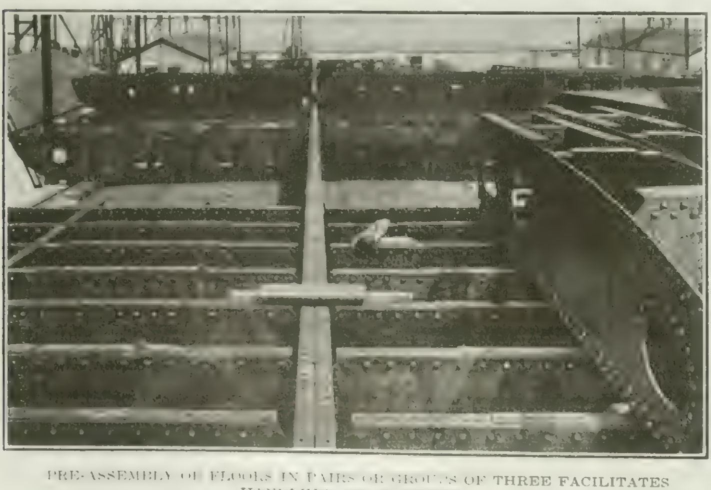
[Passed by Publication Approval Committee, Emergency Fleet Corporation.]

ENTERING upon a project for large-quantity ship production immediately ater the United States went into the war, in April, 1917, the Submarine Boat Corporation brought together shipbuilding and bridge-construction men in a combination which attacked the new problem of high-speed shipbuilding in a radically new spirit. By the early start upon the work, as well as by the effective combination of men directing the enterprise, the development of the corporation's engineering methods and its relations with outside fabricating shops were effectively determined.

Though the Emergency Fleet Corporation of the United States Government did not finally decide to let the large fabricated-ship contracts until well along in September, the Submarine Boat Corporation's planning was carried on throughout the summer in the faith that shipbuilding of the kind in which the corporation intended to engage was vital to the nation's success, and would ultimately be decided upon. Officials of the corporation have stated that they spent no less than $250,000 on developing the enterprise before the Emergency Fleet contract was a certainty. Prosecuting active development on the basis of this faith, they advanced their work so well that they were two months ahead of the other two agency yards—Hog Island and Bristol—in launching their first ship, an event which they celebrated on Memorial Day, 1918.

In 1917 grave fears were entertained that both the supply of ship steel and the amount of experienced shipbuilding labor available would not be adequate to carry out a large steel-ship program. This fact appears to have been one of the underlying elements of the bitter controversy raging throughout June and July between the adherents of wood-ship construction and the steel-ship men in the Emergency Fleet Corporation of the United States Shipping Board. The Submarine Boat Corporation project was based on manufacturing methods by which both difficulties should be circumvented. Commercial structural-steel shapes, of which the supply was relatively ample, were to be used instead of regular ship shapes, and plate steel of bridge or structural grade was to be used instead of the very scarce ship grade, made to specifications involving numerous added complications in furnace and steel mill. Furthermore, the problem of putting a ship together was to be attacked as a steel-erection problem, using bridge builders instead of shipyard men. Thus, a new supply of material and a new supply of labor would be enlisted in the work, according to the plans of the corporation. As is now widely known, precisely these expedients are what have created the vast steel-ship building industry developed in the United States within the past year.

After the Submarine Corporation's project was laid before the Emergency Fleet Corporation, and the head of the latter, General Goethals, had taken a keen interest in the proposals, the matter of design was taken up with Theodore E. Ferris, naval architect to the Fleet Corporation. The outline design previously prepared by the Washington authorities, for a 3500-ton wooden ship, was the starting point. As the development of a steel design for a vessel of similar size proceeded, and the practicability of shop fabrication and yard assembly impressed itself more strongly on all concerned, the size was increased. It went to 4000 tons, then to 4500, and finally to about 5000. Preparation of detailed drawings and molds or templetes during the summer, before the contract was received, was probably the element which saved the largest amount of time, though it also involved a large expenditure. In carrying out this preliminary work, which was done in a large shop at Bayonne, N. J., obtained for the purpose, the templets or molds were marked directly from full-size lines of the ship laid down in the mold loft, without waiting for the preparation of detail drawings, as the working drawings would have reduced by only very little the time needed for



PRE-ASSEMBLY OF FLOORS IN PAIRS OR GROUPS OF THREE FACILITATES HANDLING AND ERECTION

making molds. Since the company's project involved making the parts of the ship at various bridge and structural shops throughout the country, molds had to be furnished to many shops, and it was vitally necessary that the fit of parts should be assured before shop work was commenced. The natural result of these conditions was the decision to start on the mold-loft work as early as possible, and complete the molds for the use of the bridge shop with the least possible delay. Work was far advanced when the emergency shipyard contracts were finally let.

That assembly of ship parts manufactured at a distance was practicable had been learned in a very practical way by the corporation a year before, in building 550 patrol boats of 32-ton size for the British Admiralty. These small vessels were "manufactured" in the company's Bayonne shop, but were not assembled there. The parts were shipped to Canada and were assembled into finished boats at yards in Montreal and Levis. Though the hulls were wooden, the various methods and problems of shipbuilding, and the question of whether ships could be built by an interchangeable manufacturing system, were quite fully put to the test in executing the contract. From the satisfactory results obtained in the assembling yards, the corporation's officials became convinced that the system of separating assembly from shop manufacture could be applied to shipbuilding just as well as to machine manufacture. With such subdivision it seemed that effort could be concentrated on ship construction to any desired degree, and thus ship production speeded up almost without limit.

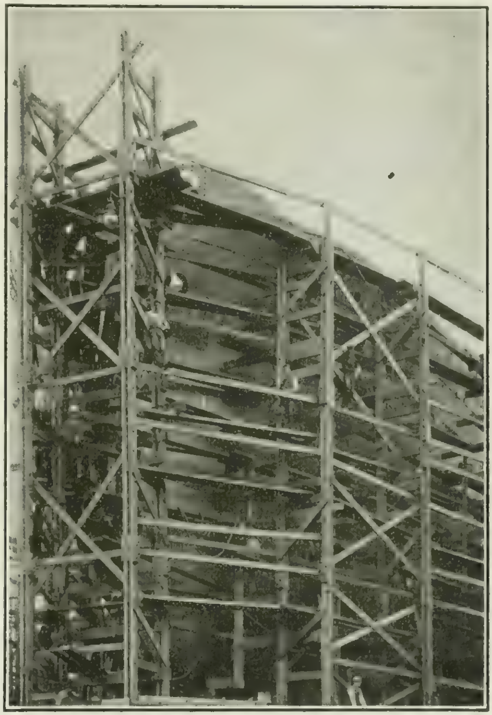
It is a noteworthy fact that shop fabrication at inland points and assembly in the shipyard had been going on during nearly two years preceding this time, carrying out some of the purposes which the Submarine Corporation people had in view—in the shipbuilding enterprise of Capt. C. P. M. Jack, for which straight ship parts were sheared, punched, and riveted by the American Bridge Co. at its Ambridge barge-building shop, and assembled at Chester, Penn. The Submarine company was not in touch with this work, however, and developed its project quite independently.

In its detail development, the corporation's project was influenced by the conviction that best results would be obtained by depending on many small shops scattered throughout the country, rather than on a few large shops. The ultimate outcome of this idea is reflected in the fact that structural-steel fabricating shops scattered from the Atlantic coast as far west as Iowa are making hull parts for Submarine Boat Corporation ships.

Data concerning the available capacity of bridge shops for ship work were collected during the summer of 1917. The very large shops, perhaps a dozen in number —those of the American Bridge Co., the McClintic-Marshall Co. and the Bethlehem Steel Bridge Co.— were not included in the program, but outside of these the best equipped plants were enlisted in the work.

Similarly, early steps were taken to find the most suitable site for the plant. The Newark Bay location, using ground already reclaimed from marsh by the City of Newark, N. J., for a shipping terminal, was chosen and arranged for in June. The immense labor market of the metropolitan district of New York, with few shipbuilding industries competing for labor, furnished a prime reason for considering this the best site for a yard. With a site chosen, bridge shops under contract, and the molds and templets largely completed, by the time the emergency ship contract was awarded the Submarine Boat Corporation was able to make rapid progress.

The Lackawanna Bridge Co. and the Worden-Allen Co. became affiliated with the corporation at an early stage of the work. This brought to bear on the work the structural-steel experience and resources of two large fabricating and erection companies, and enlisted the assistance of minds not previously applied to shipbuilding—carrying out the fundamental idea of the corporation that large-quantity production of ships at high speed was a problem of such new character as to require new men and new minds for finding the best solution.



CURVED AND IRREGULAR PLATES AT BOW FABRICATED IN YARD SHOP

In designing the ship it was realized that the parallel body of the vessel offered the largest opportunity for shop fabrication. At the same time, the analogy of tank work made it clear that the curved plates of the molded ends of the ship could also be sheared and punched in the shops, and could be curved either there or at the shipyard. In view of the difficulties in shipping curved plates, it was decided to do all the curving at the yard. For the same reason, bending the frames

of the molded ends was allotted to the yard, and this meant that the punching also had to be done at the yard, as it is impracticable to punch the channel or angle frames before heating and bending.

Plates Rolled at Yard Shop

Of all the plating of the molded ends of the ship, less than two dozen individual plates are of distinct double curvature or "formed" so deeply as to require hot forging. All others, and the bilge plates of the parallel section, can be shaped by rolling to cylindrical curvature (generally on an axis inclined to the length of the plate); this rolling is done at the shipyard shop, the plates coming to the yard fully punched, but flat.

The result is that 95% of the shopwork on the Submarine Corporation ship, including very much of the work on the molded ends, is done in the bridge shops, distant from the yard. Two small bending shops at the shipyard do the remaining 5%, all of it curved work. In this reckoning the forged plates, the stern-frame castings and a few similar items have been counted in with the bridge-shop portion, although they come from other outside shops. The steel castings, for example, are made in a Buffalo foundry, and the furnace plates are die-forged in a Chicago shop and one in Joliet.

The hull outline was furnished by the Emergency Fleet Corporation, having been drawn by its naval architect, Theodore E. Ferris. Efficiency of production required as great a length of parallel middle body as possible, while efficiency of propulsion called for a minimum length of middle body.

In the general shaping of the ship the same course was followed that has characterized all the rapid ship-production designs put into the yards during the past year. Many conventional ship curves were discarded in order to simplify the shopwork. The rounded shape of the midship section, the longitudinal up-curving of the ends, and the transverse down-curving of the decks to the side, are elements which, though having some navigation value, are now considered to be largely based on pure tradition in shipbuilding, handed down from the early wood-ship days. Great simplification in fabricating the frames and shell plating can be obtained by straightening out many of these curves. In the present instance, the midship section was made as nearly box-shaped as possible, and the longitudinal deck profile (shear) was made up of straight-line segments instead of being curved. The decks were designed without the usual transverse camber.

By making the bottom plating horizontal and the tank-top parallel to it, the transverse girders of the double bottom, the "floors," were converted from tapered girders to girders of constant web depth, much simpler to build in the shop. The sides of the ship being carried up plumb, the frames became straight, and this, in conjunction with horizontal decks, gave uniform right-angle connections at the deck beams. The deck beams were made straight instead of curved as is usual—by discarding camber. Avoiding curved sheer profile gave the advantage of having a constant flange bevel in the deck beams of each section.

The Submarine Corporation's ship has the ordinary transverse framing, with spacing of 27 in. between centers of frames. Following usual ship practice, floors with plate webs ("solid floors") alternate with open floors, consisting only of upper and lower flange angles and occasional angle stiffeners; in the parallel body two open floors occur between solid floors. This grouping was utilized in carrying out an important expedient for speeding up the erection—namely, assembling groups of floors in the fabricating shop, as noted farther on.

The frames, or vertical members supporting the shell plating of the sides, are channels in the middle three-fifths of the ship's length, and bulb angles in the end positions. The attachment of these frames to the double bottom by brackets involves no curved work, in virtue of the flat tank-top margin, as compared with the usual construction in which the tank-top is bent down normal to the bilge at the margin.

Rolled shapes of "ship" section were avoided in favor of standard structural shapes, because the latter could be obtained most readily and are in stock in the yards of the fabricating shops. Only one unusual section is used, a 7 x 3½ x ⅜-in. bulb angle in the frames of the bow portion. The middle-body frames are made of 12-in. structural channels instead of 13-in. ship channels, against the argument of naval architects in favor of the deeper and wider-flanged ship channel.

Simplification Discussed with Classification Societies

Shell-plate thickness and rivet diameter in ordinary shipbuilding are governed by the strict rules of ship-classification societies in such a way as to call for a considerable range of variation in sizes. Simplification was accomplished here, in the interests of fabricating economy. Extensive discussion of such changes with ship-classification societies was necessary, because the Emergency Fleet Corporation required that ship designs should be approved by both Lloyds and the American Bureau of Shipping, and that the inspection during erection on the ways should also be supervised by these organizations. Some delay in the development of the designs resulted from having this jurisdiction superadded to that of the Emergency Fleet Corporation's own organization.

When the attempt was made to lay out the plate work for the use of multiple or gang punches, the rigid rivet-spacing rules prescribed by ship-classification rules were found to make this impossible. No concessions as to variation of spacing could be obtained from Lloyds' inspectors, and the only way that the multiple punch could have been suited was by a considerable increase in the number of rivets. Such increase was highly undesirable, as it meant more field riveting; and, since only one or two of the shops were equipped with multiple punches, all riveting was laid out with no regard to multiple-punch requirements.

Joggling of frames and floors to follow the in-and-out shell plating, common shipyard practice, was avoided by using fillers or "liners," as bridge shops are not equipped for it. Similarly, scarfing the corners of plates at the junction of butts and seams was avoided, although called for by the rules; the inspectors permitted the use of beveled liners at these points, as sketched (Fig. 1).

Similar special operations are required in customary ship practice in the splices of the keelson girder web, which ordinarily are lap splices, requiring scarfing where the lapped web goes between the flange angles. In place of this construction a butt splice was used just the same as an ordinary plate-girder web splice, with the exception that, as the joints must be calked water- and oil-tight, a tight fit of the splice bars against the edges of the flange angles must be secured. The construction shown in the sketch, Fig. 2, was adopted; the splice plate on one side is fitted tight against the leg of the flange angle, which latter is chipped square for the purpose, and the joint is subsequently butt-calked.

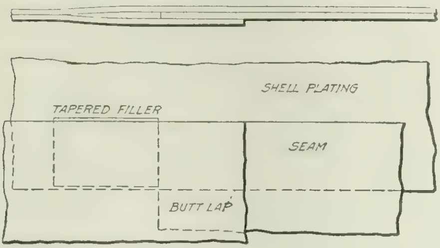


FIG. 1

In one of the fabricating shops this construction was departed from by making an ordinary butting contact of the splice plate (without chipping the angle) and welding the plate to the angle by gas flame.

To facilitate die forging of double-curved plates, the designers endeavored to concentrate the sharp curvature at any one point in a single plate, if possible. At the plate covering the propellor boss, for example, two or more plates, each of which can be forged without dies, are frequently used. In the present design, a single

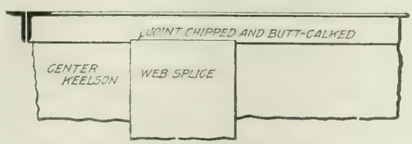


FIG. 2

plate is substituted, and in view of the quantity production this plate can be cheaply forged in dies. The ship has only 18 furnace plates: three steel plates at the stern and three at the bow, two plates at each quarter of the bilge, two propellor boss plates, and two stern plates under the transom.

Erection economy led to grouping the floors for shop assembly in sections of two and three floors, with the intercostals or longitudinal members connecting them. A large increase in shop riveting and decrease in field riveting were accomplished by this shop assembly, and the yard officials state that there is a large gain in erection speed by reducing the number of pieces to be handled.

The drawing and templet system which the corporation uses was controlled by the time available last summer for designing and mold-loft work. The structural men in the company having decided that the most satisfactory fit of parts would be secured if only straight work were assigned to outside shops, the yard was equipped to do all bending of frames and rolling of plates. The molds and templets for all the curved parts were worked out in the mold loft, formerly located at Bayonne but now directly alongside the yard shops. These molds never leave the yard and are subject to easy check either from the mold-loft lines or from actual fit on the ship. The construction of the first two ships was in fact made the opportunity for testing all the molds and, where necessary, correcting them to secure perfect fit.

The straight work of the ship was in general left to the ordinary methods of the particular bridge shop to which it was allotted. It was expected that templets would be made by each shop in accordance with its normal procedure. For check purposes, however, cardboard templets of plates, and wooden stick templets of flange angles, stiffeners, etc., were made in the mold loft and were sent to the shop. These were subject to verification by over-all measurement at the shop, before being used for checking or for laying out a working templet, thereby eliminating risk of error from shrinkage. The cardboard templet system was also used for the curved plates, for punching, and in these plates the great susceptibility of cardboard to change length with moisture variation made it necessary to apply the over-all dimension check very scrupulously.

The original plan was to retain no drawing record of the molded plate work except the general shell expansion and the order sheets showing the over-all plate dimensions as determined from the mold-loft measurements. A tabulation of offsets of all mold-loft curves was made for file purposes. Later it was decided that permanent, accurate drawings of the curved work would be useful in many ways during construction, besides affording invaluable insurance against delay in case of destruction f molds or of the mold loft. Such drawings were therefore made, from measurements taken directly off the molds. The curves of all the plates, both in developed representation and in rolling profile, were shown by offsets at each of the several frames involved, permitting accurate reproduction. Usually, four or five plates could be grouped together on one sheet, and two or more frames.

In the speedy erection of the first vessel—launched, as already mentioned, on May 30—and in the smooth progress of operations at the shipyard, resulting in the launching of 15 ships by the end of October, the full success of the shop-manufacture-and-yard-assembly idea has been demonstrated. With steady driving of erection work on the ways, high-speed shipbuilding has been made dependent only on getting the work through the bridge shop and obtaining its delivery at the yard promptly and in the order most suitable for erection. The 28 ways of the Submarine Boat Corporation's yard have all been in service since early spring. At present two ships are being launched each week—both on the same day, to minimize the disorganizing effect of launching days. By spring a schedule of three ships per week should be attained.

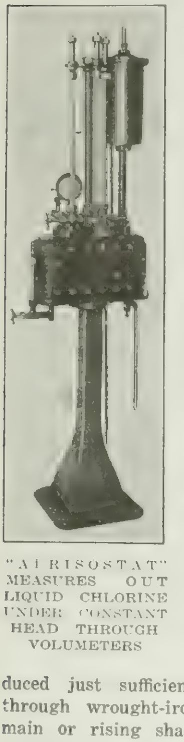
Chicago Introduces New Chlorinator

By John Ericson,
City Engineer, Chicago

(Abstract of paper read before American Public Health Association, Chicago, Dec. 9-12).

WATER treatment with liquid chlorine is practical at all of the pumping stations of the Chicago water-works. Maintenance of the delicate apparatus in proper service conditions has been somewhat difficult, and absence of trained operators, due to war service and vacations, has made the situation worse. Having its own shops and foundry, the city has been able to keep the apparatus in continuous operation, which would have been practically impossible if it had had to depend entirely upon the manufacturer for repair service.

Apparatus at the older pumping stations is capable of considerable improvement, particularly in eliminating delicate parts, joints and valves, and in giving a more dependable distribution of the desired amount of chlorine. A step in this direction has been taken in the equipment of the new Mayfair station, which was opened in August, 1918. This station has five triple-expansion plunger engines with a combined daily capacity of 110,000,000 gal., and will have an ultimate capacity of 152,000,000 gal. Water from the supply tunnel rises through a main shaft at the station, and here the chlorine solution is applied by pipes extending 55 ft. below the upper tunnels which lead to the pumps.



"AËRISOSTAT" MEASURES OUT LIQUID CHLORINE UNDER CONSTANT HEAD THROUGH VOLUMETERS

Two independent sets of apparatus are installed to provide against breakdown. Each unit consists of a battery of nine chlorine cylinders connected to a manifold receiver for equalizing the pressures. From this receiver the gas passes into an "aërisostat," which regulates the quantity of chlorine required, and wherein the pressure is reduced just sufficiently to drive the chlorine gas through wrought-iron piping to a room over the main or rising shaft. In this room are two sets of two mixing towers providing for the reception of four ¾-in. chlorine pipes. These towers are made of hard rubber; they are 7 ft. high and 8 in. in diameter and are filled with pumice stone. A chlorine pipe enters the top of each tower and extends to within 6 in. of the bottom. It is covered with a copper spraying cone into which falls a stream of filtered water that works down through the pumice stone. The chlorine gas rising in this same inclosure is absorbed by the water, thus forming the real chlorinating solution.

From the bottom of the mixing tower extends a 1-in. hard-rubber pipe connected to a 1¼-in. rubber hose through which the chlorine solution is discharged into the raw water at about 90 ft. below lake level or datum. This hose is protected by a 2-in. galvanized-iron pipe anchored to the wall of the shaft.

The "aërisostat," which is the regulating and pressure reducing part of the apparatus, consists essentially of low-pressure float-controlled chambers, based on the principle of the U-tube, with legs of different areas proportioned to equalize the effect of the higher pressure of the chlorine cylinders and the low pressure required for the delivery of the gas to the absorption tower or other point of delivery. It was developed and adopted from sensitive flour-bleaching apparatus by the Municipal Supply Co., Chicago. The main chamber is divided into two parts of proportionate areas by a partition extending to within a certain distance of the bottom. This chamber is nearly filled with pure sulphuric acid. Chlorine gas from the cylinders is admitted to the top of the chamber through a circular opening, the underside of which forms a seat for a vertical needle valve.

As soon as gas is admitted through this valve into the larger part of the chamber the gas pressure upon the sulphuric acid forces the liquid up into the smaller one. A float in this latter controls the opening and closing of the needle valve as the pressure of the gas causes the fluid to rise or fall. In the older apparatus this regulation is obtained by reducing valves of the diaphragm type, with counteracting springs. Close watching and attention are found necessary to keep these in operating condition.

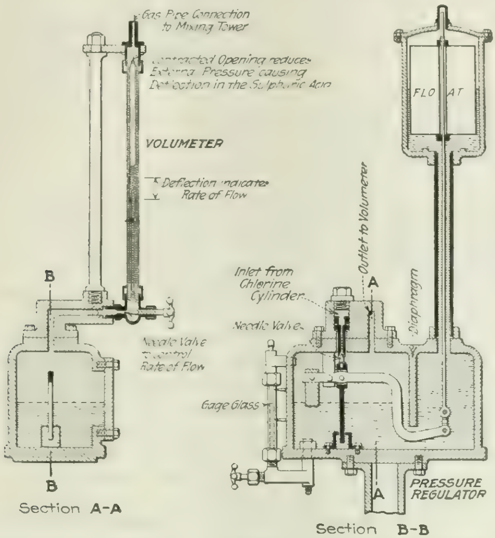
Partitions of steel and glass isolate the installation from the pump room. An electrically operated exhaust fan ventilates the inclosure, and a red pilot light indicates when the fan is operating. Heating equipment will keep the temperature within the inclosure at 90° to 95° F. and in the main gate shaft the temperature should not go below freezing. The temperature is controlled by thermostats.

Two dial-reading chlorine-weight indicators are installed as a check on the distributing apparatus. The weighing platforms are inside the inclosure but the indicators are outside and have pointers so arranged as to show the number of pounds of chlorine used. Recording gages showing the pumpage of the water and the dosing by chlorine give an accurate account of the proportion of chlorine used to the water pumped. It would be far more desirable, however, to have a satisfactory means of regulating automatically the amount of gas used in a definite proportion to the pumpage. This seems feasible with a venturi meter when used to record the flow of water, as it may be connected to the apparatus controlling the flow of chlorine, automatically increasing and decreasing the flow of gas as the pumpage increases and decreases. This problem will receive attention.

Although the most modern apparatus and all improvements which past installations have suggested are used at the Mayfair station, it appears that considerably more experimental work will have to be done, and a special study of the chlorine plant at this station will be made with a view to future improvements.

Chlorination for the sterilization of water for domestic purposes is evidently a correct principle, judging by the results obtained in Chicago since complete chlorination has been in vogue. Bacteriological tests

made on untreated water in 1916 showed 18 colon bacilli present in 1 c.c. per 1000 samples, while samples of water treated with chlorine showed only 0.9 per cubic centimeter. There is, therefore, a strong indication



SULPHURIC ACID IN BALANCED VALVE ARRANGEMENT KEEPS LIQUID CHLORINE DRY

that the use of chlorine reduced the death rate due to typhoid fever more than 70 per cent.

Bacteriological tests made on untreated water during 1916 showed colon present in 1 c.c. in 18 samples out of 1000 examined, whereas the corresponding number of contaminated samples in treated water during the first nine months of 1917 was $\frac{9}{10}$, or less than one per 1000 samples examined. During the first nine months following complete chlorination of the water-supply the death rate from typhoid fever was reduced by 71.44%. There is, therefore, a strong indication that the use of chlorine reduced the death rate due to typhoid fever more than 70 per cent.

Chicago Faces Sewage Disposal Problem

BY C. D. HILL

Engineer of the Board of Local Improvements, Chicago

(Abstract of paper read before American Public Health Association, Chicago, Dec. 9-12).

AT PRESENT the matter of sewage disposal at Chicago is in a critical stage. The Federal Government may restrict the flow from Lake Michigan so that it will be impossible to dilute the sewage to the extent required by the act of 1889. Under this condition the state Government would be justified in objecting to the discharge of the grossly polluted water from the canal into the Des Plaines River, and in requiring the construction of works for treatment of the sewage. To build treatment works that would so purify the sewage that with the limited dilution of lake water the effluent would not constitute a nuisance would require years, and would cost so much that legislation would be necessary.

There is in Chicago a lack of appreciation of the seriousness of this situation. Few realize the opposition of Federal officials to the operation of the drainage channel in accordance with the original plan, and still fewer realize the opposition by other cities along the Great Lakes. This opposition is due largely to a mistaken notion as to the effect of the flow of water through the channel upon the level of the lakes.

Even if we should obtain from the Federal Government permission to operate the channel at its full capacity, it would be necessary to install auxiliary purification works, and once more we would repeat history by showing the inadequacy of present methods long before new works could be installed.

No serious mistake has been made in the successive steps through which the sewage-disposal works of Chicago have evolved, except the mistake of procrastination. Each step has been logical and reasonable, and other methods would probably have been unwise. When the present works were planned a few progressive engineers favored sewage treatment. If such a plan had been followed, probably the method adopted would have been obsolete before the work of treatment had been fairly started.

The best means of sewage treatment may not have been developed as yet, but the time is approaching when some method supplementing dilution of the sewage must be adopted.

Ohio Engineers Have Fixed Charges for Professional Services

Per diem rates of pay for engineering service of various kinds have been standardized to a certain extent in the Mahoning Valley, Ohio, through the efforts of one or two men who have been sending out rate cards to the engineers of the valley. Some of the rates are as follows: For consultation, opinion, testimony, preliminary investigation, reports, and consulting capacity upon design, minimum, $25 per day. (While absent from the city, attending court, or performing similar duties, or traveling, each day of 24 hours, or a fraction thereof shall be considered as one day, irrespective of the actual time spent on the case. Otherwise seven hours shall constitute one day.) For examination or reports of an extensive nature covering several days, minimum, $15 per day; engineer in charge of field work, minimum, $10 per day; assistants, classed as instrumentmen of party, minimum, $5 per day; assistants, classed as rodmen, chainmen, etc., minimum $3.50 per day; inspector on paving, sewer, etc., minimum $3.50 per day; minimum charge for field work, $10. To all the above an additional charge will be made to cover actual expense, including stakes. Residence lot, minimum charge $10; calculating, draughting, etc., $10 per day, minimum charge, $2.50 per day; minimum charge for any one map, $5. For percentage work on sewers or disposal plant under $3000, per diem rate; for contracts under $30,000, 8% for first $15,000 and 7½% for second $15,000. For paving, the charge is to be 1% less than for sewers.

The client is to pay for one inspector on percentage work. The above rates are a base for contracts with a reasonable time limit in the contract, and all overtime is to be based on the per diem rate.

Principles Controlling the Layout, Marking and Maintenance of Trunk Highway Systems

Detailed Account of Methods Followed by Wisconsin Recently in Inaugurating a 5000-Mile System of State-Maintained Highways—Patrol System, Paid For by State, Is Administered by Counties

By A. R. Hirst
State Highway Engineer of Wisconsin
(Paper read before the Joint Highway Congress, Chicago, Dec. 12, 1918.)

(Concluded from last week)

A STATE trunk highway system which is not completely constructed—or even if it is completely constructed—is of no great value to the traveling public unless it is so marked on the ground that the traveler may follow it without trouble. The marking and signing of a state system is a problem in itself, and to this problem we have devoted a great deal of attention.

Our state trunk highway law provided that each state trunk highway should receive a number, which should be displayed along the road itself in a standard design, similar on all state trunk highways except the number. These highways are numbered in order of their length in miles, from 10 upward, the longest (456 miles) being number 10. The idea in selecting 10 as the lowest number was that every highway number should contain two digits, and thus give uniformity.

WISCONSIN STANDARD STATE TRUNK HIGHWAY MARKER AND METAL DANGER SIGNS

Danger signs are uniform for hills, curves and railroad grade crossings, except in central wording

After considering a large number of designs for the standard marker it was decided to use a triangle containing at the top the words "State Trunk Highway," then the number in large figures, and in the lower point of the triangle the word "Wis." The triangle is 10 in. wide at the top and 13 in. long and is placed on telephone poles on a white-lead and oil-paint background 18 in. wide; the triangle and the lettering being coach black. We find that it is advisable to be rather profuse with these road markers. There should be one or two on each side of intersections with other roads, and an occasional one between intersecting roads. The traveler welcomes their kindly reminder that he is still on the right road, especially at night, even when they are not absolutely essential for guidance. The white bands are just as valuable as the marker itself in outlining the route. Where a turn should be made the white band is widened to 30 in. and an "R" or an "L" stenciled beneath the marker in the white field. These markers were placed upon the telephone and telegraph poles, fences, culvert end walls, and in some cases on boards nailed to trees, where other objects were not available.

By the coöperation of the 71 counties, the whole system was marked in one week. Each county did the marking within its limits, the stencils and instructions being furnished by the State Highway Commission. As a matter of interest, 1 gal. of good, thick white-lead and oil paint covered about 60 average poles, two coats, the bands being 18 in. wide. The cost of marking in the counties varied with the care taken, the complexity of the roads, the length in the cities, etc.; the highest county rate per mile was $5.25; the lowest $1.00. The total cost of marking the 5300 miles was about $9000, or at the rate of $1.70 per mile.

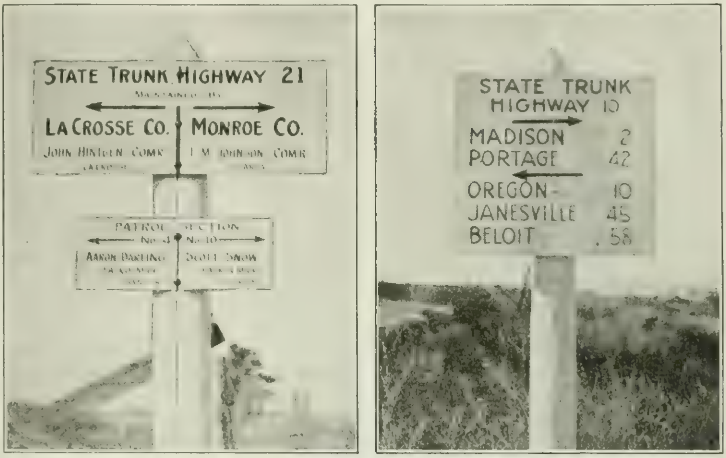
The marking covers 5300 miles, although only 5000 miles are on the system and mantained. This is due to duplicate marking where two trunk highways follow the same road for a distance, and to the fact that the marking continues through all cities, although streets, in fully built-up districts, of places larger than 2500 population are not a part of the system and are not state-maintained. Careful and full marking through cities and villages is very essential and can hardly be overdone.

The system of numbering the highways has proved to be very satisfactory. The principal highways are now called by their numbers just as naturally as people call trains by number. For instance, if one asks in Madison the road to Wausau, he will be told, "Take State Trunk Highway No. 10," or if one is in Milwaukee and wishes to go to Fond du Lac, they will tell him just as naturally to "Take No. 15," and so on.

Other Signs and Markers—We have erected county-line signs and state-line signs giving the name of the two counties and the county highway commissioner's name and address. On the same principle, every patrol section has a sign at each end, giving the name of the patrolman each way from that point. These two types of signs are placed so that the traveler may

know who is responsible for the maintenance of the section of road over which he has just passed and of the section into which he is passing. We have found these signs very valuable in stimulating the natural spirit of competition and pride which should exist in patrol work.

We have also set up standard mile-posts or markers showing the state trunk highway standard design and number and the mile number measured from the east or south end of that especial state trunk highway. These mile-posts serve to tie our office records to the road itself, and also enable any traveler encountering good or bad conditions to boost or to complain to us as the case may demand, and enable us to locate the exact place mentioned. Culverts and bridges are numbered and tied into the mile numbers: thus, the first culvert in mile number 25 on trunk highway 10 is 10-25-1, and the first bridge is 10-25-11, etc. All mile-posts are of wood and cost us about $1.50 each, erected. We are erecting about 2000 direction signs. These are board signs painted white, with black lettering. They are divided into "on system signs"—that is, signs at intersections directing both ways to places on that state trunk highway or beyond, and giving the mileage—and "off system signs," located at intersections with other roads and directing to important points not on the state trunk highway system. These "off system signs" are located only at the intersection with the one road which should be taken from the state trunk highway to the point in question. A lecture could be given on the danger of indiscriminate signing, where several consecutive intersections give directions to a certain point when only one road should be used to get to that point. In brief, we believe that indiscriminately located direction signs do more harm than good.



WISCONSIN STANDARD COUNTY LINE AND PATROL SECTION SIGNS, AND "ON SYSTEM" TWO-WAY DIRECTION SIGNS

We have also designed and have had made special metal danger signs for railroad grade crossings and dangerous hills and curves. These are the only metal signs we have used, and cost us $1.365 each, f.o.b. Madison. Caution signs stenciled on telephone poles or other convenient objects are used where there is no real danger if reasonable care is exercised.

Direction signs and all other signs are erected on wooden or concrete posts painted white. All posts and the mile markers should be erected as close to the traveled way as is possible without interfering with maintenance operations or being dangerous to travel. This is necessary in order to bring them within the area of motor-vehicle lights at night, when the markers on telephone poles are sometimes hard to catch.

Protection Marking—In addition to the above, all of which serve to outline the course of the system in one way or the other, we expect next year to paint or whitewash the end walls of all culverts, the end posts of all bridges, to place posts painted white at the end of all culverts without end walls, and where the fills are not high and we have no guard rails we shall outline the edge of the fills with stones painted white or with occasional white posts. This epidemic of white along the state trunk highways will be an additional distinctive marking and help travelers to follow the system, especially at night, besides serving the first essential purpose of indicating points of danger on the edge of the road. Some of our counties have this year done much of this kind of work, and it has been found very effective for night travel.

Including the marking of the triangles (costing $9000) the total cost of marking, signing and protecting the state trunk highway system will be $25,000, or at the rate of $5 per mile. We believe that this expense, and much more, can be fully justified by the results attained. Our people are well satisfied with the system of marking and signing used, and we have received many compliments from travelers from other states who have passed through Wisconsin.

Maps

The next thing after the system is laid out, surveyed, recorded and marked is the publication of a map, which will enable the traveling public to select their routes and the numbers properly. We are publishing a wall map (scale 1 in. = six miles) showing all roads in the state, with the state trunk highway system, and the secondary roads outlined in red. This is small enough for general office use, and while the sale of such a map is limited, it is valuable for display in hotels, garages, clubs, etc.

A map for general public use in touring is published on a scale of 1 in. = 16 miles. In addition to showing the numbered and marked state trunk highway system and the principal secondary roads, the points of historic and scenic interest and state institutions are also lo-

cated and numbered. Accompanying this map is a little booklet on Wisconsin giving her history, an index to historic, scenic, manufacturing and state property features located on the map, some record of the state's agricultural and manufacturing resources, and other material of interest. These maps are sold for 10c. each. After the first edition, the cost of which included about $350 for the plates and set-up, succeeding editions cost, addressed ready for mailing, about 7c. each, including 1c. for postage. About 20,000 were sold in 1918. We expect a larger circulation in future years.

It has been suggested that we issue sectional maps on a larger scale, but we do not believe that it is advisable. It takes a very large scale to enable one to follow a road map on the ground. With a good marking system a small map which enables one to select a route and get its number is as good as any.

The sale of the ordinary touring books giving routes by descriptive reading matter has been seriously curtailed in Wisconsin by the state numbering and marking system. These books still have their field of interstate travel, but we believe should coincide more carefully with state routings, where established, than some of them do at present. Many of the routes given in these books must have been established before the present dry era came in. Some of the route-book publishers are correcting their publications to date and are following our state trunk highways wherever offered.

Construction

All Federal-aid construction is concentrated on the state trunk highway system. The legislature has also provided that at least one-half of the state-aid money, together with the county funds, should be expended on the state trunk highway system. So far as possible these funds will be used to construct those places at present impossible to maintain in their present condition. We have no hope of reconstructing the entire system in an adequate manner for several years, but are using the limited funds available to get rid of the road terrors and thus strengthen the weak links in the transportation chain.

In our state-aid construction for the next year or two we are going to relax from our previous standards and convert construction funds into heavy maintenance work covering much more mileage. This will be true in both grading and surfacing work. Results secured by our gang maintenance this year fully justify this extreme departure from our previous practice, if good patrol maintenance is immediately established.

We are insisting that no detours be made around construction except where traffic absolutely cannot be maintained. We do not believe that state or county organizations have been considerate enough of travel. Detours almost inevitably lengthen and confuse the route and almost inevitably are worse for the traffic than if it were allowed to go through. We insist that no more road be torn up at a time than is absolutely necessary, and that the contractor keep his grading smoothed up and help travel through wherever travel can possibly be admitted. Wherever a detour has to be established we are thoroughly marking its points of departure from the trunk highway, outlining by paper detour signs, similar to the state trunk highway marking, its course around the construction, and placing the patrolman on the detour to do as much as he can for the detour route during the period of construction.

PAPER SIGN USED ON ROAD CONSTRUCTION

We are having great trouble in getting contractors and foremen to be considerate enough of travel. They seem to think that the traveler is a common enemy, instead of realizing that he is largely paying the bill, and that inconveniencing him unduly and arbitrarily may make an enemy to the good-roads movement, when we should all be seeking to make every man its friend.

Maintaining the System

We are now coming to the most important work in connection with a state trunk highway system. We do not believe that a state should lay out a state trunk highway system unless from the instant it is laid out it is maintained by the state at the expense of the state. The maintenance should be either under the direct control of the state department or, if under county control, subject to direct state supervision.

The fault with practically all so-called "trails" in America has been that they have been established with a great deal of gusto, barrels of paint were used in marking them, and then those interested have stepped aside and let the traveler encounter what he might, without any attention being paid to securing systematic maintenance of the roads which he is invited to use. The ordinary trail promoter has seemingly considered that plenty of wind and a few barrels of paint are all that is required to build and maintain a 2000-mile trail. Inevitably, with the establishment and marking of trails, more travel is directed to them. If this increased travel is not immediately accompanied by adequate maintenance, the trail, instead of being the best road through that neighborhood—which it may have been at the time of its establishment—will very shortly become the worst, and one to be avoided.

In the same way, if a state lays out a state trunk highway system, it must at the same time provide for its adequate maintenance. The counties will not maintain it, the towns will not maintain it, neither will the cities nor the villages, because all of them reason that some day the Federal Government or the state, or both, is going to build it—or at least help to build it on very favorable terms—and why should they spend any money on it for either construction or maintenance? We hold it a truism that the establishment of a preferred system of roads by any unit of government should carry with it the immediate maintenance of that system by the establishing unit. It cannot be over-emphasized that a state system of roads should not be laid out unless real state control of its main-

tenance is also provided. The state should pay for the maintenance, for state control without state money is bound to be difficult, not to say impossible, to administer. The same general principles would absolutely apply to any Federal system which might be laid out.

There is much to be said for the Wisconsin system in which the state has general supervision, the county organizations carry out the details of the maintenance work in accordance with state requirements, and the state repays the cost to the counties when the work is properly done. A one year's trial of this method has worked out quite well in Wisconsin. We cannot say that it has or has not worked out as well as would a system of exclusive state control. Under the plan of organization, long established for state-aid construction, county maintenance directed by the state seemed to be the logical method, and we will say that almost without exception the county organizations have co-operated wonderfully well and have gotten excellent results. Where they have not, our law gives the state department adequate remedies.

Patrol System—We believe in the patrol maintenance system. Patrol sections of proper length, whatever the character of the highway, should be placed in charge of a patrolman who is solely responsible to those above him for the condition of his section. We have established about 480 patrol sections on our 5000 miles of highway, varying in length from as little as six miles on very bad earth road stretches, to as much as 20 miles on some of the macadam truck patrol sections. We believe that the average patrol section should be not more than seven miles, if the road is an earth road in average condition. Sections may be longer or shorter than this, according to the character and condition of the road.

Patrolmen in Wisconsin were obtained through advertisements in local papers after the patrol sections were determined. Applicants were asked to appear at the county seat and were looked over and questioned by county authorities and a representative of the State Highway Department. Starting salaries were fixed at from $120 to $135 per month, and the patrolman is required to furnish a good team and a wagon. The county furnishes the remainder of the tools, consisting usually of a small four-wheeled road grader for two horses, a road planer or road drag, or both; plow, shovels, picks, brush hooks, etc. Patrolmen are required to sign a contract and to give a bond for $500. No very great difficulty was encountered in obtaining patrolmen, except in certain localities where a large amount of war work was being done. After the selection of the patrolmen, county road schools were held at each county seat at which the division engineer and the county highway commissioner explained in detail the methods to be used in patrol maintenance. A pamphlet on patrol maintenance was also published by the commission, giving instruction for the gang and patrol maintenance of the various types of road.

Of the 560 patrolmen originally hired, 75 were discharged and replaced before the end of the season. It was necessary in many cases to raise the compensation, so that at the end of the season the scale was from $120 to $140 per month. Next year, unless conditions change, we expect to pay more, especially for the better patrolmen. The patrolmen are engaged continuously during the maintenance season, which with us lasts about eight months. In the winter season we expect to use them a part of the time for winter hauling of surfacing materials and for snow removal, where the counties are forced to remove the snow owing to the failure of local units to do so. The patrolman's wagon is marked with the standard triangle and number, and he is required to wear a distinguishing badge, to display a flag when off the road during working hours, and to make daily and semi-monthly reports.

Experience With Patrolmen—In general, the patrolmen have more than justified our expectations. At least 65% of them have given excellent service. About 20% are on the division line between good and poor, and about 15% will not be with us next year. We have had a small percentage of sections which as a result of a combination of disasters have given us considerable worry. We believe that when a section threatens to become a continuous "hoodoo," the only thing to do is to take it in hand and devote the organization's time and money to it until it is brought up to standard. In 1918 we shall reduce the length of many of our patrol sections and thus increase the number of our patrolmen. This increase will probably be about 20% and will cut the average length of our sections from 9 to 7.5 miles.

We are trying to make the patrolmen's job an attractive one, and are going to make a specialty of paying the better men more money than the poorer ones, so that

ONE MAN, ONE TEAM AND FOUR-WHEEL ROAD MACHINE—WISCONSIN HAS FOUND THIS THE MOST EFFECTIVE MAINTENANCE TOOL

they will realize that good services are appreciated. We hope to develop an *esprit de corps* by providing certificates of merit, banners to be displayed on especially well-maintained sections, and bonuses for consistently good work to the good patrolmen. We want to make the patrolman's job one well worth while, for upon him rests the success or failure of patrol maintenance.

Very few complaints have been received that the patrolmen were loafing. There has been some of this, inevitably, but between the county highway commissioner's getting around almost daily, our division engineer or division maintenance engineer's visiting each patrolman about once a week and reports from travelers and neighbors, we have kept a pretty close check on the patrolmen's activities, and believe that there has been comparatively little shirking.

In addition to the patrol maintenance, we organized each county for a certain amount of gang maintenance. This includes heavy road machine grading; scarifying, shaping and placing light resurfacings on old gravel and macadam roads; also surface treatments. Roughly, the expenditure for maintenance has been divided, one-half for patrol maintenance and one-half for gang maintenance. The expenditures in 1918 were at the rate of about $250 per mile. The cost of patrol maintenance per mile on earth and gravel roads averaged $125, the remainder being expended for gang maintenance or maintenance of the more expensive surfaces, such as macadam.

Wisconsin made an error in distributing the funds available for maintenance to the counties pro rata with the state trunk highway mileage lying in them. The distribution of maintenance funds should be made by the state department on the basis of maintenance needs. Type of road and amount of travel, of course, determine the funds which should be used, not any fixed factor of road mileage, population or valuation, or even automobile ownership. Other states should not repeat our mistake.

It may be interesting to summarize briefly some of the conclusions we have reached as a result of one year's state maintenance. These may not be final, but they seem well founded on our experience so far.

We find that earth roads of light clay or loam are easy to maintain either by dragging and planing or with the road grader, providing we have a rain about every 10 days. Continued dry spells are almost as troublesome as continuous wet spells, especially on light soils.

The two-horse, four-wheeled blade grader is the most effective tool for earth and road maintenance. The road planers are the second most effective, but must be built much stronger than usually shown or sold, if they are to stand the pounding of constant use.

We are going to start an intensive campaign for applying a sand or gravel light surfacing, on earth roads which are sticky or slippery after rains. We have been astounded at the results from light (2-in. to 4-in.) sand and gravel coatings on heavy clay soils, if followed by patrol maintenance. This is probably the most valuable lesson we have gotten from this year's maintenance experience.

We have learned that well maintained earth roads need very little crown. The flatter and wider an earth road the better, if it has good drainage and is kept constantly smooth. The same is true for all other types.

On sand roads, we find that marsh hay and straw are effective if covered with sand at the time of application, and that sand prolongs by much the life of these materials. Cedar bark and cedar shavings are the best temporary sand coverings. Our tar-hay experiment on sand was quite successful, but this method of sand maintenance is entirely too expensive, costing at least $700 per mile per year to maintain a good 16-ft. composition surface. We believe that the economical thing to do with sands is to cover them with good clay or gravel as rapidly as funds permit. Tar-hay, hay, straw, and weeds wear out rapidly and are far more expensive in the long run than a clay or gravel permanent treatment under even very disadvantageous and expensive hauling conditions.

The roughest roads on the state trunk highway system have been the water-bound macadam roads which have been surface-treated in past years. It is probably theoretically possible to maintain a limestone macadam road with surface treatments, but with the instruments of maintenance in the way of man-power which we have to use in these days, effective results are very difficult to obtain. The untreated water-bound macadam roads maintained with light coatings of sand, pea gravel or stone screenings, or even with a road machine, have been more satisfactory than have the treated macadams that were not properly maintained from their construction. We expect as rapidly as possible to scarify all of our worn macadam roads, widen them to 16 or

GANG MAINTENANCE—UTILIZING CATERPILLAR TO HAUL TWO ROAD MACHINES WHICH BRING UP THE DIRT FROM BOTH SIDES

18 ft. and cover them with a coating of 2 or 3 in. of fine gravel.

We have about given up the water-bound stone macadam road as too expensive to maintain. Some of the penetration macadams bound with tar or asphalt have given much better service than expected, and have shown themselves superior in maintenance possibilities to any water-bound structure we have built. This is another reversal of a former opinion.

We have found that the most satisfactory cheaply built roads to maintain are the gravel roads. We have scarified many miles of old gravel roads and at a cost of $200 or less per mile have produced a surface very satisfactory and easy to maintain. The more experience we have with gravel, the more convinced we are that it is the lowest cost surfaced road, both to build and maintain, and much superior to water-bound macadam. We believe that the particles of gravel in the top 4 in. of a gravel road should not be larger than 1 in., and we would crush even finer, if it were not so expensive to produce fine crushed gravels. Gravel roads give the best and smoothest service without surface treatments. If it is necessary to treat them to eliminate dust use very light oils and don't try to build up a protective coat.

Horse-Drawn Maintenance Wagons Preferred

We have found trucks and tractors not generally satisfactory for patrol maintenance. Trucks give too much opportunity for "joy riding," are economical only when used for hauling, and then only when rapid loading and unloading facilities are available. Tractors give fair service, but to make them economical the sections must be so long that a part of the road lies undragged for too many hours after it gets in condition for dragging. It is a fact that with both the trucks and tractors if the patrolman starts as soon as a road is fit for dragging, on the long sections the road has become too dry before he completes the two round trips necessary. Furthermore, neither tractors nor trucks provide the ditch and shoulder maintenance that can be gotten with a team. We are distinctly going to discourage the use of both trucks and tractors in patrol maintenance except as supplements to team patrol, and stand by old Dobbin.

Summing up the maintenance results, we can say that on the state trunk highway system in Wisconsin, despite the fact that our construction has been cut to less than half of the normal, due to war conditions, the main roads in Wisconsin were never so good as they have been throughout this season. We estimate that in one year we have improved the average condition of the 5000 miles at least 50%. Competent estimates are that in the one year the increased number of miles per hour which can be safely averaged by auto over the state trunk highways is seven. This improvement and this increased mileage per hour means much.

It is not safe to make broad statements, because conditions as to soils and availability of materials vary so much in various states. Nevertheless, we believe that any state can equal or surpass this record at an average cost of about $250 per mile per year. If more money can be made available the first few years, so much the better. We have learned to have the greatest respect, which we did not entertain heretofore, for the less expensive methods of maintenance and construction. In fact, 1918 has taught us all in Wisconsin more than we have learned in several preceding years of routine construction.

We feel distinctly confident that if one year has enabled us to obtain the results which have been produced, a succession of years will give us a passable highway system at an expense within our means. Maintenance will bridge over the gap which there must be between our present practically unroaded condition and the ultimate system of adequate highways built to bear modern traffic, which all states are going to have as fast as these systems can be financed and built.

Probably the best commentary on the maintenance results of this year is the fact that at the November meetings of our county boards many of the counties adopted county truck highway systems to be maintained in 1919 by the counties by the patrol system. It is probable that the total mileage on these county systems is half that on the state system, so that Wisconsin will have 7500 miles of patrolled highways in 1919.

A Plea for State Maintenance

The states which are doing nothing to maintain through routes until they are constructed are making a grave mistake. Much can be done with the most unpromising system of roads if moderate maintenance funds are expended efficiently under the patrol system. It must be conceded that earth roads and the temporary surfacings of light types fail upon certain occasions to give 100% service every day in the year, but on a surprisingly large number of days they can be made practically as good as any road. While they are not the ultimate, the man who waits for the ultimate is apt to find it upon the other side of the Styx.

If any state expects to build a complete modern state trunk highway system within a year or two, it need not establish state patrol maintenance; if it cannot, we urge it to get into the real maintenance game and wrest the best results possible out of what it now has.

If a state as yet unroaded, with insufficient funds available for construction on a large scale, wishes to do the most for its roads and for its people, we are convinced that for a few years it can do it by expending its money largely in intelligent maintenance, good grading and temporary surfacings over the entire system, rather than by building a few miles of high-class construction in isolated stretches. In the average state $2,000,000 a year will adequately maintain and do much to improve a road system of 7000 miles or more; it will build each year about 80 miles of modern road.

Eventually, we must all build certain of our main highways of the highest type of construction. We must immediately construct in this manner certain stretches which cannot be maintained so that they may bear the traffic which does or should use them; but the great mass of roads, even the most important roads, in the average state must wait several years before they can be rebuilt adequately. Why not recognize the fact and devote less state funds to construction and more to maintenance, not only of the inadequate road structures already built, but of the common earth roads as yet untouched?

I know this is unorthodox, especially coming from a state highway engineer, but if it be treason, make the most of it. For the next few years, if we have our way, Wisconsin is going to devote herself largely to maintenance and temporary grading, draining and surfacing.

When we do spend large sums of money for final construction in that period, it will be for adequate widths of concrete or brick or whatever type may surpass these in final economy and ease of maintenance. Those roads which cannot be maintained unless surfaced, and which we are financially unable to build of the final type, will be built largely of fine crushed gravel, surfaced at least 16 ft. wide. This, we are convinced, is the cheapest and the most maintainable of all low-class surfaced roads.

Ideas Gleaned from Other States

These conclusions are not entirely original with us. To the other Western states, especially Michigan, Minnesota and Iowa, we owe many of the fundamental principles upon which we have built, possibly, a more adequate maintenance structure.

It will be noted that we have said little about construction, which was at the outset urged as the basic reason for the selection of a state system. This is a considered omission. Construction will take care of itself as fast as Congress, the legislatures and the people can be persuaded to provide the money. In the meanwhile, we urge all states to get a proper state system laid out, to concentrate as much as possible of their construction funds upon it, and to build adequately when they do build. Pending, however, the final complete construction, which will be delayed many years in nearly all states, the important things to do are so to maintain the system, and so to remedy temporarily but adequately the bad spots and the real impediments to travel upon it, that the whole system is safely and comfortably passable throughout its length from the day of its establishment.

Not the stoppage of construction, but good construction—reduced a little, if necessary, to provide for the immediate maintenance of the whole system—is the burden of this effort.

Report on Terminals for Philadelphia-Camden Bridge

Washington Square in Philadelphia was recommended by Prof. Warren P. Laird, consulting architect for the interstate bridge commissions of New Jersey and Pennsylvania, as the site for the western terminus of the proposed Delaware River bridge. The Camden terminus, he finds, should be at Court House Square. At these two points, respectively, seven and five channels of access or exit would be available. The recommended bridge location, Professor Laird stated in a report to the Pennsylvania commission recently, takes into account the produce traffic from New Jersey to Philadelphia, the city's harbor facilities, industrial activities, and æsthetic considerations. It affords the bridge a suitable setting as a great public monument. Direct trolley connection of Philadelphia with the Camden railway terminals would be possible. A total expenditure of $15,000,000 to $20,000,000 would be required to build the bridge.

Commission Control Does Not Remove Hazard of Utility Investment

Ruling in Indianapolis Water-Rate Case Makes Company Share War Risk and Modifies Former Commission's Position

By Leonard Metcalf
Consulting Engineer, Boston, Mass

The author writes of the Indianapolis case with the knowledge gained through long and intimate connection with it as consulting engineer to the company.—Editor.

The recent decision of the Public Service Commission of Indiana on "The Application of the Indianapolis Water Co. to Revise and Increase Water Rates," rendered Oct. 17, 1918, is of importance to owners, operators and investors in public utilities in the State of Indiana, because it appears to make clear that the Indiana commission purposes to stand hereafter on investment cost, rather than upon the broad concept of value as laid down in past decisions by the United States Supreme Court. To the general public it is of importance as showing this commission's trend of thought upon valuation methods, its concept of "fair value," and its view of the proper placing of the burden of hazard.

Part of War Hazards Put on Utilities

Hitherto, it has often been asserted that the existence of the Public Service Commission eliminated the burden of hazard under which the corporation operated, and that the corporation must therefore be content with a lower rate of return, corresponding to this reduced hazard. The decision of the Indiana commission in the Martinsville Telephone Co. case, followed by the recent Indianapolis Water Co. rate decision, both quoted below, makes clear the fallacy of this assumption and indicates that in the State of Indiana the hazard of reduced revenue from investment must be shared, if not in the main borne, by the corporation, even though the rate of return allowed by the commission in normal times may appear to many to assume or be more in keeping with that of a reasonably assured or protected investment than of one of some hazard. These decisions are:

"However, to this commission it appears fundamental that there should be an equitable distribution of the burdens of the war and that within reasonable limitation this burden should be shared by the utility as well as the public. This consideration is one of the elements entering into the determination of the amount of return." (P. S. C. I., No. 3962, Martinsville Telephone Co.)

"Under Section 122 the commission is not at all concerned with the fixing of rates which will provide a fair return upon the reasonable value of the property, but is concerned with the single purpose of determining temporary rates which will 'prevent injury to the business or interests of the people or any public utility of this state.' . . Is there danger of impairment of credit—of insolvency? Is its service in peril? Then there must be determined, obviously, not what is a reasonable return but what relief is necessary, in order to prevent injury to the utility, to protect its property, to meet its extraordinary but just financial needs, to prevent insolvency, to maintain its credit, to provide adequate service—and which at the same time will not impose unjust burdens on the people." (P. S. C. I., No. 3868, Indianapolis Water Co.)

A brief review of the facts leading up to the Indianapolis decision, and some references to the decision itself, may be of interest.

On Mar. 24, 1916, the Indianapolis Water Co. prayed for authority to issue certain securities on the strength of previous outlay. On the following day the City of Indianapolis filed objections to the granting of the company's petition. On Nov. 20, 1916, the hearings before the Indiana Public Service Commission began, and were continued for several weeks, detailed evidence being presented by the company as to the original cost, the reproduction cost and the fair value of the property.

On Mar. 15, 1917, the commission submitted its findings in an able opinion (No. 1400), written by its then chairman, Thomas Duncan. In substance, the commission reported that "the cost of reproduction new less depreciation" amounted to $9,670,191; and that "there has been invested in this property, in actual money, excluding going value, more than $8,000,000 . . . . and an appreciation in the value of the real estate of at least $1,500,000. Under the law, in arriving at the value of this property this appreciation of real estate should be added to the actual expenditure."

Upon this basis the value would have been $9,500,000. The commission also reported that "the present owners have invested in this property at this time $9,740,768.-75"; and that "the property . . . could not be duplicated today for less than . . . $12,500,000."

Value of Property Fixed by Old Commission

The commission finally fixed "the value of the . . . property . . . used and useful, at not less than $9,500,000"; found that the annual sum of $1,133,465 was "necessary for the successful operation of this property" as of date Dec. 31, 1916; and prescribed certain rates to be put into effect, which it was assumed would, on the average, produce the income reported necessary by the commission. With reference to the rate of return, the commission found that "the only guide we have as to what the rate should be is that it should be such as to invite the investment of capital in like enterprises in such volume as to meet the public need. In this proceeding we have allowed a rate of 7%." In comment upon this rate the commission said:

"The evidence taken on the hearing of this matter discloses clearly that the rate agreed upon will not yield the needed revenue during the first year of operating under such rate. It is believed, however, by the commission, that growth of the company's business and possible economies that may be effected will enable the company under this schedule of rates, tolls and charges, to earn 6% dividend on its stocks, and that the earnings under the rates will gradually increase. It is difficult to establish any rate that will yield, the first year of its operation, the needed revenues of a company that is continuously growing and which rate will not, in the following years, be excessive. It is better to establish a rate that will yield slightly less than the needed revenues and that will remain in force and effect until it earns over a series of years an average annual return that equals the needed annual revenues of the company."

In compliance with the old commission's order, contained in this opinion, No. 1400, the Indianapolis Water Co. put the prescribed rates into effect on May 1, 1917, and when the first year had passed, finding that the prescribed schedule failed to earn even the 6% rate anticipated by the commission, and that it was facing a seriously diminishing revenue, which it feared and believed would seriously impair its credit and borrowing capacity, petitioned the Public Service Commission of Indiana, on May 18, 1918, for revision of and increase in its rates.

In this interval, it is to be noted, the personnel of the old Public Service Commission, which had been responsible for Opinion No. 1400, had almost completely changed and, as will appear hereinafter, with the coming of the new commission a distinct change in viewpoint and policy was enunciated.

Hearings were subsequently had before the new commission, and resulted in the handing down of its Decision No. 3868 under date of Oct. 17, 1918, to which reference follows, as it appears likely that, if the opinions expressed in this decision shall hereafter govern the actions of this commission, the higher courts will be appealed to later by some of the corporations affected, when world conditions are better stabilized.

After some discussion with reference to the basis of its review of the growing difficulties of the Indianapolis Water Co., due to the new schedule of rates and the growing burdens of the war, the commission concluded to predicate its action upon its authority, under Section 122 of the Indiana Utility Act, to give relief in emergency cases. The commission then took up the need of the company for relief, based upon the earlier finding of value, contained in Opinion No. 1400 of the old commission, modified by the change in conditions which had taken place in the interval from Dec. 31, 1916, to Apr. 30, 1918, refusing to reopen at this time the question of modification of basic value due to the war, giving weight now only to the extraordinary conditions faced by the company.

Dissent from Findings of Old Commission

The new commission first states that the old "commission in Case No. 1400 accepted the fair present value ruling, the application of which was controlled largely by the theory of cost-of-reproduction-less-depreciation. This has been and is now the prevailing method of valuation in Indiana"; but the commission hastens to call attention to its own different view:

"To a commission not well schooled in the philosophy and fundamentals of utility regulation, it would seem that a continued disposition toward this method of valuation would rapidly lead into unfathomable depths of speculative valuation and create a thoroughly artificial and unjust basis for property values."

The new commission concludes that:

"Of necessity, therefore, there can be no better guide to, or basis for, rate-making valuations than honest and prudent investment. . . . It is sufficient to say, however, that mere striving toward the attainment of prudent investment should produce a larger measure of substantial justice than the makeshift measures of evaluation in vogue during recent years. The commission, of course, does not assume the radical position that there should now be a sudden change in methods of evaluation, but it does believe that the goal should be kept in sight, and should be attained by measured steps in that direction. . . . But prudent investment should be the controlling factor."

Question of Real Estate Appreciation

The present commission dissents further from its predecessor's conclusion that under the law the appreciation of real estate should be added to the actual expenditures in arriving at a fair value, and urges that "if prudent investment is in ratemaking to be the controlling factor in determining utility values, what justifica-

tion can there be for capitalization of the unearned increment?" overlooking the fact that, unless the owner of the property is permitted to enjoy this increment, as has heretofore been the case under court rulings, there is denied to him the return which all other investors enjoy, and he is thus discriminated against; and, further, that if change in public policy is to be dictated in this direction, past rates of return must be increased to induce capital to continue its interest in such investments, with the reduced rate of return which would result from the denial to capital of this hitherto enjoyed increment in value. This practical side of the problem seems to have been overlooked.

In a matter so vitally touching the public welfare, one may seriously question, without discourtesy to the present Public Service Commission of Indiana, the soundness of a discussion as greatly at variance with financial experience the world over as it is with a long and consistent line of Federal and state Supreme Court decisions, founded upon the law and general human experience. It seems highly probable that if it determine the future position of the State of Indiana and course of action of its commission, it will lead to costly litigation which, if past precedent be a safe guide, will enforce a return of the commission to its earlier views, and incidentally involve the cost to the poor consumer of this further litigation. Human progress is beset with just such difficulties, and the direct middle path is reached often only after attempting the devious, sometimes alluring, paths on its margins. But it is well to heed the lesson taught by the cost of unnecessary retracing of devious trials, already explored and well blazed.

The sincerity of view and the desire of the Public Service Commission to do full justice to the corporations as well as to the people of the State of Indiana are not here called into question, but merely the soundness of some of its recent conclusions and enunciation of principles.

Allows Six Per Cent. on Its New Valuation

The commission then analyses the revenue and operating expenses of the company for the past year, and forecasts probabilities for the immediate future. It refuses to sanction some of the salaries and expenditures of the company and properly eliminates its war relief and charitable contributions, to an aggregate amount of approximately \$31,000. It details some of the important items of increase in cost of operation, for coal, electric power, oil, gasoline, alum, chlorine gas, freight and labor, and finally concludes that an increase in revenue is justified, of approximately \$80,000, 16 per cent, of the operating expenses for the year which ended Apr. 30, 1918, after subtracting the deductions above referred to. Of this \$80,000 increase, approximately \$13,000 is estimated, by the commission, to be earned through the normal increase in revenue, thus reducing the net increase permitted by it to 13.4% of the operating expenses allowed.

The commission says:

"In view of the present uncertainty of future economic conditions, the impossibility, even by most careful calculation, of accurately prophesying future cost, and in order to maintain the credit of the company and to prevent injury to its business and interest, the commission believes that relief should be granted; that in so far as it can be reasonably calculated the measure of relief should be sufficient to provide during the war period a return of 6% on property values amounting to \$9,664,000."

It wisely places this burden upon the large consumers of water, whose rates now appear to it to be slightly below an equitable level.

It will thus be seen that in effect the commission concludes that the demand for relief from the danger of impairment of credit of the company will be met by granting it increase in rates sufficient to realize a 6% rate of return upon the value fixed by the commission, though it does not contend that this return is a fair one upon the fair value of the property, and it is obvious that the basic value used in no wise reflects the change in conditions due to the war or the rate of return found necessary by the old commission and in accord with other rulings of the present commission. From the point of view of the removal of the danger of the present situation to the corporation, and the value fixed by the commission upon this property, the action of the commission would seem to be fair, but it is important to note that it obviously does not meet the common assumption that commission control removes the hazard of investment and that such an obligation is specifically disclaimed by this commission in its decisions quoted above.

Asphalt Pavements Constructed in Rainy Weather

"GIVEN the essentials of a suitable subfoundation, and particularly a well drained asphaltic concrete base, it would seem that the wearing surface or 'topping' may be put down in any conditions of weather that the workmen engaged in laying it can tolerate," is a statement made in the Oct. 18 issue of the *Surveyor* of London, by T. G. Marriott, engineer, the Limmer and Trinidad Lake Asphalt Co. The conclusion is drawn from experience on work at Oxford, England, in 1915-16, when laying of asphalt was continued practically throughout a year which had a record for rainy days.

The work in question comprised the laying of about five miles of 4½-in. Trinidad asphalt macadam on the principal motor omnibus routes of the city. The pavement was laid in two coats, directly upon the existing roadbed, after the usual scarifying and rolling to the required level. No Portland cement concrete was used, and the contract provided for the continuous prosecution of the work during the winter months, subject to the discretion of the city engineer.

Complete records were kept by the Radcliffe Observatory of Oxford of the amount of rain and snow which fell during the period of construction. This extended from the middle of July, 1915, to the middle of June, 1916, or through 11 months, thus covering all seasons, These records show that there were 183 rainy days and 33 days when it snowed. Coupled with this, the climate of Oxford is generally damp and raw and unfavorable for laying asphalt. The subsoil of the road was found to consist largely of valley gravel and there was therefore a good foundation for the work.

From this experience Mr. Marriott concludes that modern, mechanically mixed asphalt will adapt itself to all-year-round work.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

An Exceptionally Complete Handbook

CONCRETE ENGINEERS' HANDBOOK: Data for the Design and Construction of Plain and Reinforced Concrete Structures—By George A. Hool, S.B., Professor of Structural Engineering, The University of Wisconsin, and Nathan C. Johnson, M.M.E., Consulting Concrete Engineer, New York City; assisted by S. C. Hollister, B.S., Research Engineer, Corrugated Bar Co.; with Chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 860; illustrated. $5.

The 865 relatively small-type pages of this book demonstrate the use of unusually sound judgment by the well known authors in carrying through their definite purpose to "make available in concise form the best of present-day knowledge concerning concrete and reinforced concrete, and to present complete data and details, as well as numerous tables and diagrams, for the design and construction of the principal types of concrete structures." Indeed, the book is much more than a handbook. The data are, on the whole, presented in concise form, the voluminousness resulting from completeness of treatment, with illustrative examples.

It is probable that engineering educators, in view of the new attitude toward their problems resulting from their war experience, and the call for specific knowledge such as is voiced by Dr. Mann (see p. 1068 of last week's issue) will consider favorably the possibility of using this book as a text for instruction in the whole subject of reinforced-concrete construction.

The book is divided into 19 sections, treating the subject matter in fairly logical order, except where the section on floor surfaces precedes the sections on properties of mortar, concrete, and reinforced concrete. The sections are: (1) materials; (2) general methods of construction; (3) construction plant; (4) concrete floors and floor surfaces, sidewalks, and pavements; (5) properties of cement, mortar, and plain concrete; (6) general properties of reinforced concrete; (7) beams and slabs; (8) columns; (9) bending and direct stress; (10) moments in rigid building frames; (11) buildings; (12) foundations; 13) retaining walls; (14) slab and girder bridges; (15) concrete floors and abutments for steel bridges; (16) arches; (17) hydraulic structures; (18) miscellaneous structures, and (19) estimating. The five appendices are on standard specifications and tests for portland cement; working stresses; rules pertaining to flat-slab design according to various city ordinances, the Am. Soc. C. E. special committee and the standard building regulations of the American Concrete Institute; standard notation; and extracts from report of the Joint Committee of the American Concrete Institute and Portland Cement Association on concrete barges and ships.

Especially well handled in the first two sections are the discussions on money values, the effect of water on concrete, the theory of voids, the proportioning and checking of materials on the job, the placing of concrete, waterproofing, form design, with tables and diagrams; bending and placing steel. Harvey Whipple is the author of complete data on concrete stone, block, and brick, including details of manufacture.

The discussion of construction plant, while concise, contains many valuable data on the preparation of the concrete aggregates, quarrying, crushers, screening and washing. It gives the impression of first-hand information. Strong emphasis is placed on the possibilities of economy. Similarly, the section on concrete floors is exceptionally adequate in its treatment of this relatively new and important problem. Full, practical details of construction are followed by a discussion of remedial measures to be adopted to repair floors where necessary. A free use of micrographs tends not only to increase interest, but to add to exact knowledge.

Adelbert Mills is the author of Sec. 5 on the properties of mortar and concrete. He includes good comparative statements of the results of tensile and compressive tests, and introduces the elements of cost analysis. He recommends that the usual specification for sharp sand be omitted. Relatively few results of experiments are reproduced, the most valuable and authoritative apparently having been selected. The section forms a valuable collection of the results of recent exhaustive investigations condensed into concise, definite conclusions.

This comment also applies to the discussion of general properties of reinforced concrete in Sec. 6. In Sec. 7 the beam-and-slab theory is completely and concisely developed, with illustrative examples and useful diagrams; included is a good article on the ratio of length to depth of beam for equal strength in moment and shear, and on the economical proportions of rectangular beams. Sec. 9, on bending and direct stress, contains useful diagrams, including treatment of tension over part of the section, and also Wolfe's graphical method for rectangular or hollow circular columns under eccentric load.

In the full treatment of moments in rigid building frames, based upon the slope-deflection method, valuable equations and diagrams developed for practical cases are presented. The fact that high bending in columns for special cases of loading may occur, and the idea that maximum stress conditions in building frames must be considered, suggests that building-frame analysis lags far behind bridge-truss analysis in this respect. The text includes criteria for maximum combined stresses in columns, and should aid materially in developing this feature in future design.

Walter S. Edge is the author of a section on flat-slab construction. In it are included examples of the computation for various flat-slab rulings and systems (such as the Akme, Corr-Plate, Pittsburgh, Chicago, A. C. I.) and including extensive tables. Various systems of unit-built construction are also illustrated. In the discussion of roofs, the methods of preventing condensation are fully considered and equations for cases of rigid roof frames are given.

The treatment of retaining walls includes cantilever wall analysis diagrams, also counterforted walls in very complete detail, with illustrative problems. Slab-and-girder bridges also receive adequate treatment, with many illustrations.

The elastic theory of arch analysis as developed by Turneaure and Maurer is presented, and a nearly complete reproduction is made of Victor Cochrane's paper on arch design, including the diagrams for influence lines. Arch construction and arch centering are both fully presented.

Dams are treated by A. G. Hillberg, who gives a concise but complete presentation of the subject, including preliminary studies, design of foundation, dams of gravity section, a full discussion of the effect of uplift, tabular form of final computation, etc., and including arch dams, spillways, overflow dams, and sluices. The matter on siphon spillways is new and valuable. The sections on reservoirs, standpipes, and small tanks are good, the problem of dome analysis being treated, with an illustrative example. Tables of loads on pipe in ditches are included. The section on estimating is by L. H. Allen, and includes unit costs with examples, quantity with general suggestions.

The typographical work is satisfactory, but in many cases the lettering on the diagrams is hard to read, the reduction being too great, or the original lettering too small. The division into sections and numbered articles instead of chapters is a departure from usual practice. References to outside sources would be improved if dates as well as volume numbers were included. It is unfortunate that the names of the various authors of special sections were not included in the table of contents.

Another Cost Data Handbook

HANDBOOK OF MECHANICAL AND ELECTRICAL COST DATA: Giving Shipping Weights, Capacities, Outputs, and Net Prices of Machines and Apparatus, and Detailed Costs of Installation, Maintenance, Depreciation and Operation. Together with Many Principles and Data Relating to Engineering Economics. By Halbert P. Gillette, Consulting Engineer, M. Am. Soc. C. E., and Richard T. Dana, Consulting Engineer, M. Am. Soc. C. E. New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd. Leather; 4 x 7 in.; pp. 1716; illustrated. $6.

The many who have found useful the long line of cost data handbooks published by these two authors in the past quarter century will welcome this accession to the list, and gladly recommend it and its predecessors to others. The present work "is designed to be a companion volume," say the authors in their preface, "to our two civil engineering books, the 'Handbook of Cost Data' by Gillette, and the 'Handbook of Construction Plant Data and Its Cost,' by Dana. . . . These three handbooks are so written as not to overlap, and can be used to supplement one another."

Nearly 150 pages of the present volume, or 9% of the total space, are devoted to discussion of "General Economic Principles," (81 pp.) and of "Depreciation, Repairs and Renewals" (63 pp.). As each page contains 500 words or more and the subjects are systematically presented, these chapters are good-sized monographs. They deserve careful attention, particularly on the part of those engaged in utility valuation. A table of "Estimated Lives in Years in Plant Units," compiled from various cited authorities, occupies seven pages of the second of these chapters, besides which other physical data for use in computing depreciation, as well as tables and diagrams for the mathematical process itself, are given.

After these discussions the authors take up in detail such structures, plants and operations as buildings, chimneys, steam and hydro-electric power plants, wire systems, gas works, pumps and pumping, moving and installing machinery, and fuel handling. Much of the material, probably most of it, has been gathered from a variety of printed sources, but that is to be expected in a book of this kind. Thanks are due the authors for their wide search, their industry and their skillful presentation of a vast mass of cost data which will be useful to civil as well as to mechanical and electrical engineers.

The City Cleansing Service

MUNICIPAL HOUSE CLEANING: The Methods and Experiences of American Cities in Collecting and Disposing of Their Municipal Wastes—Ashes, Rubbish, Garbage, Manure, Sewage, and Street Refuse—By William Parr Capes, Director New York State Bureau of Municipal Information, and Jeanne Daniels Carpenter, A. M., LL. B., Boston University, Expert in Economics and Municipal Research; With an Introduction by Cornelius F. Burns, President of New York State Conference of Mayors and Other City Officials. New York: E. P. Dutton & Co. Cloth; 7 x 10 in.; pp. 232. $6.

Much useful information on street cleaning and the collection and disposal of city wastes is here given. The text is chiefly a compilation from various accredited sources, skilfully arranged, and in places interpreted for lay officials. Some commonly and long accepted facts and opinions are placed in quotation marks and credited to one of hundreds of engineers who state them every day in their reports, and some more or less chance remarks or descriptions of experimental or little-used procesess are brought forward with equal solemnity—as is almost inevitable in such a compilation of technical data by persons not versed in the art or the science being treated. As a rule, these merely detract slightly from the value of a good piece of compilation and popular interpretation. Rarely does one find so sweeping and unwarranted an assertion as this, from p. 81: "There is almost an unanimity of opinion now in favor of the use of mechanically operated fine screens." Besides the text, the volume contains a considerable amount of tabulated information from the larger cities of the country on street cleaning, refuse collection and disposal and sewage disposal. This material was collected by the authors for the organization with which they are connected. The dates to which these and most of the other data of the book apply are not given. The volume is handsomely made, but the price seems exorbitant.

British Industrial Control in War Time

WAR-TIME CONTROL OF INDUSTRY: The Experience of England—By Howard L. Gray, Professor of History in Bryn Mawr College. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 304. $1.75.

Progressive measures for the control of British industry, from the beginning of the war to the close of 1917, are outlined in this interesting volume. In the concluding chapter some comparisons are drawn between control in England for three years and in the United States for less than a year. In several respects the comparison is favorable to this country—which had the benefits of British experience and fewer handicaps. The book contains chapters on control of railways, munitions, labor, coal mines, wool and worsteds, hides

and leather, shipping, food and agriculture. The portions of the book dealing with labor are impressive. With no apparent prejudice one way or the other on the part of the author, the narrative indicates that a large part of the difficulties experienced in dealing with labor were due to a conviction on labor's part that profiteering not only deprived it of its due reward in wages but also increased the price of food. It was largely because of this cause that the Government took over the railways and many of the munitions plants, and exercised a wide measure of price control.

Our Army Engineers in France

AMERICAN ENGINEERS BEHIND THE BATTLE LINES IN FRANCE—By Robert K. Tomlin, Jr., War Correspondent for the McGraw-Hill Publications. New York: McGraw-Hill Book Co., Inc. Cloth; 9 x 12 in.; pp. 91; illustrated. $2.

Those who have followed with growing interest Mr. Tomlin's war engineering articles from France as they appeared in *Engineering News-Record* during the past year will welcome the republication in a single handy volume. Those who have not seen some or all the articles now have an opportunity to get them all.

The author was for some years managing editor of *Engineering Record* and *Engineering News-Record.* He went to France solely for the purpose of presenting war activities from the engineering viewpoint. Among the subjects treated are dock, road and railway building, water-supply, map making from the air and on the ground, and the work of the Army engineer schools. The many illustrations add to the interest and forcefulness of the text.

British Public Health Problems

HEALTH AND THE STATE—By William A. Brand, M.D. (State Medicine), Lecturer on Forensic Medicine, Charing Cross Hospital. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 354. $4 net.

Primarily a plea for a British ministry of health, to be concerned chiefly with research, and for coördinating and strengthening local health administration, this volume contains a careful examination of preventable or reducible causes of death, with particular reference to environment, which latter the author holds to be dominant. Much attention is given to British national insurance and medical treatment, which the author considers weak both as regards legislation and administration. The book deserves the attention of American public health students and administrators.

Dictionary of Shipbuilding

MODERN SHIPBUILDING TERMS: Defined and Illustrated—By F. Forrest Pease, Staff Instructor, Education and Training Section, United States Shipping Board, Emergency Fleet Corporation; Including a Series of Photographs Showing the Progressive Steps of Construction, Together with an Appendix on Electric Welding. Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 143; illustrated. $2.

Setting himself the task of explaining to the shipyard or shipping novice the peculiar terms that make up the nomenclature of the subject, the author put together a very instructive list of words and definitions. It compares favorably with other recent works of similar purpose. The hurried needs of the day must serve as excuse for the imperfections that appear in even a cursory glance through the work, though even the publishers' editing might have improved on the definition of "Galvanizers," which reads, "Same as outside, except that the pieces galvanized are larger than generally galvanized."

Photographic plates showing ships in process of construction are placed at the back of the book, and references in the text, together with reference letters on the views, direct the reader to parts representing the terms defined. Compared with distributed text illustrations, as in the old Webster dictionary, this arrangement is less convenient, but its instructional value is evident. Special care seems to have been given to this illustrative supplement, embracing nearly 70 full-page plates.

Work of the United States Forest Service

OUR NATIONAL FORESTS: A Short Popular Account of the Work of the United States Forest Service on the National Forests—By Richard H. Douai Boerker, M.S.F., Ph.D. Arboriculturist Department of Parks, City of New York. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 238; illustrated. $2.50.

After a general introduction of some fifty pages reviewing the importance of forestry and allied matters, the author presents a detailed but thoroughly readable account of our many and vast national forests. Their creation, organization, administration and protection from fire, trespass, insects and erosion, are described, and also the sale and rental of forest resources. Handsomely presented, well chosen illustrations add to the interest and value of the book. The typography is excellent. An index is needed, but there is a detailed "Contents."

The Development of Official Statistics

THE HISTORY OF STATISTICS: Their Development and Progress in Many Countries; In Memoirs to Commemorate the Seventy-fifth Anniversary of the American Statistical Association. Collected and Edited by John Koren. New York: Macmillan Co. Cloth; 6 x 9 in.; pp. 739. $7.50.

As these historical surveys and reviews of the present status of official statistics of nearly all the leading countries engaged in the war were planned before the conflict began, it is little short of marvelous that it was possible to secure them before the war had closed. The volume opens fittingly with a brief address on "The American Statistical Association, 1839-1914," by John Koren, president, who was also editor of the book. It continues with a comprehensive review of "Seventy-Five Years of Progress in Statistics: The Outlook for the Future," by S. N. D. North, ex-president of the association named and ex-director of the United States Census. Next, eminent statisticians in the various countries covered review the history and development of official statistics in Australia, Austria, Belgium, Canada, Denmark, France, Germany, Great Britain and Ireland, Hungary, India, the Netherlands, Norway, Russia, Sweden, the United States and its several states. Promised articles on Italy and Japan were held up by the war. A thoroughgoing index, so essential to the full usefulness of such a work, is provided. The volume is a worthy memorial to the American Statistical Association, which has played so large a part in the encouragement and development of statistical science.

Progress Report on Run-Off

The November *Journal* of the Boston Society of Civil Engineers (715 Tremont Temple, Boston, Mass.; 50c.) devotes 35 pp., or nearly its entire space, to a progress report of the society's committee on run-off. Besides a short glossary, there are sections on "The Use of the Current Meter in Stream Gaging," "The Effects of

Ice on River Discharge," "Methods to be Used in Compilation of Data Analysis of Run-Off Records," all by C. H. Pierce, and "The 0.2 and 0.8 Method of Current Meter Measurement in Power Canals," and "Precipitation, Evaporation and Run-Off," both by Arthur T. Safford, chairman of the committees. Discussions of these progress papers are desired.

Civil Employment of Soldiers

The Federal Board for Vocational Education is distributing two series of pamphlets designed to promote the restoration of soldiers and sailors, both sound and disabled, to gainful occupations in civil life. There are separate pamphlets addressed to the men, to their families and to American employers of labor. Some of the pamphlets tell of a plan of Federal vocational education. Those wishing information should address the board mentioned above, at Washington, D. C.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given, it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

THE A-B-C OF AVIATION: A Complete, Practical Treatise Outlining Clearly the Elements of Aëronautical Engineering, With Special Reference to Simplified Explanations of the Theory of Flight, Aërodynamics and Basic Principles Underlying the Action of Balloons and Airplanes of All Types. A Nontechnical Manual for all Students of Aircraft—By Captain Victor W. Pagé, Sig. R. C., A. S. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 257; illustrated. $2.50.

AIRPLANE CHARACTERISTICS: A Systematic Introduction for Flyer and Student and for All Who Are Interested in Aviation—By Frederick Bedell, Ph. D., Professor in Physics, Cornell University. Ithaca, N. Y.: Taylor and Co. Cloth; 6 x 9 in.; pp. 121; illustrated. $1.60.

AMERICAN SOCIETY FOR TESTING MATERIALS STANDARDS: Issued Triennially, 1918. Philadelphia, Pa.: University of Pennsylvania. Cloth, 6 x 9 in.; pp. 858; illustrated. To non-members, Cloth, $9, Half-Leather, $10; To members, for extra copies, Cloth, $6, Half-Leather, $7.

This is the first publication of the so-called A. S. T. M. Standards to be issued on the triennial plan separate from the society's year book. It contains the standard specifications already adopted, including steel, wrought iron, cast iron, nonferrous metals, cement, etc.; standard tests of various kinds; information on publication and personnel of standing committees, and a good index.

ASPHALT RELATED BITUMENS, AND BITUMINOUS ROCK IN 1917—By John D. Northrop. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 18; illustrated.

DESCRIPTIVE GEOMETRY—By H. W. Miller, M. E., Revised in 1917 by The Department of General Engineering Drawing in the University of Illinois, Urbana, Ill. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 7 in.; pp. 169; illustrated. $1.50.

THE ECONOMICAL USE OF COAL IN RAILWAY LOCOMOTIVES: Prepared under the Direction of a Committee Consisting of J. M. Snodgrass, Major E. C. Schmidt, H. H. Stock, S. W. Parr and C. S. Sale. Urbana, Ill: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 71; illustrated.

ELEMENTARY MATHEMATICAL ANALYSIS: A Text Book for First-Year College Students—By Charles S. Slichter, Sc. D., Professor of Applied Mathematics, University of Wisconsin. Second Edition, Revised and Entirely Reset. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 5 x 7 in.; pp. 489; illustrated. $2.50.

FACTORS FOR OBTAINING CUBIC YARDS ON SLOPING Cross Sections From Cubic Yards on Level Cross Sections; Base Widths and Vertical Heights on Level Cross Sections With Zero Crowns—Designed by Arthur Alvord Stiles, State Reclamation Engineer of Texas; Supplement to Bulletin No. 5 of the State Reclamation Department, Entitled "Tables of Cubic Contents of Levee Embankments, June, 1917." Austin, Tex.: State Reclamation Department. Paper; 6 x 9 in.; pp. 25. Sent free on request. [The supply of Bulletin No. 5, to which this is a supplement, is exhausted.]

FINANCIAL STATISTICS OF STATES, 1917—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 129.

FLOW OF WATER THROUGH ONE AND ONE-HALF INCH PIPE AND VALVES—By Frederick W. Greve, Jr., Assistant Professor of Hydraulics. Bulletin No. 1, Engineering Experiment Station. Lafayette, Ind.: Purdue University. Paper; 5 x 9 in.; pp. 21; illustrated.

About 40 ft. of "ordinary black commercial water-pipe" in two approximately equal lengths were tested; also the same pipe with standard brass valves inserted between a gate, a globe and a check valve, singly.

THE FUSIBILITY OF COAL ASH AND THE DETERMINATION OF THE SOFTENING TEMPERATURE—By Arno C. Fieldner, Albert E. Hall, and Alexander L. Feild. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 141; illustrated. 20c. from Superintendent of Documents.

THE FUTURE DEVELOPMENT OF THE SHANGHAI HARBOUR: Report to the Whangpoo Conservancy Board—By Vattenbyggnads Bryan, Represented by Dr. J. G. Richert, C. W., and P. G. Hornell, C. E., and H. von Heidenstam, C. E. Shanghai, China: The Board. Paper; 9 x 12 in.; pp. 51; illustrated.

Prospectus of a most ambitious scheme to dam the mouth of a river and create a tidal lock and wet dock for a harbor, extending miles back from the lock. Scheme described in *Engineering News-Record*, Nov. 21, 1918, p. 935.

THE HEATING OF HOUSES: Coal and Electricity Compared; Report Feb. 28, 1918, Hydro-Electric Power Commission of Ontario. Toronto, Ont.: The Commission. Paper; 7 x 10 in.; pp. 12.

HOW INDUSTRIAL FATIGUE MAY BE REDUCED: Preliminary Report of Divisional Committee on Industrial Fatigue, Section on Sanitation, National Committee on Welfare Work. Washington, D. C.: U. S. Public Health Service. Paper; 6 x 9 in.; pp. 12.

HYDRAULIC EXPERIMENTS WITH VALVES, ORIFICES, HOSE, NOZZLES, AND ORIFICE BUCKETS: Part I—Loss of Hydraulic Head in Small Valves, by Arthur N. Talbot, Professor of Municipal and Sanitary Engineering in Charge of Theoretical and Applied Mechanics, and Fred B. Seely, Assistant Professor of Theoretical and Applied Mechanics; Part II—The Flow of Water Through Submerged Orifices, by Fred B. Seely; Part III—Fire Streams from Small Hose and Nozzles, by Virgil R. Fleming, Assistant Professor of Applied Mechanics; Part IV—The Orifice Bucket for Measuring Water, by Melvin L. Enger, Associate Professor of Mechanics and Hydraulics. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 80; illustrated.

While they last, these concise summaries of experimental work at the Hydraulic Laboratory of the University of Illinois may be obtained by interested engineers without charge.

ILLINOIS SOCIETY OF ENGINEERS: Proceedings Held at Quincy, Ill., Jan. 24-25, 1918—Wheaton, Ill.: E. E. R. Tratman, Sec. Paper. 6 x 9 in.; pp. 148; illustrated. 50c

IOWA ENGINEERING SOCIETY: Proceedings Held at Waterloo, Iowa, Feb. 20-21, 1918—Iowa City, Iowa: J. H. Dunlap, Sec.-Treas. Paper; 6 x 9 in.; pp. 148; illustrated. 50c.

A NEW THEORY OF THE STEAM TURBINE—By Harold Medway Martin, Wh. Sc., A. C. G. I. Reprinted from *Engineering*, London, England. Paper; 8 x 11 in.; pp. 22; illustrated. 2s. 6d.

OHIO ENGINEERING SOCIETY: Proceedings Held Jan. 30-31, Feb. 1, 1918—Norwalk, Ohio: John Laylin, Sec.-Treas. Paper; 6 x 9 in.; pp. 174; illustrated.

POWER: Its Significance and Needs—By Chester G. Gilbert and Joseph E. Pogue, of the Division of Mineral Technology, U. S. National Museum. Washington, D. C.: Smithsonian Institution. Paper; 6 x 9 in.; pp. 53; illustrated.

Proposes a common-carrier system of transmission for electric current, whether generated by water power or from coal.

THE PUBLIC WORKS DEPARTMENT, MADRAS PRESIDENCY: ADMINISTRATION REPORT FOR 1916-17—Part. II, Irrigation—Madras, India: Public Works Department. Paper; 9 x 12 in.; pp. 206; illustrated. 3s. 9d.

QUEBEC STREAMS COMMISSION SIXTH REPORT: Printed by the Order of the Legislature—Quebec, Can.: The Commission. Paper; 7 x 10 in.; pp. 140; illustrated.

THE RATE OF COAL CONSUMPTION IN VARIOUS ELECTRIC GENERATING STATIONS AND INDUSTRIAL ESTABLISHMENTS IN CANADA AND THE UNITED STATES: Report, Feb. 15, 1918, Hydro-Electric Power Commission of Ontario—Toronto, Ont.: The Commission. Paper; 7 x 10 in.; pp. 12; illustrated.

ROCK QUARRYING FOR CEMENT MANUFACTURE—By Oliver Bowles. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 152; illustrated. 25c. from Superintendent of Documents.

THE SAFETY MOVEMENT IN THE IRON AND STEEL INDUSTRY, 1907-1917—By Lucian W. Chaney and Hugh S. Hanna. Washington, D. C.: Bureau of Labor Statistics. Paper 6 x 9 in.; pp. 289; illustrated.

SOME TESTS OF DOUGLAS FIR AFTER LONG USE—By Arthur C. Alvarez; Bulletin of the Department of Civil Engineering, University of California. Berkeley, Cal.: The University. Paper; 7 x 10 in.; pp. 119; illustrated.

Beam, compression, shearing and impact of 10 x 12-in. to 6 x 8-in. Douglas fir timbers taken from old city hall of Oakland, Cal., after having been in use 36 years.

TERRACING FARM LANDS—By C. E. Ramser, Senior Drainage Engineer. Washington, D. C.: Bureau of Public Roads, United States Department of Agriculture. Paper; 6 x 9 in.; pp. 39; illustrated.

UNIFIED MATHEMATICS—By Louis C. Karpinski, Ph. D., Associate Professor of Mathematics, University of Michigan; Harry Y. Benedict, Ph. D., Professor of Applied Mathematics, University of Texas, and John W. Calhoun, M. A., Associate Professor of Pure Mathematics, University of Texas. New York: D. C. Heath & Co. Cloth; 5 x 8 in.; pp. 518; illustrated. $2.80.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Advise Continuance of Chicago Technical Societies' War Committee

Closer association of 19 technical societies in Chicago through a war committee has been found of sufficient value for that body to recommend the continuance of the committee in its present form. At a meeting held Dec. 6 it was suggested that matters on which the combined influence might be made effective for the betterment of the community and profession would include the employment question, legislative action on licensing, the technical man's place in the constitutional convention soon to be held in Illinois, and the proper steps to be taken to insure that the state budget, now being made up, contain provision for the supervision of the expenditure of the $60,000,000 good-roads bond issue. It is proposed to coöperate with the employment activities which the secretaries of the four founder societies in New York have taken over from the Engineering Council.

The report of the services rendered by the war committee during its brief existence since June, as given by the secretary, E. S. Nethercut, includes the following: Two general meetings on war subjects were held to which the 5000 individuals of the member societies were invited. A group meeting of eight societies brought out more than 200 to hear a discussion on light and fuel problems. Governmental requests for technical men were complied with, from 50 to 75 men being placed directly.

One of the larger works was the giving of information by the committee to men seeking to put themselves in touch with the service where their talents could be utilized to the best advantage. Through the committee's efforts $30,000 was collected for the third Liberty Loan and $90,000 for the fourth.

Minnesota Engineers Propose Inclusive State Technical Society

Affiliation of technical societies for joint action during the war seemed the natural thing. Minnesota had previously its Joint Engineering Board, with six organizations represented. As the necessity for giving broader powers to this board is now felt, a tentative plan has been presented to all of the societies in the state to come into an all-inclusive organization of still wider scope, to be called the Minnesota Polytechnic. It would act in all state-wide and inter-society matters, have an official publication and a paid secretary who would send out notices for all societies, and handle all inter-society and all committee work.

Any member of an affiliated society would be a member of the Polytechnic, but to gain membership he must do so through a local society. The board of directors, one representative for each affiliated society, would meet monthly, and there would be an annual convention, at which delegates of uniform representation from the affiliated societies would transact business. Funds would come from the affiliated societies.

Four societies, or chapters of national societies, in addition to the six now affiliated, are eligible. Expansion of the powers of the state organization would include making them definite, providing for engineers who are not now members of local societies and for such chapters as would serve drainage engineers, municipal engineers and surveyors.

The proponents of the new society write in the November *Bulletin* as follows: "In approaching this question, the fact must not be lost sight of that there will be, and probably very soon, a great national united engineering society, taking in all branches of the profession. Any state organization should be so planned that it may become a part of and responsible to this national organization in technical matters, retaining full power of self in state and local affairs."

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Five-Ton Capacity Truck Should be The Heaviest Allowed

Sir—I read with considerable interest and pleasure, in your issue of Nov. 28, the article, "Highway—Motor Truck Problem from the Standpoint of the User, Manufacturer and Engineer."

I have been combatting for the past four years the idea of using more than a five-ton load on our improved highways, or the highways we may make in the future. This, of course, excepts special roads where Government aid might be applied for a specific purpose.

Before I became a member of the West Virginia State Road Commission, nearly two years ago, I was a truck user myself, having been a road contractor for a number of years, on a fairly large scale. For excavation haulage, as a rule, I did not find the truck profitable, but for hauling all kinds of material I used it largely.

But, coming to the load, I have not opposed five tons (not very vigorously at any rate), but I want to state, for what it may be worth, that I have gotten better results by the use of a three-ton truck. It is true, where I had a three- to ten-mile haul, I used a trailer, hauling brick, sand, cement and gravel, and got better results than I ever got by using a heavy five-ton and surely better than I could by using more than a five-ton load. This was because the three-ton truck made very much better time. It was also not out of commission so much through breaking down, etc., and I did not have to keep as many men on the road to take care of the maintenance. My observation has been, since I quit being a user—and I visit all the counties in the state where road construction is going on—that probably the three-ton truck still gives the best results. However, as stated, I do not oppose vigorously a five-ton-load truck, and I am very much pleased to have my views in this matter

backed up as strongly as they are in the article above mentioned.

I wish to back up the statement that the truck has come to stay. There is no question in my mind about that, but I want to tell the people that they must not deceive themselves about truck haulage for long hauls and heavy freight. Thirty-five to 50 miles is going to be the limit from a standpoint of economy, and that only for certain classes of freight, not the heaviest.

The amount of stuff hauled for the past three or four years, as every one knows, has been abnormal. The question of expense did not figure. It was only a question of getting the goods at any price. The railroads were caught by this abnormal demand for the transportation of merchandise and materials of all kinds when they were in the worst condition they had ever been in. I am a believer in railroad regulations, but our roads had been regulated until one-half or more of them were in the hands of receivers. The roadbeds and the rolling stock had run down. In my opinion, they were not getting money enough to run their business on a business basis. Too much regulation! As a heavy shipper, had I been charged 15% more freight, I feel that I would have made from 15 to 20% more money, because I could have demanded service, and service is what we need in the matter of transportation. Moreover, the roads could and no doubt would have given me better service without any very strong effort on my part. Now the railroads are going to come again, for we are going to give them money enough to run their business right, and they are not only going to do the heavy hauling, but, from an economical standpoint, must do the long hauling.

I say, then, that while the truck has come to stay it is not for long hauls or extra-heavy hauls, and the public is not going to build and maintain roads to carry loads, including vehicles, of 12, 15 and 20 tons.

If you give me the right kind of an engineer and inspection, I will build a road, out of any of the standard materials mentioned by "Engineer" in your publication above referred to, that will take care of three- to five-ton-load trucks with the recognized amount of maintenance and give long service, but I want nothing heavier than five tons and prefer a three-ton load as the maximum.

I want to say that the motor trucks and the motor passenger vehicles and the construction that will take care of a two-ton truck and less are going to be the class of transportation that will help the country most at the present time. We must take care of these and not allow Mr. Heavyload to put them out of business by destroying the road. Heavy-load at best is going to be handled by but a small percentage of the people who will be taxed to build and maintain the road.

T. S. SCANLON,
Secretary and Treasurer, West Virginia State Road Commission.
Charleston, W. Va.

Railroad Versus Motor Transportation

Sir—Articles and letters appearing in your magazine on motor-truck and railway transportation lead me to contribute the following:

Whitefish, Mont. (population 3000) and Kalispell, Mont. (population 5500), are distant from each other 17 miles by highway and 24 miles by railway. Deep snows through January and February practically prohibit the use of motor trucks or autos during those months. Kalispell is a wholesale center, and practically all groceries, hardware, gasoline, etc., used in Whitefish must come from there. Kalispell is a county seat, and there is much passenger travel between the two places.

For 10 months in the year the truck company and the two passenger auto companies carry 95% of the freight and passengers. The freight and passenger rates by auto are the same as by rail, the autos having the best of it by seven miles in distance.

During January and February 95% of the traffic, freight and passenger, is by rail, as the autos quit when the snow gets deep.

The railroad must pay for the cost of "readiness to serve," or has a fixed operating cost. Its rates are based on this cost, divided into twelve months. Having business only two months in the year, it must lose money. If the railroad had the business 12 months in the year, it would still lose money in January and February, in all probability, owing to weather conditions.

I conclude as follows: If the motor trucks and passengger autos take the cream and leave the skim milk for the railways, the motor-truck business will be fine for the trucks, but will rob the railways of money they need for fixed operating expenses. W. K. TRIPPET.

Whitefish, Mont.

Correcting a Possible Misinterpretation

Sir—I wrote an article for the Nov. 28 issue of your paper, entitled "Limitations To Be Placed on Trucks, From User's Viewpoint," and, owing to my duties in Washington, I did not have an opportunity to read the proof you submitted before the paper went to press. In fact, my time was so limited that I was unable to go over it to correct grammatical errors, and suggested to your editorial department that such corrections be made for me by your own staff.

Unfortunately, however, the intent of the second paragraph, in the second column, appearing on p. 968, was misinterpreted, and if printed as I originally wrote it, it would have read as follows:

"It is thought that perhaps the first converts to the belief in the utility and desirablity of passenger cars, aside from those owning them, were the officials of the state highways departments, and quite logically so because, although when they realized that owing to the use of passenger cars the road surfaces were subject to considerably more wear, they rapidly appreciated that the use of these vehicles would serve to stimulate the interest of the general public in their work, which would mean that they would get greatly increased support in their road-building plans."

Inasmuch as the paragraph referred to, as it was printed in your issue of Nov. 28, might be misinterpreted by your readers as casting aspersions on the public-spiritedness of the highway engineering industry, I am exceedingly anxious that this letter be printed to make it perfectly plain that there was no such intent in my mind when the article was written.

New York. GEORGE H. PRIDE,
President Heavy Haulage Company.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Jackhamers, Jacks and a Steam Shovel Make Cut in Old Pavement

A TRENCH for a new street railway track in Chicago was recently cut through an 8-in. concrete base at the rate of about 200 ft. per day. The plant and force employed consisted of a portable drilling outfit, a revolving steam shovel, and two gangs of jack and bar men. The cut was 20 ft. wide along the center of the street, and was made after the wood-block paving had been removed.

A portable air compressor, operating four jackhamer drills, led in the work. Holes about 6 in. apart and 1 in. in diameter were drilled through the base. First, a row of holes was drilled on each side of the cut; then, transverse rows, 6 or 7 ft. apart were put through the strip to be removed. Two gangs of bar and jack men followed the drillers, breaking up alternate 75 to 100 ft. sections of the slab. Each gang broke out the concrete in transverse sections, corresponding in width to the space between the transverse rows of drill holes, and threw the fragments behind.

By use of two or three ratchet jacks with a hold under the edge, the base slab was lifted until it cracked into pieces of one or two square yards, with smaller pieces. Men with bars pried the slabs apart, and others using heavy two-handed sledges broke the larger pieces into sizes which would pass a ½-cu.yd. steam-shovel dipper. Pieces which failed to break from the edges of the cut were wedged free with steel points sledged into the drill holes. The steam shovel followed the rearmost breaking gang and loaded the broken concrete into dump wagons for disposal. The work was done for the Chicago surface lines.

Combination Platform Saves Time for Motor Trucks at Terminal

MOTOR trucks which were used in the aircraft spruce production program in the Northwest were unloaded at terminals by the use of inclined platforms. These platforms were built so that the wheels on the side away from the bank of the stream would run up onto a higher level, leaving the wheels on the river side at grade. Thus, the bed of the truck tilted toward the skids down which the log was expected to roll, and it was only necessary to release it from the truck bed. When large logs were being hauled they were not chained in place, their weight being expected to hold them. Metal chocks on the cross-beams, appearing in silhouette in the picture, served to prevent the load from slipping off in transit.

The picture shows a large 6-ft. log just rolling off after the chocks on the river side were removed. At the extreme right is shown the reloading platform used for putting the trailer on the truck body. On some of the hauls the trailer was always loaded for the return trip, to increase the traction. When this was done the truck could climb the extremely steep grades (up to 19%) without chains, which were expensive in terms of time, tires and roadway planking. To load

TILTED PLATFORM TIPPING 6-FOOT LOG FROM TRUCK

a trailer it was backed up onto the platform over a pair of runways, one for each wheel. These runways were built up so as to be convenient for one man to handle. The truck then moved forward, the runways were removed, and when the truck backed up against the platform the trailer was run onto the body and chained.

The photograph was supplied by G. W. Gauntlett, district superintendent for the Warren Spruce Co., at Raymond, Wash.

Old Rails Make Hanging Ways for Pile Hammer

BY JOHN H. SAWKINS
Schenectady, N. Y.

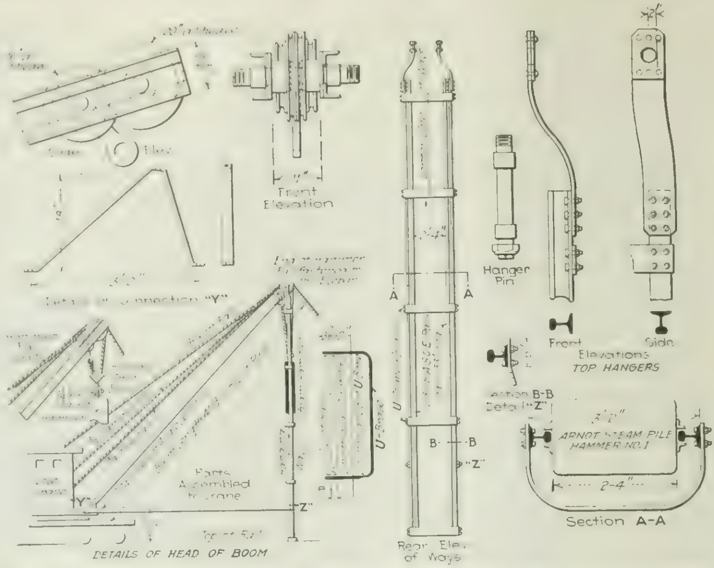
HANGING ways for a pile hammer designed to be used in connection with a locomotive crane were recently constructed, at small cost, of old rails and steel plates. The ways cost $250, including labor and material. Henry Steers, Inc., contracting engineers, New York, were the builders.

Three features of the design and construction are the eccentricity of the pin holes in the top hangers; the link connections at the boom end for the hammer fall and the single block, and the adjustable horizontal braces connecting the bottom of the ways with the locomotive crane.

Eccentricity of pin holes was provided so that the ways would hang plumb from the tip of the boom. The eccentricity was calculated as follows: The center of gravity of one of the U-braces was found, by balancing it on knife edges, to lie 10 in. back of the center line of the rails, as shown by the sketch. Two 85-lb., 33-ft. rails weighed 1870 lb., and five plates, each ⅜ in. x 6 in. x 5½ ft., weighed 424 lb. Taking moments, $1870e =$

$124 \times (10 - e)$. Then e = eccentricity = 1.85 in., or, say, 2 in. This calculation neglects the two ½ x 7-in. hanger plates; these, however, are practically balanced.

The plumb position of the ways coupled, with the connection of the hammer fall, eliminates any horizontal thrust on the rail guides as the hammer rises and falls. Such a thrust, besides causing stress and vibration, tends to make the ways pick out at the bottom. Notice, from the drawing, that the vertical axis of the single block will coincide very nearly with a vertical line through the center of gravity of the ways, for any position of the hammer.



HANGING WAYS FOR LOCOMOTIVE CRANE PILE HAMMER BUILT OF OLD RAILS

Adjustable horizontal braces permit raising or lowering the boom, to alter the height of the ways. As the boom height is altered, the distance between Z and Y changes. This change is met by shifting the connecting bolt back or ahead in the series of holes at the Y end of the braces.

Dump-Car Train and Spreader Backfill Sewer Trench

TRENCH for a 16-ft. concrete sewer in Chicago was backfilled recently by a dump-car train hauling a standard spreader. Standard-gage track for backfilling ran along the edge of the trench, which was from 40 to 45 ft. wide on top and 30 ft. deep, and was excavated in two lifts. The first cut, about 10 ft. deep, was made by a steam shovel loading to dump-car trains which wasted the spoil; the cut had sloping sides and, as indicated by the figures just given, was very wide at the top. The second cut was made by a dragline excavator working on the floor of the cut made by the steam shovel, and digging a trench about 22 ft. wide, with nearly vertical sides.

The spoil from the second cut, a heavy clay, was used for backfilling. It was loaded by the dragline excavator into trains of 6-cu.yd. side-dump cars, with a standard-gage spreader car at the rear. As the cars were dumped the train was hauled ahead, and the spreader scraped the dumped spoil sidewise into the trench, as shown by the illustration. No hand spreading or handling of the backfilling other than as described was necessary. The T. J. Florschner Contracting Co., Chicago, was the contractor.

SEWER BACKFILLING PLACED BY DUMP-CAR TRAIN WITH SPREADER CAR

Divert Rivers to Protect Harbors

To prevent silting in the adjacent harbors of Los Angeles and Long Beach, Cal., by floods from the Los Angeles River and the San Gabriel River, it is proposed to cut a new channel 650 ft. wide to discharge both rivers into the ocean east of Long Beach harbor. The estimated cost is $1,000,000. For this there is available a Federal appropriation of $500,000 and a state appropriation of $250,000, while the state has promised to equal the Federal appropriation. Los Angeles County has appropriated $800,000 for right-of-way, and the Secretary of War is to institute condemnation proceedings for the required land

NEWS OF THE WEEK

New York, December 19, 1918

Engineers Urge Policies for Public Works

National Department Favored, Also Placing of Civil Engineers on Waterways Board

Appropriation of $1,000,000,000 for public works of drainage, irrigation and flood protection was urged in a resolution adopted by the National Drainage Congress at its meeting in Chicago, Dec. 13-14. It also petitioned President Wilson to appoint the waterways commission of seven members authorized by the act of Aug. 12, 1917, and, while the law requires an Army engineer at the head of the commission, the petition suggested the appointment of not less than three civil engineers as members, "in recognition of the services rendered to the United States Government in its time of need by a great body of civilian engineers."

Ask for National Department

Creation of a national department of public works, with its executive head a member of the President's cabinet, was another recommendation. Prosecution of the following projects was advocated: the Atlantic coast waterway; the Lake Erie and Ohio River Canal; the Ohio River improvement; storage reservoirs on the Alleghany, Monongahela and other rivers, as means of flood control and aids to navigation; the Lake and Gulf waterway from Chicago; and the improvement of the Upper Mississippi, the Missouri and the Columbia Rivers.

Federal aid for drainage of swamp and overflow lands, similar to that already extended for irrigation, was urged. As local projects of this class have been devised usually with little regard to general plans covering the valleys in which they are located, the Governors of the states are asked to consider the desirability of unifying state agencies responsible for water resources, and the desirability of advocating the passage of state acts to revise the drainage laws. Related to this was a resolution authorizing the president of the drainage congress to appoint a committee to report some plan of stabilizing the value of drainage bonds and other securities for improvement works.

Diversion of flood waters and their subterranean storage for the benefit of the semi-arid lands was also advocated, with the recommendation that Congress provide necessary funds.

Plans were favored for providing good agricultural lands for soldiers and sailors returning to civil life, such lands to be sold at cost and upon favor-

(Concluded on page 1146)

Representative Highway Congress in Chicago Unit for National System

Interstate Motor-Truck Transportation Here To Stay—Enlarged Federal-Aid Appropriations Approved

Federal highways and a Federal highway commission to build and control them—this, and motor-truck regulation, were the problems threshed out most energetically at the joint highway congress at Chicago, Dec. 9-13, under the auspices of the American Association of State Highway Officials and the Highway Industries Association. Nearly 1500 highway officials, engineers, contractors, material and equipment men, and good-roads enthusiasts registered.

Discussion waxed strongest on the question of proposed Federal legislation, which states rights adherents strongly apprehensive of any bill which might curtail or restrict the powers of state officials.

The Association of Highway Officials, in separate session, indorsed the Page bill, which would amend the present Federal-aid act by increasing the appropriations by $50,000,000, available on passage, $75,000,000, on July 1, 1919, and $100,000,000 per year for three years. It would also eliminate some of the post-road limitations and permit payment of half of the cost of accepted roads, with no limit as to total cost. On the question of a Federal highway commission and a national system the two organizations were somewhat at variance, the joint congress asking for legislation immediately and the highway officials passing the following resolution:

Resolution of State Highway Officials

"Resolved, that the executive committee is requested not to submit any further legislation than the Page bill [noted above] to the present short session of Congress; that the executive committee formulate and submit to the various state departments, as soon as may be, a separate bill providing for a Federal body or officer with adequate power and funds to administer all Federal and Federal-aid highway laws, which are now, or may hereafter be, in effect. It is the sense of this meeting that the law should be so drawn as to take the fullest possible advantage of the experience and personnel of the present Federal administrative body, the effectiveness of which is hampered by the present limitation on salaries, and the present too great centralization of the administrative functions, especially as concerns construction matters.

"We favor an adequate Federal highway system upon which the Federal-aid funds may be concentrated. The Federal system should be selected by the various states and connected at the state lines by the Federal department in cases where connections are not made by adjoining states. Nothing in any Federal enactment should prevent any state from gaining all the Federal aid accruing to it, nor deprive any state of the full administrative and legal control of all highways within its borders, and of the location of the improvements on the Federal highway system."

The highway officials asked for the immediate release of highway engineers now in Government service and for an investigation in conjunction with the Highway Industries Association of motor-truck regulations and limitations, with a recommendation to be based on such an investigation. Not only are existing data to be examined, but experiments on different types of pavement are called for, to be carried out by various states. Another resolution provided for the development of a comprehensive plan of experiments on which a recommendation can be made for a uniform traffic law for the different types of pavements. The officials also called upon the War Industries Board to remove all restrictions on the use of reinforcing and structural steel for highway bridge purposes, and instructed the executive committee of their association to urge upon the Capital Issues Committee the release of control of highway bond issues.

The newly elected officers of the highway officials are as follows: A. R. Hirst, president; Paul D. Sargent, vice president; A. D. Williams to continue as acting secretary in the absence of Col. Joseph Hyde Pratt on overseas duty, and W. S. Keller, treasurer.

Governor Lowden Starts Joint Sessions

Economics and ultimate service were the burden of Gov. Frank O. Lowden's address in opening the joint sessions and welcoming the delegates to Illinois, where a $60,000,000 bond issue has recently been voted. "Keep the good-roads idea sold like good salesmen," was his advice to those who would stop the good-roads propaganda. That ap-

pointing officials must keep out incompetents, that engineers must recognize their heavy responsibility to build the roads as economically as private companies would, that material men must be satisfied with a fair profit (for upon this factor largely depends the beginning of the building in Illinois)—these were sentiments upon which the Governor elaborated.

James I. Blakslee, fourth assistant postmaster general, presented a vigorous argument for good roads by which the mounting high cost of living may be reduced. Motor postal routes will aid materially, in his estimation. He said: "The establishment of vehicle truck routes would eliminate wasted food which cannot get to market, employ labor in essential occupations, utilize a modern mechanical device, encourage the construction and improvement of highways, let the producer produce, the consumer consume and the conveyor convey."

Mr. Blakslee's suggestions for three different methods of meeting the cost of construction and improvement of highways are as follows: First, for a highway entirely Federal or national in character—for which the Federal Government should defray the cost of construction, improvement and maintenance—an interstate highway available not only for the transportation of merchandise and food products, but also useful for military purposes. He proposes a system of 15,000 miles, costing about $30,000 per mile, which could be paid for in a reasonable time from the earnings of the service performed upon it. Second, for a highway supported by the Federal Government and the state local subdivision. Third, for a highway, supported by the state, county or township, which would include the construction and maintenance of dirt, gravel or sand clay roads which should be paid for solely by the local state, county or township, and would be utilized as feeder roads and finally connect with the national trunk roads.

National Highway Transport Here

Roy D. Chapin, who was, until his resignation last week, chairman of the Highway Transport Committee, said, in speaking of "The Present and Future of Highway Transport in America":

"A year ago highways transport had arrived nationally, though few of us knew it. Today it is known, discussed, praised, criticised, encouraged, and every month sees it grow in volume by leaps and bounds. The war pointed out that our highways could greatly supplement all other forms of transportation, and who can tell just how much our share in the war was speeded up by highways transport, not only here but in France?

"Today it is our duty to develop broadly this mighty, new form of transportation, properly coördinate it with others, safely guide it through these early stages of growth and make it responsible for opening up every nook and corner of our land.

"There must be regulation of highways transport. Its full development is dependent, partly, on the elimination of irresponsible operators, the stabilizing of rates, the working out of uniform bills of lading, and methods of insuring loads. Analysis must be made of the desirability of exclusive franchises to operate over certain highways. It is the present thought of our committee that such franchises are not conducive to the best interests of the people. Provided rates for traffic are properly stabilized, competition over the highways would seem far better for the shippers, and only in this way will rates finally come down."

As to what the Government should do, in this period of readjustment, toward the development of highways and highways transport, Mr. Chapin believes there should be in Washington a comprehensive organization, not only for the administration of Federal road funds, but also for the exhaustive study of the possible growth of highways traffic during the next decade, from which resultant recommendations should be made to all the highway authorities of the country as to the type of roads that should be built to handle this traffic successfully.

"A Suggested National Highway Policy and Plan," the subject of a paper by E. J. Mehren, editor of *Engineering News-Record*, printed on page 1112, carried the conviction home, without much argument left, that the time is ripe for a national system, Federally administered. At any rate, practically no opposition was offered at a succeeding session, when resolutions adopting this platform for a 50,000-mile system,

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What Next in Engineering Education?

The demobilization of the S. A. T. C. in the engineering colleges, and the rapid transition to peace conditions, are being recognized as the greatest opportunity ever presented to introduce changes in engineering education long debated but prevented by inertia or fixed academic traditions. Engineering educators, as was evidenced at the recent meeting of the S. P. E. E. at Boston, are actively engaged in the work of revising pre-war courses to meet new demands. They need the coöperation and help of practicing engineers. "Engineering News-Record" urges all to give thought to this vital subject and send in their ideas for publication. They can thus aid in preparing the specifications for the desirable engineering graduate, as suggested by Dr. Mann in his address at Boston (see p. 1068 of last week's issue). Practicing engineers must help the teachers, and we welcome all communications on this timely subject.

Highway Industries Association Holds Annual Meeting

Following the joint Highway Congress at Chicago last week, the Highway Industries Association held its annual meeting. Besides the disposal of routine and administrative matters, the meeting indorsed the resolution of the Highway Congress in favor of increased Federal-aid funds, a national highway commission and a national highway system, and authorized the president of the association to appoint a finance committee and a membership and organization committee.

In conformity with the constitutional provision that additional directorships be established for each 50 members in the organization, the president declared a new directorship created, the association now having 67 members. David S. Ludlum, president of the Autocar Co., was elected to this directorship.

The directors reëlected were W. P. Blair, representing the National Paving Brick Manufacturers' Association; A. T. Rhodes, representing the Granite Paving Block Manufacturers' Association; E. J. Morrison, representing the National Association of Asphalt Block Manufacturers; W. T. White, representing the National Automobile Chamber of Commerce.

The following officers were elected: President, S. M. Williams, sales manager of the Garford Motor Truck Co.; first vice-president, G. P. Coleman, state highway engineer of Virginia; second vice-president, E. J. Mehren, editor of *Engineering News-Record;* third vice-president, Charles J. Lang, president of the Lakewood Engineering Company.

Engineers Urge Public Works

(Concluded from page 1145)

able terms. The resolution proposed, to further this development, the formation of a bureau of agricultural colonization and training in the United States Department of Agriculture; this to be supplemented by national, state and local training schools and farm associations.

Highway development was indorsed, and alliance with the National Highway Association was proposed. Edmund T. Perkins, Chicago, was elected president of the National Drainage Congress.

Shipyards May Now Accept Private and Foreign Orders

The United States Shipping Board announced during the past week that American shipbuilders may accept contracts to build wood ships for either foreign or domestic account, without special authorization from the board. Similar permission was granted to companies building steel ships so far as domestic orders are concerned, but the former prohibitions stand with respect to orders of foreign owners.

Cancellations of many contracts for wood ships were announced Dec. 13, supplementing previous cancellations.

The precise number of ship contracts that will be affected is not yet known, as it will depend on the money spent on the particular ship. Work is to be discontinued on every ship on which not more than $200,000 has been spent. The cancellations, however, may for the present be regarded as suspensions, since their disposition will depend upon the success of Chairman Hurley's efforts to sell wooden ships in Europe.

Orders for wooden ships totaled 731, of which number, 367 ships have been launched, 193 are under construction, and 171 keels are still to be laid.

Federal Aid Refused to Hudson Tunnel

After a long hearing, the Senate Committee on Interstate Commerce has voted against a favorable report on the Calder bill which authorized the Federal Government to appropriate $6,000,000 to join the states of New Jersey and New York in building a highway tunnel under the Hudson River at New York City. In all probability, this means a rejection of the similar Eagan bill in the House of Representatives.

McAdoo for Extending Federal Control Five Years

Extension of Government control of the railways for five years, or until Jan. 1, 1924, is urged in a recent letter from Director General of Railroads McAdoo addressed to Senator E. D. Smith, chairman of the Senate Committee on Interstate Commerce, and Representative Thetus W. Sims, chairman of the House Committee on Interstate and Foreign Commerce. Mr. McAdoo maintains that it would be impossible to obtain legislation during the present session of Congress providing a permanent solution of the railroad problem, and that it would be impracticable and opposed to public interest to attempt private operation of the roads under the present laws.

In speaking of the carrying out of necessary improvements in the national railway system, Director General McAdoo says: "The period of two years is entirely too short a time within which to plan and carry out the comprehensive improvements which ought to be made to meet the country's requirements under peace conditions. Many of the improvements could hardly be completed and put into operation inside of the two-year period and under such circumstances and facing a change to private management at the end of two years it would be unwise in the highest degree to make the improvements and impossible to secure the hearty coöperation of the railroad corporations."

The alleged inadequacy of present legislation with respect to the division of authority over railroad corporations between state and Federal commissions was emphasized as an important argument against the return of the roads to private control in the near future.

Public Health Requires Engineering Service

Convention Considers Medical, Technical and Administrative Problems of Sanitation and Industrial Housing

Engineering in relation to public health was represented only fairly well at the largely attended 46th annual meeting of the American Public Health Association held in Chicago Dec. 9-12. While the greatest interest in the general meetings centered on discussion of the various phases of the influenza epidemic, engineers were more particularly served by the section on sanitary engineering, which held two sessions. The attendance and the discussions at these sessions, however, were limited. Some papers related to bacteriological work were included in the program of the laboratory section. In addition to six general sessions of the association, there were about 25 sessions, held by the seven sections into which the convention was divided.

Municipal and Shipyard Sanitation

Chlorination of the water-supply of Chicago was described by John Ericson, city engineer, and in the discussion it was pointed out that one element of the success of this treatment is variation of the dosage in accordance with wind and weather conditions on the lake, as these conditions are found to influence directly the bacterial content of the water. While Chicago already has the remarkably low typhoid death rate of 1.7 per 100,000, it is expected that the figure for 1918 will be below 1.5.

Conditions at Milwaukee in regard to quality of the lake water were described by T. Chalkley Hatton. Treatment of Chicago sewage by dilution in the Drainage Canal was indorsed by C. D. Hill, engineer of the Board of Local Improvements, and Langdon Pearse outlined the experiments on preliminary treatment of sewage before its discharge into the channel.

Sanitary work at the shipbuilding yards was reviewed in a paper by Lieut.-Col. Philip S. Doane, director of health and sanitation for the United States Shipping Board. In the 11 yards operated by the board it was not difficult to carry out sanitary measures, but the other 160 yards work under contracts, none of which calls for specific sanitary equipment, and only a few of which provide for maintenance of sanitary and hygienic conditions. Thus, the health department had to work diplomatically and in an advisory capacity, but in most cases the yards carried out the suggestions made. Interconnection of dual water systems for fire protection and drinking supply, with only a single gate valve for the protection of the latter, was a common trouble that has been almost entirely eliminated. Water-supply, sewage disposal, food protection, toilets, fly and mosquito conditions were the principal centers of activity. Closely related to this subject was the mosquito control at Hog Island, described by B. F. Royer, acting state commissioner of health for Pennsylvania.

Housing Shipyard Workers

Housing work of the United States Shipping Board was described by Morris Knowles, chief engineer of the housing department of the board, who showed plans of various layouts and also photographs illustrating the types of structures employed. In the discussion the great extent and importance of the housing work carried on by different departments of the United States Government were mentioned by C. B. Ball, chief sanitary inspector, Chicago. It is being recognized that a house must be something more than a shelter; it must provide for health, comfort and convenience and for the maintenance of family life and conditions. A serious problem at present is the future of this Government work. Mr. Ball urged that it should not be stopped because the war has stopped, but should be carried to completion and supplemented by plans for the operation and maintenance of the new industrial towns and villages.

Recovery of grease and tankage from garbage has fallen off slightly under war conditions, in spite of the educational work of the Food Administration. This was shown in a report presented by Samuel A. Greeley, Chicago. Prices have increased from about 5c. to 15c. per pound for grease and from $7 to $18 per ton for tankage.

"A Critical Study of the Bacterial Count in Water and Sewage," dealing with the probabilities of errors, was presented by Milton F. Stein, designing engineer, Division of Sanitary Engineering, Cleveland. The paper, which draws conclusions of value to sanitary engineers as well as bacteriologists, is printed in the *American Journal of Public Health*, November, 1918.

Education in Sanitary Matters

General education in sanitary matters as a means of preventing disease and promoting both public health and physical fitness was the keynote of the presidential address by Dr. Charles J. Hastings, Toronto. The necessity for this is shown by the fact that from 50 to 75% of our volunteers, drafted men and conscripts for the recent war, were found physically unfit for military service. This unfitness was due mainly to preventable and curable diseases and physical defects. Public recognition of the health officer was discussed by Dr. Lee K. Frankel, New York. He presented statistics showing that of 417 cities, 153 had full-time officers and 264 part-time officers, most of the former being in cities under 50,000. In the majority of cases no training in taking care of the public health is required of candidates for office.

Chicago Highway Congress

(Concluded from page 1146)

serving 90% of the people at a cost of $1,250,000,000, were submitted.

A. R. Hirst's paper on "The Underlying Principles Controlling the Laying Out, Marking and Maintaining of a State Highway System," was a most valuable paper with deductions from pioneer experiences which no highway engineer should miss. (See *Engineering News-Record* of Dec. 12, p. 1065; also p. 1128 of this issue.)

Motor-Truck Regulation

Motor trucks must be regulated and the truck makers and users are as keen for doing it as the road men. George M. Graham, chairman of the Motor-Truck Committee of the National Automobile Chamber of Commerce, presented the truck side of the case most forcibly, as set forth on p. 1109. His thesis was based on the proposition that the highways should be the servant of transportation, not its master. Against his proposed truck regulation law for a 14-ton limit, 800-lb. per inch width of tire, respective speeds of 30, 20 and 15 miles per hour over country, suburban and city pavements, were arguments by several engineers indicating that the values were too high.

A. D. Williams, chairman of the State Road Commission of West Virginia, combining his own remarks with a written discussion sent in by F. H. Zouck, chairman of the Maryland State Roads Commission, said: "If we are to face in the next three years as much change in loading and rate of speed upon the public road as we have experienced in the past three years, but very few miles of the present improved roads of this country will be found remaining intact, and with that thought standing boldly before us it is the duty of every person interested in the highway movement to stop, look, listen, pause and consider before venturing further, because if we do not there is bound to come a reaction of public sentiment that may parallel that of the old canal days.

The Truck and the Railroad

"The truck cannot be made to compete with the railroad as an economical proposition. The experience during the past war emergency cannot be made a criterion for future action, except to direct our attention to the danger of overloading the highways. The truck has its place as a feeder to the railroad and as a medium between the farm and the market, but the load limit should be not over 600 lb. per inch width of tire for brick, concrete and asphaltic roads, and not over 400 lb. for the average water-bound macadam road. The load upon earth roads must be governed by the weather and the soil conditions. I would not advocate embargoes, but a loading to correspond with the conditions of the highway.

"I agree with Mr. Graham that when a road is constructed and a few individuals use that road for profit they should bear the cost of maintenance; but if the truck manufacturers insist on increasing the loading over 600 lb. per inch width of tire and advocate heavy-tonnage vehicles, no type of road now in existence will endure sufficient tonnage to be satisfactory in license cost to the truck operator."

C. J. Bennett, state highway commissioner of Connecticut, defined the position of the highway engineer with reference to trucks as follows:

"We appreciate the value of the motor truck. We would not banish it. We know that it holds an important place in the general scheme of transportation. It is extremely useful to us in our own work. We realize that we must build our roads to stand motor-truck traffic. We must also maintain them properly. The only question is, to determine the maximum motor truck for which we must design and construct our highways. Right here, the interests of the highway engineers and the motor-truck manufacturers begin to diverge.

"It is not fair to say that it is all a question of maintenance. Even with unlimited funds, maintenance has not always succeeded in preventing damage by trucks. It does not seem feasible to place embargoes on trucks for a time. We must meet the issue fairly and design a truck for which we can build roads continuously usable.

Effect of Unreasonable Weight

"An attempt to exceed a reasonable weight in motor trucks would do two things: First, make it necessary to replace a large amount of mileage already constructed with expensive construction; and, second, on that account reduce the expansion of the highway systems—for, under present conditions, there is a definite limit to the amount of money which states can appropriate for highway construction.

"My suggestion, therefore, is that the motor-truck interests modify their demand for roads which will stand unreasonable weights, and place their attention upon the development of a maximum standard motor truck which will be reasonable in its weight, the speed at which it can be operated and its width and height."

Connecticut's law, framed before the war, in 1917, represents Mr. Bennett's idea of a liberal regulation. It calls for a 12½-ton total load, 700 lb. per inch of tire width, 9½ ft. total width and a maximum speed of 25 miles per hour.

A resolution was passed appointing a committee to confer with the Motor-Truck Committee of the National Automobile Chamber of Commerce, to decide upon and work for the passage of a uniform motor-truck law.

Reception to Captain Robert W. Hunt on Eightieth Birthday

Capt. Robert W. Hunt, head of the firm of Robert W. Hunt & Co., inspecting and testing engineers, Chicago, was the guest of honor at a reception given at the Mid Day Club, Chicago, Dec. 9, in recognition of his 80th birthday.

Landscape Architects Hold Reconstruction Meeting

A special meeting of the American Society of Landscape Architects was held in Washington, D. C., Dec. 7, to consider problems affecting the profession in the reconstruction period.

"This meeting was called," said Prof. J. S. Pray of Harvard, president of the society, "to consider how we may best be of service here and overseas during the reconstruction period. The country is faced, for instance, by a large building program. Better and more economical results will be secured by the coöperation of the landscape architect. He is likely to be called in more and more upon these and city-planning problems."

It was stated by F. L. Olmsted that the landscape architecture branch of the Housing Bureau had proved the possibility and value of coöperation between the architectural, town-planning, and engineering professions. Mr. Olmsted pointed out that in that branch of the Housing Bureau each of these professions had been represented by a division, all working together in the solution of many problems.

Shipping Board's Annual Report Cautious As To Future

In its annual report to Congress, published Dec. 15, the United States Shipping Board expresses its conviction that the shipbuilding program should be carried through, and it also suggests that the program should be extended. On the latter point, however, it says: "It [the board] feels that until the situation is further developed it should not recommend specifically the degree nor the manner in which the program should be extended. In view of these circumstances, the board deems it advisable to submit to the Congress at a future date its recommendations in these particulars."

As summarized in the report, contracts were made by the Emergency Fleet Corporation during the year for 1604 steel ships totaling 10,514,000 tons, and for 1034 wood and composite ships totaling 3,024,000 tons carrying capacity. The steel vessels include 1297 cargo ships, 80 tankers, 94 troop ships, and a number of other large vessels, besides 112 tugs and 16 barges.

Discuss Bridge Over Chesapeake Bay at Baltimore

Active discussion by Maryland interests of a project for a bridge across Chesapeake Bay to connect Baltimore with the Eastern Shore, has led to the appointment of a committee by Governor Harrington to develop the scheme in more detail. J. E. Greiner, consulting engineer, Baltimore, is a member of the committee. The proposed route of the bridge is from Bay Shore to a point in Kent County near Tolchester. Some of the plans proposed have in view a double-deck structure nine miles long, costing about $10,000,000.

First Government Concrete Ship Is Launched

The 3000-ton concrete freighter "Atlantus," launched at Brunswick, Ga., Dec. 4, is the first of the Government's concrete oceangoing ships to take the water. This vessel was built under the direction of the Emergency Fleet Corporation, by the Liberty Shipbuilding Co., after designs prepared by the contractor. It was the first and only ship started by the company under its first contract, which was superseded by a later agency contract. Under the latter the company is building concrete ships at a new yard in Wilmington, N. C.

TWO VIEWS OF LAUNCHING OF 3000-TON CONCRETE SHIP "ATLANTUS" AT BRUNSWICK, DECEMBER 4

The "Atlantus" was built at an old yard on old end-launching ways. Being the only ship provided for at this site, there was some difficulty in the construction and, in all probability, little economy in cost. As shown in the accompanying views, the boat is much more ship shape than its predecessor in concrete ships, the "Faith."

In the "Atlantus" the new burned-clay light aggregate developed by the Government was used. This aggregate, giving a concrete weighing about 110 lb. per cubic foot, was made in the Birmingham district especially for this ship.

East San Francisco Bay Cities Study Water Problem

The cities of Oakland, Alameda, Berkeley and Richmond, on the east side of San Francisco Bay, have joined in the appointment of a committee to study and report on the possible sources from which an ample water-supply for the east bay cities might be obtained. It is expected that at least two years will be required to make the field investigation, and it is not expected that the commission will be able to do more than make preliminary plans. The essential thing, it is felt in the east bay cities, is that the four municipalities have come to the point where they can get together in a coöperative plan.

The first meeting of the committee was held on Dec. 2. C. E. Hewes, city manager of Alameda, was elected chairman, and Clyde C. Kennedy, city engineer of Berkeley, was made secretary. Two subcommittees, one composed of city attorneys and the other of city engineers, were named. The subcommittees are to meet once a week, and the joint committee will meet once a month in the Oakland city hall. Other members of the joint committee are: Perry Brown, city engineer, Oakland; Burnett Hamilton, city engineer, Alameda; H. D. Chapman, city engineer, Richmond; D. J. Hall, city attorney, Richmond; E. J. Garrard, councilman, Richmond; H. D. McGlashan, district engineer, United States Geological Survey; C. M. Boynton, commissioner of public works, Berkeley; Earl Sinclair, city attorney, Berkeley; H. L. Hagan, city attorney, Oakland, and Judge St. Sure, of Oakland. The four city engineers were to leave immediately after the first meeting for a trip over the Hetch Hetchy work with M. M. O'Shaughnessy, city engineer of San Francisco.

Weekly Ship Deliveries Reach High Figure

Full reports on ships delivered to the United States Shipping Board during the first week of December show that 22 steel ships were delivered, totaling 131,700 tons, and two 3500-ton wood ships, making the total deliveries of the week 138,700 dead-weight tons. Of the steel ships, nine were requisitioned from private orders; these range in size from 3500 to 12,500 tons. The 13 others, built on Fleet Corporation contracts, include nine Great Lakes vessels of 3500 to 4200 tons carrying capacity.

One particularly fast building record is represented in the list. The 9600-ton cargo ship "Edenton," delivered by the Skinner & Eddy Corporation, Seattle, Dec. 5, was built in 72½ working days, from keel-laying to delivery.

National Road System Recommended

Professional Men at Reconstruction Congress Urge Federal Control, With Payment by Localities

Resolutions recommending a national system of highways were presented to several of the group meetings of the War Emergency and Reconstruction Congress at Atlantic City two weeks ago. Most of them were in general form, but the one adopted by Major Group 10, Industrial Professions, is sufficiently explicit to warrant its reproduction. It reads as follows:

Whereas, at present sections of the country remote from each other are not connected by satisfactory highways, and,

Whereas, it is to the best interest of the nation both in times of peace and war that such highways should be provided without delay, and

Whereas, experience has shown that past dependence on state initiative has proved entirely insufficient and unsatisfactory. Now, therefore, be it

Resolved, that the War Emergency Reconstruction Congress earnestly recommends suitable action on the part of the Federal Government to secure the construction and maintenance of a modern system of well built trunk line highways connecting the Atlantic and Pacific coasts, and the northern and southern sections of the country as well, utilizing existing highways where available and suitable. That a proper system of taxation, having reference to the wealth of the several states served, and their respective benefits, be created with a view to apportioning national expenditures so as not unduly to burden any one section of the country for the benefit of another. And be it further

Resolved, that we recommend that this action be taken as quickly as possible, so that if there be a surplus of available labor from the demobilization of our troops and war industries' employees they may be utilized upon this work.

Proposes an Interstate Port Control for New York

Present Port Development Commission Makes Tentative Draft of Interstate Treaty

As a preliminary move to a unified control of the port of New York which will not stop at state or municipal lines, the New York-New Jersey Port and Harbor Development Commission has just published for public discussion a "Tentative Draft of a Supplementary and Amendatory Treaty between New York and New Jersey." This treaty creates a legal plan for comprehensive development of the Port of New York.

The proposed treaty, an amendment of the existing treaty of 1834, pledges each state to coöperate "in the future planning and development of the port of New York, holding in high trust for the benefit of the nation the special blessings and natural advantages thereof." It makes possible the creation of a "Port of New York District." The treaty does not fix the boundary lines of this district. They are to be fixed by the legislatures of the two states. The treaty creates what is called "The Port of New York Authority," made up of six commissioners, three appointed from each state, who are to constitute a body "corporate and politic," having authority to purchase, acquire, construct, lease and operate any terminal or transportation facility within the district, to make charges and establish rates of toll for the use of the same, and to take, own, hold, lease and operate any kind of property, borrow money and secure the same by bonds or mortgage upon any property held or to be held by it.

Other Provisions of Treaty

It is expressly provided that the treaty is not to affect the legal title to any property now vested in or held by either of the two states or by New York City or any other city, county or village within the district; nor does it affect the revenues now derived by the city from its dock properties. The treaty would authorize the port authority to make orders, rules and regulations within the port district for the improvement of navigation and commerce of the district not inconsistent with the Constitution of the United States or of either state, or with acts of Congress; but it provides a method by which these rules, orders and regulations are to be made effective only after submission to the municipalities within the district for their approval.

The proposed plan does not deal with the physical or economic features of port development. These features are being separately studied by the commission and will form the basis of its report to the legislatures of both states. The treaty is based, however, upon the assumption that the commission will conclude from its study that comprehensive development of port facilities must come through the coöperation of the two states, joining, where necessary, with Federal and municipal authorities, acting through a legally constituted agency vested with broad legal powers, to build, maintain and operate port facilities, to improve commerce and navigation at the port, to borrow money for the purpose, and to deal with all phases of the matter, by public or private ownership or operation, or both.

Charles Piez Succeeds Schwab as Director General

Charles Piez, vice-president and general manager of the Emergency Fleet Corporation during the past year, who has been acting director since the resignation of Charles M. Schwab two weeks ago, was selected as Mr. Schwab's successor, at a meeting of the board of trustees of the Emergency Fleet Corporation in Washington, Dec. 11.

Mr. Piez' duties during the past year have been essentially the supervision of ship construction under control of the Fleet Corporation, the most important part of the corporation's work. He is therefore considered to be thoroughly well prepared for the position of chief authority in the corporation. Bainbridge Colby, one of the trustees, on the part of the board expressed high appreciation of Mr. Piez' share in the corporation's work.

Millions Willed To Study Disease and Promote Health

The residuary estate of Capt. Joseph R. De Lamar, mine owner and capitalist, has been willed in equal parts to Harvard, Johns Hopkins and Columbia Universities, "for the study and teaching of the origin of human disease and the prevention thereof" and for the study and teaching of health conservation through food and diet. Laboratories, lectureships and publications, the last two both scientific and popular, are specified in the will. The estimated value of the residuary estate is $10,000,000, besides which $10,000,000 willed to a daughter of the testator will be added to the fund if the daughter dies without issue.

Seattle Projects Total $12,000,000

Plans for an extension of the water system of Seattle, Wash., the cost of which was estimated some years ago at $3,700,000, have been completed by A. H. Dimock, city engineer. The extension will involve the construction of several reservoirs, tunnels, pipe lines and other works. Preliminary work is being done for the construction of a 36,000-kw. hydro-electric plant on the Skagit River; the plant will cost, it is estimated, $5,500,000. A number of sewerage projects which were postponed on account of the war will amount to about $1,000,000, and about $2,000,000 will be required for the construction of several main thoroughfares of the city, some of which will be commenced at once. In addition, minor improvements will entail the expenditure of a considerable sum.

President Favors Early Resumption of Highway Construction

President Wilson favors the earliest possible resumption and extension of highway construction under the Federal-aid road act, as indicated in *Engineering News-Record* of Dec. 5, p. 1045, and has written to Secretary of Agriculture Houston to that effect. The Secretary of War also has written to Mr. Houston in similar vein. The text of the President's letter follows:

"Dear Mr. Secretary:

"I heartily agree with you that it would be in the public interest to resume in full measure the highway construction operations under the Federal-aid road act, and to do so as speedily as possible. I understand the necessity which existed for their contraction during the stress through which we have been passing, but that obstacle is now removed. I believe that it would be highly desirable to have an additional appropriation made available to the Department of Agriculture, to be used in conjunction, if possible, with any surplus state and community funds, in order that these operations may be extended. It is important not only to develop good highways throughout the country as quickly as possible, but it is also at this time especially advisable to resume and extend all such essential public works, with a view to furnishing employment for laborers who may be seeking new tasks during the period of readjustment. Knowing that the Department of Agriculture and the state highway authorities in each state have been carefully working out road systems and developing plans and specifications, I have no doubt that all activities in this field can be vigorously conducted through these two sets of existing agencies, acting in full accord.

Faithfully yours,
WOODROW WILSON."

Coast Survey Needs Equipment

The need of more equipment for the Coast and Geodetic Survey is pointed out in the annual report of the superintendent of the survey to the Secretary of Commerce, issued Dec. 14. The need of Government-owned power launches for propelling wire-drag surveying apparatus is emphasized. A lay exposition is made of the principles of the wire-drag survey.

Engineering Societies

The Albany Society of Civil Engineers held its annual meeting and dinner Dec. 17. Maj. James E. Hewes, general manager of the Albany Southern R.R., addressed the meeting on "Army Engineering and Transportation."

The Springfield Engineers' Club, Springfield, Ill., was addressed Dec. 10 by a representative of the National Tube Co. on pipe-manufacturing processes. A moving picture, produced by

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

the National Tube Co., entitled "From Ore to Finished 'National' Pipe," was shown.

The Engineers' Club of Philadelphia will be addressed by Dr. M. W. Franklin on "Peace," at the weekly luncheon on Dec. 24.

The Engineers' Society of Western Pennsylvania has been advised by the City of Pittsburgh of the acceptance of its deed of dedication for the homestead of the late George Westinghouse, in the Homewood district. The property is deeded to the city as "Westinghouse Park."

The Engineers' Club of Columbus was addressed Nov. 29 by Prof. C. W. Foulke, Ohio State University, who delivered a paper on "The Industrial Value of the Purified Water of Columbus."

The Northwest Master Builders' Association is to hold its second annual meeting in Seattle Feb. 20-21. The association was founded last year and held its first meeting in Tacoma.

The Washington State Good Roads Association will recommend to the consideration of the state legislature a proposal for the building of at least one east and west cross-state highway, and the use of automobile license revenues as a basis for a road building bond issue, in accordance with a resolution passed at the annual meeting held in Pasco Dec. 5. Arthur D. Jones, Spokane, president of the association, outlined plans for a state highway system as a reconstruction measure. The following officers were elected: President, N. B. Coffman, Chehalis; treasurer, Perry L. Sinclair, Ilwaco.

The Virginia Good Roads Association will hold its eighth annual convention in the auditorium of Murphy's Hotel, Richmond, Va., on Jan. 14-16, inclusive. C. B. Scott, state highway engineer, Richmond, Va., is secretary of the association.

Personal Notes

CLIFFORD OLDER, of Illinois, has been elected president of the Association of Mississippi Valley State Highway Departments. Frank E. Rogers, of Michigan, was elected secretary.

S. W. WAKEMAN, general manager of the Fore River plant, Bethlehem Shipbuilding Corporation, has been made general manager of a new unit of the company, including the Buffalo and Providence works as well as the works at Squantum and Quincy, which constitute the Fore River plants of the company.

WALT DENNIS, principal assistant engineer, Wabash Ry., with headquarters at St. Louis, has been appointed division engineer with headquarters at Moberly, Mo., succeeding W. W. Greenland, appointed superintendent at Moberly, as mentioned elsewhere.

LIEUT. COL. W. D. UHLER, Motor Transport Division, U. S. A., has returned to his work as chief engineer of the Pennsylvania State Highway Commission.

B. M. WILLIAMS has resigned as city engineer, El Paso, Tex. He has been in the city engineering department for the past eight years.

DANIEL B. NIEDERLANDER, formerly chief engineer of the Edgewood Arsenal Plant, Buffalo, recently received appointment as district appraisal engineer for the Bureau of Aircraft Production, at Buffalo.

W. I. JEFFERDS, formerly assistant chief draftsman, Erie R.R., has been appointed resident engineer at Meadville, Penn.

W. W. GREENLAND, division engineer, Wabash Ry., with headquarters at Moberly, Mo., has been appointed division superintendent at the same point. He was formerly assistant engineer at Moberly and in 1915 was appointed engineer maintenance of way of the division.

S. D. CLINTON, bureau of valuation, Interstate Commerce Commission, resigned recently to become associated with the Vulcan Iron Works, Seattle, Wash.

ROBERT W. WADDELL, former assistant city engineer, Kansas City, Mo., has been appointed city engineer. He has been acting head of the engineering department of the city since early in June, at the time of the injury of Curtis Hill, city engineer.

C. O. IRVINE, assistant engineer, Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., has entered the engineering department of the Philadelphia & Reading Railway.

LIEUT. ERNEST W. WOODRUFF, Yonkers, N. Y., formerly of the engineers' staff of the New York City Municipal Bureau of Highways, is reported as severely wounded.

CHARLES E. PHELPS, JR., chief engineer of the Maryland Public Service Commission since its organization in 1910, has resigned to enter private practice. At the time of his appointment as chief engineer of the commission he was in charge of the construction of underground electrical conduits in Baltimore.

Obituary

HENRY PRENTICE MORRISON, for three years commissioner of public works, Borough of Richmond, New York City, died Dec. 17 at West New Brighton, N. Y., at the age of sixty-one. He was born in Troy, N. Y., and was graduated from the New York University in 1880, with the degrees of B. S. and C. E. In 1881 he entered the Department of Public Works and a year later was made county engineer for Richmond. In February, 1902, he was appointed deputy commissioner of highways, sewers and water-supply, after which he engaged in private practice.

JOHN STERLING DEANS, vice-president and consulting engineer and previously chief engineer of the Phoenix Bridge Co., died at his home in Phoenixville, Penn., Dec. 16. Mr. Deans became chief engineer of the company in 1892. He was the constructor of many notable structures, including the Pecos River district on the line of the Southern Pacific and the elevated railways of New York City.

JOHN J. CANNON, chief engineer of the Guerber Engineering Co., Bethlehem, Penn., died Dec. 8. He studied at Lehigh University in the class of 1911, and entered the employ of the Guerber Engineering Co. in the frog and switch shops. At the time he was made chief engineer of the company, in 1914, he was head of the estimating department.

CHARLES P. BROOKS, consulting engineer, Salt Lake City, died in that city Nov. 30. After his graduation from the Sheffield Scientific School, Yale University, in 1870, he entered the office of the city engineer of New Haven, Conn., and two years later became locating engineer for the Texas & Pacific R.R. Soon afterward he became connected with the city engineering department of Chicago. In 1874 he formed a partnership with R. H. Brown in Salt Lake City, known as Brown & Brooks. He had served as a member of the Salt Lake City Board of Health, as county surveyor of Salt Lake County and as consulting engineer for the Board of Public Works on the construction of the Salt Lake City sewage system. In recent years he was identified with mining interests.

A. R. W. SPERRY, who was appointed chief engineer, Anderson-Cottonwood Irrigation District, California, early in 1917, died in Stockton, Dec. 6.

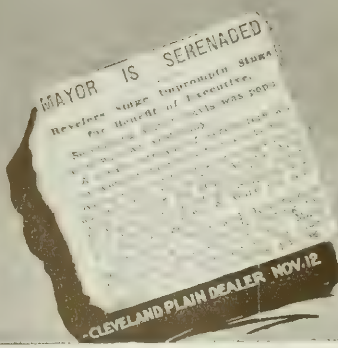
ROBERT P. ABENDROTH, assistant engineer of the Queens County, New York, topographical bureau for the past 14 years, died in Flushing, N. Y., Dec. 11. He was 53 years old.

GEORGE S. CANFIELD, JR., previously deputy engineer, Spokane County, Washington, died recently in Spokane.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.
December 26, 1918

Laying Timber Road of "Fore-and Aft" Type with Longitudinal Planking, for Motor-Truck Haulage of Airplane Spruce


MAYOR IS SERENADED
CLEVELAND PLAIN DEALER NOV.12

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Harvard School of Engineering Reorganized

CONGRATULATIONS for the reorganization of the Harvard Engineering School are in order. Regrets that the Gordon McKay bequest to Harvard could not be used for the Harvard-Technology merger should be forgotten now that Harvard has worked out an independent plan to meet the ruling of the Massachusetts Supreme Court. The outline of the reorganization scheme printed on p. 1198, the large and growing endowment, the Harvard spirit, the names of the faculty, all give rise to high hopes and full confidence for the success of the reorganized school.

A Leaf from the Shipbuilder's Book

BRACKET plates in ships' frames are universally flanged on their free edges. Bridge and structural practice, on the contrary, employs angle stiffeners riveted on, when the edges of gussets and knee plates call for reinforcement. The two methods are roughly equivalent. In the shipyard, flanging has been found to consume less material and less labor. It may demonstrate the same superiority in the bridge shop. Apart from any saving in production costs, flanging has a distinct value through the added proof of quality of material which it furnishes; the test of ability to bend is perhaps the most significant single test of structural steel at the engineer's command. Many steel designers and shop men engaged in ship construction during the past two years look with favor on the possibilities of flanging. If flanged work, abandoned long ago, should again be introduced in structural steel practice, the shipyard would make some return to the bridge shop for the contributions it has received from the latter.

Are There Enough Engineers?

WHETHER the demand for engineers exceeds the supply is a question generally discussed without data on which to base the argument. A little light is thrown on the subject by statistics recently compiled by the Engineering Division of the United States Employment Service, from answers to inquiries as to the number of technical men employed and needed, sent to essential as well as nonessential industries, public utilities and other organizations having technical staffs. In five Middle Western states, where the response was most satisfactory, 1453 replies were received, showing that 7931 technical men were employed and 520 were needed. The percentages of needed men over those employed were as follows: Iowa, 6%; Illinois, 6%; Indiana, 8%; Michigan, 4%; and Missouri, 1%. The inquiries were answered in October, at the peak of the demand. During this month nearly 3800 men registered with the division, and the demand for men was for about half that number. The number of registrants was slightly less during September and slightly more in November. The demands were considerably less in both months. No definite general conclusions should be drawn from these statistics, the division suggests, but they indicate that the war had not absorbed the available supply of engineers, to any extent.

Vacant Directorship in Bureau of Public Roads

THE President and the Secretary of Agriculture have the opportunity now of rendering a great service to the highway interests of the country, by appointing an engineer of vision and strength to the vacant directorship of the Bureau of Public Roads. The vacancy has come at the beginning of a new era in highway work. The bureau itself and the Secretary of Agriculture are backing a bill for the expenditure of $425,000,000 of Federal money on roads in four years, and bills for even larger expenditures will be introduced. To supervise properly these funds there should be, we believe, a National Highway Commission, but the appointment of a truly qualified director for the bureau is demanded, even though the commission should be created soon. Such an appointment would indicate to the nation that the administration appreciates the importance of the highway problem. Executive ability is an obvious qualification of the appointee, but equally important are vision commensurate with the magnitude of the problem and sympathy with modern developments in highway transportation. Lack of vision and of sympathy with new conditions have been the chief deficiencies in the bureau in the immediate past. But of one thing the President and the Secretary need to be forewarned—they cannot obtain the type of man needed for $4500, which is the very inadequate salary attached to the directorship. The position has been more than a $10,000 one in the past. It will be much bigger in the future. Government salaries are notably low, but no man adequate to the responsibilities of the place should be asked to take it for less than $10,000. Congressional action may be needed to change the compensation, but Congress will not long hesitate when the responsibilities of the work are presented, together with a list of the salaries now paid the more prominent state highway engineers of the country.

Congress Aims Blow at Fair-Compensation Contracts

CONGRESS has put itself on record against the cost-plus-sliding-scale-fee contract. In the Army appropriation bill for 1919 this form of contract is prohibited except when certificate is made by a responsible Government official that it is impracticable to employ any other form.

The need for vigorous action is plain. Unless organized contracting becomes its guardian, the fair-compensation contract, widely applied to public work as a result of the war, will fall back to its former restricted use on private work of large companies which have confidence in the contractor.

For the moment the cost-plus contract has virtually ceased to exist in Federal public works practice. Until the Congressional mind reacts to the different convictions of the building public, cost-plus contracts will not be restored. The public must be educated to the value of this contract. Note that this schooling must go beyond the engineer and the contractor, to the owner. If all contractors advocated (and all do not) the cost-plus contract, and if all engineers, instead of comparatively few, were arrayed in its support, it would not be enough. Owners must be converted to the equities of the fair-compensation contract before it will assume the position that it deserves in the construction industry. That we may not lose the gain secured by war construction, quick conversion is essential, but it cannot be accomplished through the work of a few missionaries, no matter how full of the spirit they may be, or how capable they are as exhorters. It requires concerted effort. Organized contracting must enlist as the defender of the faith.

Organized contracting—let it be said in humiliation—may claim no credit for the fact that the fair-compensation contract was written into our $1,300,000,000 worth of war construction. At the beginning of the war this construction was not under the guidance of contractors. They were the persons most vitally involved, yet they had no organization; they had no representation in the drafting of the contract for emergency construction. But now that the fair-compensation contract has demonstrated its value to the public, as well as to the construction industry, will the contractors of the country allow it to be legislated out of existence, without protest?

Here is work of public and personal benefit for the Associated General Contractors of America.

A New Era in Transportation

IN THE news that the retiring Director General of Railroads has assured Mississippi River interests that freight barge lines will be established, we read one of many accumulating items of evidence that a period of large-scale expansion and improvement of transportation machinery is ahead. War-time experiences demonstrated that meeting the requirements of this service is among the country's most urgent needs. A survey of the available facilities shows retarded development of railroads, ships, roads and waterways. There is much work to be done before this condition will be transformed.

Appreciation of the importance of well developed means of transportation is keen beyond all previous knowledge. As a people we have for some years been learning better each day how necessary is an efficient highway system. Last winter forced upon us new views of railroad capacity and limitations. More recently we have learned a great deal about ships, so that at present the creation and retention of a large merchant marine are assured for years to come. We are less ready as yet to enter with spirit and energy into waterway development, but an awakening may come at any moment. The national mind looks on the problem of transportation in a new way.

Communities that have long been blind to the existence of natural barriers at their gates now see the need of overcoming them. For example, Philadelphia is dealing in serious manner with the question of a bridge over the Delaware River. The New York-New Jersey highway tunnel project was placed before Congress as soon as the declaration of the armistice gave opportunity for considering anything other than war—and this promptness was indeed appropriate in view of the knowledge gained last year of the weakness of New York City's traffic connections. These efforts to initiate the construction of improved transportation facilities come from the same ultimate source which has put the strength of conviction into our shipping program. We have come to realize concretely that every means of transportation must be made workable and efficient.

Large responsibilities for engineers are contained in this prospect. The engineer will be called upon for new planning, based on an outlook far beyond the accustomed. The problems to be solved are those of the future, of a new era. It is likely to be a new era in transportation, as it promises to be in human relationships.

Agreement Among Engineering Societies on Broadening Scope

ALL four of the great national engineering societies now have committees at work studying the organization of these societies and considering various proposals for changes. An extended discussion took place at the annual meeting of the American Society of Mechanical Engineers recently, when its committee on this matter presented a preliminary statement. At the same session addresses were made by Prof. A. N. Talbot, president of the American Society of Civil Engineers, and Prof. Comfort A. Adams, president of the American Institute of Electrical Engineers, reviewing the work under way in these two societies.

It is already evident that there are a number of diverse subjects with which these committees will have to deal. Probably the underlying idea back of the entire movement is best expressed in a resolution adopted by the mechanical engineers' committee. The purport of this resolution is that the engineer has been in the past too closely limited to the purely technical side of his work, and that the scope of engineering societies should be widened to aid their members to prepare themselves for and undertake broader responsibilities. There has been in the past, however, and still exists in all the societies, a conservative opposition to papers and discussions which deal with economics and sociology or with matters of legislation or Governmental affairs.

This barrier is, of course, being rapidly broken down, as is witnessed by the prominence given to "human engineering," including the relations of labor and capital, in the papers at the mechanical engineers' meeting recently, and the papers which have been presented before the civil engineers on valuation and ratemaking. Such of these barriers as still remain in the constitutions or practice of the various societies are pretty certain to be swept away soon. Engineers have come to realize that a grasp of such matters is essential to the individual engineer if he is to render the larger service toward which his ambitions tend.

There is, in the second place, a very general demand in all branches of the profession, as evidenced at the recent meeting, that activities in these directions shall not be confined to mere presentation and discussion of papers, but that engineering organizations shall take an active part in public affairs, not merely in matters where the welfare of the profession is concerned, but in those where the engineer needs to guide and direct public opinion and public policy on questions of which the engineer is the most competent judge. To some extent the engineer *is* being recognized. A very considerable proportion of the men who had the chief responsibility in carrying out the great war program were engineers. With the reëstablishment of peace, however, the tendency is very strong in all matters under Government control to put the politician in places of chief responsibility and relegate engineers to purely technical work. One of the problems before the profession is to devise methods by which it can make its influence felt, so that engineers who have the necessary personal as well as technical qualifications will be selected for public positions where technical and executive ability are requisite for the efficient conduct of work.

A National Problem: How to Maintain Production

ONE of the after-the-war problems which appeals most directly to engineers, although it directly concerns everyone, is the problem of employment; employment for millions of soldiers mustered out of service, employment for the vast factories and machinery equipment which are turning out war material, and for the huge army of men and women who are working in them.

The war, with all its terrible total of deaths and suffering and destruction, has had some compensations. It has taught the world some new lessons in economics. It has demonstrated the wonderful possibilities of production by modern methods when all the energies of a nation are actively employed.

For more than four years a large part of the working forces in all the civilized nations has been diverted from the ordinary occupations and directed to the work of killing and destruction. No one would have believed, in advance of the actual demonstration, that it would have been possible to keep the world's population fed and clothed and housed—inadequately, it is true, but in some sort of fashion—and turn such a large percentage of the workers and the factories into the job of waging war and making war supplies.

Suppose now that the war is won and the problems of reconstruction face us we are able to find a way to maintain productive activity, not at its war-time rate indeed, with its necessarily heavy sacrifices, but at a rate that shall keep fully employed all the available labor and productive machinery. If we can do this, then that part of the loss and destruction of the war which admits of repair can be made good in a time that would have seemed incredibly brief to one who knew only the pre-war rate of production.

The war-time excess of demand over supply, which caused prices to mount by leaps and bounds, will not end because the war ends. The world has used up its surplus stock of food and fuel and clothing and machinery. But the price paid for the supplies to be used in making good the war's waste will be no longer of secondary importance. The burden of taxation will bear heavily on all productive industry for many years to come. If production is to be maintained, therefore, the work must be done economically and efficiently and at only a moderate margin of profit.

Continuous production at full capacity enables the manufacturer to run on a small margin of profit over direct labor and material cost. The workman who has a steady job the year round can prosper on a lower wage rate than the one who is employed on a part-time basis. Hence, if full speed in production can be kept up, the cost of the product can be reduced below what will be possible if we drop back to pre-war conditions.

Let us at all costs not lose sight of the foundation fact that the more goods there are produced the more there will be for all to share. Under the pre-war conditions it was supposed that the world was suffering from overproducton. We know now—unless the lessons of the war have been already forgotten—that it was not overproduction but underconsumption. At least nine-tenths of the population of civilized lands always wants more than it can buy. There may indeed be overproduction in individual industries; but to say that overproduction exists in all industries is equivalent to saying that men and women have all they desire, and that is contrary to human nature.

It ought to be plain enough now that the carefully reared structures by which in each industry before the war the capital and the labor were each strenuously endeavoring to see how big a price they could maintain for the product, were all contributing to the general injury of the whole. Had that limitation of production continued to hamper industry, the war would have been lost. If that artificial enhancement of prices and consequent limitation of production is reëstablished, we shall be no longer a united nation, economically speaking, but a conglomeration of industrial factions, each seeking to benefit itself at the expense of all its fellows.

It will take a long time to transform the work of munition production; and a longer time to fill the needs of the world impoverished by the four years' struggle. It is necessary to look beyond that time, however, to a time when sympathy with the cripple and interest in the returned soldier will not be at the high pitch it is today. It is, then, under the normal conditions of peace, that we must find a way to keep the wheels of industry running at full speed, so that the world as a whole may be made even richer in material things than it was before the war.

A Study of the Slip in the Calaveras Dam

Based On a Survey, Borings and Pile Drivings—Consideration of Materials Used for Steam-Shovel and Sluiced Fill—Reconstruction Plans

BY ALLEN HAZEN
Consulting Engineer, New York City

A DESCRIPTION of the slip in the Calaveras Dam, by Leonard Metcalf and the writer, appeared in *Engineering News-Record*, of Apr. 4, 1918, p. 679. This was written immediately after the slip and summarized the information then available in regard to it. Since that time an accurate survey of the slip has been made. Thirty test borings and 85 test piles have been driven, and the situation has been studied by the engineers of the Spring Valley Water Co. The following is presented as a supplementary statement.

MATERIALS USED IN CONSTRUCTION

The first material placed in the dam when construction was begun four years ago, extending to El. 630, was sluiced gravel from the floor of the valley above the dam. Over a large flat place in the upper central part of the dam this material was from 40 to 50 ft. thick.

The largest stones in the gravel were excluded by screens. Everything that could pass the pumps—that is, stones up to 4 to 6 in. in diameter—went into the dam. The finest part of the gravel was sand. The particles of this gravel and sand were all hard and permanent. Their specific gravity averaged about 2.70. The soil of the valley above the gravel was sluiced with it, but, generally speaking, there was no clay in it and no considerable amount of very fine particles. Without attempt to describe them with precision, it may be said there were but few particles less than 0.10 mm. in diameter. The few that were smaller came mainly from the soil.

This gravel all settled solidly to place in the dam, drained promptly and formed hard, solid embankment. It is now covered by the remaining parts of the dam, and it is possible only to reach it by borings. There are limitations to the information that can be obtained from boring samples and it has not been possible to examine the gravel in place as fully as the more accessible material. With exceptions, to be mentioned, there is no reason to think that any part of this gravel was moved during, or took part in, the slip.

The remaining higher parts of the dam were composed of steam-shovel fill and sluiced material from the adjacent hillsides. The steam-shovel fill was mainly a soft sandstone rock. It is hardly a true sandstone, for the particles of sand in it are not siliceous. On continued exposure it breaks up largely, forming a material that is almost as fine in grain size as clay. Its specific gravity varies from 2.0 to 2.6, averaging about 2.3.

As the solid particles composing the sandstone have an average specific gravity of about 2.65, it follows that there must be from 5 to 23% of voids in the sandstone as it comes from the quarry. A specific gravity of 2.3 indicates 13% of voids. These original voids remain in the unbroken pieces of rock in the dam. In addition, there are the voids between the pieces. The porosity and the lightness of the rock explain why the material cannot be compacted to as great a weight per cubic foot as some others.

The cementing material of the sandstone seems to be in part calcium carbonate and in part calcium sulphate. Of these, calcium sulphate is more soluble in water, and to this may be attributed the fact that the sandstone is very much stronger when it is dry than when it is wet.

... OF CONSTRUCTION OF THE CALAVERAS ... UNTIL THE

When first thrown out by blasting, large masses of the sandstone seem firm and hard, but upon exposure to the weather a great part of it disintegrates, some of it rapidly and some slowly, until the hardest rocks are reduced to piles of clay—either powder or mud, according to the season.

The Steam-Shovel Fill Not Rolled

The steam-shovel fill was dumped from cars and wagons into the dam. It was not rolled. As first dumped, it was comparatively loose. Where there was teaming over it, compaction took place at the top of each layer, but not so much elsewhere. The result of this incidental rolling is well shown in some of the remaining sections of the dam, where there is a harder layer 6 or 8 in. thick at intervals of 4 or 5 ft., representing the tops of the successive layers. Under heavy pressure, as the weight above the material was increased, it settled, and in the lower parts of the dam, where it is now exposed, a considerable degree of solidity has been attained.

The parts of the steam-shovel fill that have been under greatest pressure now weigh about 110 lb. per cubic foot, dry. With the moisture normally carried the weight is about 120 lb. per cubic foot. When so compacted the material has about 34% of voids; this includes the voids in the unbroken pieces of rock. Nearer the surface and under less weight the material is lighter and the percentage of voids is greater.

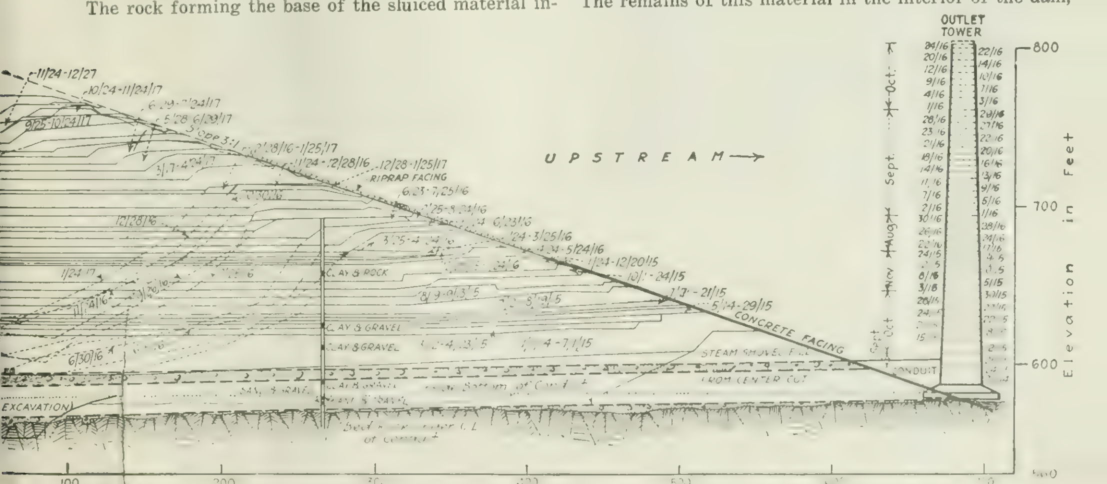
The sluiced material above El. 630 was obtained from the surrounding hills. In general, the soft material above the harder rocks was taken for sluicing; it contained both the surface soil and the disintegrated soft rock. Some of the rock in the neighborhood was serpentine, but serpentine was recognized as an undesirable material for dam building, and it was avoided in the sluicing operations. Small masses of it here and there were sluiced because it was inconvenient to exclude them, but, generally speaking, no serpentine or decomposed serpentine was placed in the dam. The little that went in played no part in the slip.

The rock forming the base of the sluiced material included the soft sandstone and shales. The shales differed from the sandstone principally in being softer. There were also other shales, darker in color and having no resemblance to the sandstone formation. There was also a certain amount of diatomaceous earth which occurred at one place north of the dam.

All of this material went through centrifugal pumps and through long lines of pipe at high velocities. The harder particles were worn by this treatment until they were almost spherical in shape. They looked like particles of creek gravel but could be easily distinguished from them because they were completely broken by a gentle tap of the hammer. These large particles were deposited in the toes of the dam, and the spaces between them were partially filled with clay. The material so produced was similar to the steam-shovel fill in weight and stability. The softer particles were pulverized, and the proportion of fine material resulting from the treatment was large.

Steam-Shovel Fill and Sluiced Material

In general, the amounts of steam-shovel fill and of sluiced material above El. 630 were about equal, but as some of the sluiced material was hard the proportion of soft clay was very much less than half of the volume of the dam. The method of placing generally followed was to put the steam-shovel fill on the tops of the two toes, upstream and downstream from the central pool. The sluiced material was placed between. The pool in which the sluiced material was deposited was often of considerable width. The steam-shovel fill and the hard parts of the sluiced fill were always encroaching upon this pool and narrowing it. As the dam grew higher the proportion of steam-shovel fill increased. The material deposited along the edges of the pool rested on the soft, sluiced material underneath. The steam-shovel fill was heavier per cubic foot than the soft, sluiced material, and to a large extent, when placed upon it, the former must have broken off and settled down through the softer and lighter mass and into the deeper and heavier and more solid portions of the sluiced material. The remains of this material in the interior of the dam,



OCCURRENCE OF THE SLIP IN MARCH, 1918, SHOWING METHOD OF FILL EMPLOYED

as disclosed by borings, give some idea of what happened. The whole lower part of the interior of the dam is made up of masses of steam-shovel fill lying between and partially separated by the sluiced clay into which it had fallen and by which it was surrounded.

Finest Sluiced Material Near Center of Dam

This sluiced material was naturally finest in grain size near the middle of the dam, but there was a considerable width through which no appreciable variation has been noticed. Outside of this there are more large particles, and the material is in general more pervious.

Chemical and physical analyses of samples of the sluiced clay have been made, and they give a fair idea of its composition. Corresponding data for the original rock and for creek gravel are given for comparison.

CHEMICAL COMPOSITION OF MATERIAL

	Clay Core Sluiced	Steam-shovel Fill Soft Sandstone	Creek Gravel
Silica, SiO_2	57.7	60.0	57.0
Alumina, Al_2O_3	17.9	9.7	12.5
Iron, Fe_2O_3	7.3	15.5	13.7
Lime, CaO	1.7	4.2	5.2
Magnesia, MgO	2.6	3.9	4.2
Specific gravity of solid particles	2.65	2.65	2.70

In general, about one-half, or little less than one-half, of the clay core is ferruginous clay, with particles very small in size, down to 0.002 mm. in diameter. The remainder of the material consists of larger particles, up to 0.02 mm., of minerals like the rocks in the neighborhood of the dam site. These consist mainly of silicates of iron, aluminum, etc. There are but little lime and magnesia in them. All of the core material is very small in grain size, ranging from 0.002 to 0.02 mm.

There is a striking scarcity of grains of middle size in the material that results from the application of the hydraulic process to the soft sandstone rock and to the soil above it. This scarcity amounts to an almost complete absence of particles through a wide range of sizes. The clay core is composed almost entirely of particles less than 0.02 mm. in diameter. The coarse part, consisting of rounded masses of rock hard enough to withstand the agitation of the sluicing operations, is mainly 10 mm. in diameter and over. No considerable quantity of particles of intermediate sizes, between 0.02 and 10 mm., can be found in any part of the sluiced material above the gravel. The gravel from the valley floor was mainly composed of particles within this range, and the range was completely filled out within the limit, so that there were no breaks in the series of grain sizes.

Of Possible Fundamental Importance

This difference may be of fundamental importance. The way in which a soft rock breaks up may determine whether or not a substantial sluiced dam can be made from it. Our present evidence is that soft rock that breaks at once to clay without producing sand and gravel is not desirable sluicing material. If this proves to be the fact, the objection to sluicing such soft rocks will not extend to other materials, and the conditions found in the Calaveras dam will have no bearing in considering the probable behavior of materials that have the full range of particle sizes.

The large mass of fine-grained material went slowly down into the water in the central pool in the dam. It soon reached a condition where the remaining voids almost prevented the further escape of water. Material composed mainly of particles less than 0.01 mm. in diameter does not settle rapidly in water, nor does it allow water to pass through it when it is settled. The excess of water in it, if it escaped, had to do so either by horizontal drainage through the toes or else by a process of exclusion from the settling of the solid matter while the water rose vertically upward through it.

The material was so fine in grain size that the horizontal movement of water through it became inappreciable. There were hundreds of feet of it, in horizontal extent, in the bottom of the dam, and no one knows how many years would have been required for the surplus water to have worked out by seepage. In the same way, the material was so fine-grained and the mass was so little heavier than water that the settling of the mass through its own excess of water was extremely slow. The sluiced material in the middle of the dam remained at the time of the slip with so large a percentage of voids that it could not be anything but an unstable semi-liquid.

Sluiced Material with 40 Per Cent. Voids Seems Stable

Tests have been made of the sluiced material that flowed from the dam and of that which remained in the dam. Generally speaking, it may be said that the upper part of the material that flowed contained about 65% of voids or of water by volume. The least compacted material remaining in position in the dam after the slip contained from 45% to 50% of voids. One cannot set precise limits, but so far as the evidence goes sluiced materials that contained 40% of voids, or less, were stable. Between 40% and 50%, the material is open to question. It was not sufficiently solid so that one could have confidence in it, but it was solid enough to have resisted flowing, in many cases. The material that flowed was that which contained 50% and upward of voids.

In comparison with this, the behavior of soft clay, as it dried out in the air, is interesting. In drying, a crust was formed over the top clay standing in pools after the slip. This increased rapidly in thickness and was soon cut by deep cracks. In the course of three or four months the level of the pool of clay remaining near the center of the dam had dropped almost two feet. The drop is believed to be due entirely to the compacting of the material, resulting from evaporation.

Samples of this air-dried material from the top have been cut out and examined. They contain on an average about 35% of voids. When dry there are 65% of solids in it, instead of the 35% in the original material. One cubic yard of clay, measured as it flowed, has been reduced in volume by evaporation to 0.54 cu.yd. If it could have been so compressed in the dam it would have made the hardest and strongest kind of embankment, only a little less resistant than the soft sandstone rock in its original position in the hills.

A section through the dam showing the order in which the materials were placed, giving an idea of the method of placing the steam-shovel fill, and showing the

progress of the work up to Mar. 24, is illustrated in Fig. 1. Fig. 2 is a map of the dam after the slip. The letters on it refer to the various parts of the dam.

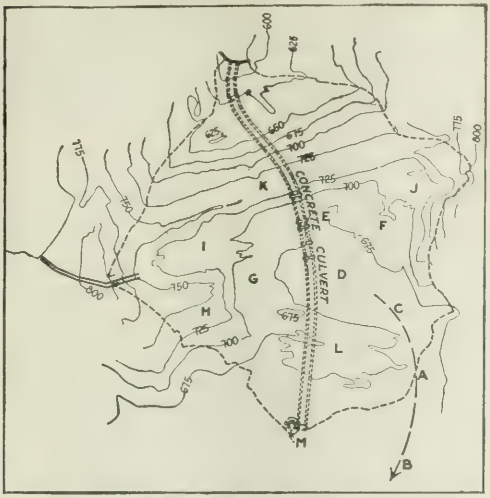


FIG. 2. TOPOGRAPHIC MAP OF CALAVERAS DAM IN APRIL, 1918, AFTER SLIP

Fig. 3 shows a developed section of the dam before and after the slip.

The upper toe of the steam-shovel fill had moved forward 300 ft. or more and had dropped in elevation perhaps 80 or 100 ft. on an average. It has also turned approximately 30° horizontally, in moving. It seems certain that there must have been under a large part of this upper toe some clay that acted as a lubricant, but, if so, it was broken up or dissipated or pushed out in the process of slipping, for the numerous borings through this part of the dam have given no indication of any considerable mass of clay. It may be pointed out, however, that a mass of clay sufficient, when wet and under pressure, to act as a lubricant would quickly become dried out and absorbed between masses of steam-shovel fill, and it would not be surprising if no trace of it could be found afterward in samples taken from borings. It has been found by boring that there is pervious gravel connected with the lake under the whole of this slipped mass. Water enters freely in the lower part of each well and stands thereafter exactly at lake level.

The sluiced clay, which was mainly in the central part of the dam, flowed out in great part through a narrow channel, following approximately the line C A B. This material came out as a cataract that was observed by those who saw the slip when the dam first opened. It must have scoured a path through the underlying sluiced gravel, to the bottom of the valley. The material flowed out rapidly, and until the level of that which remained in what we have since called the pool, at C and D, was only 5 ft. above lake level at the lowest and most fluid point. When the flow slowed up parts of the solid upper toe, L, broke off and fell across this outlet channel. This happened principally at two places, marked A and B. The material so broken off formed dams across the channel. There is a lower pool between A and B and an upper pool at C which is deeper than the lower one. The pool C contains only soft clay to the very bottom. In the upper part, of the pool, however, at D, the sluiced gravel remains at the bottom, and above it are masses of steam-shovel fill that have settled into and are surrounded by clay.

Of the total depth of 80 ft. of material now remaining at D, 55 ft. is made up of material so hard that a 2400-lb. hammer dropping 25 ft. caused only 0.3 ft. penetration of a pile. Only the upper 25 ft. are of softer material that is not stiff enough for use in reconstructing the dam.

One part of the upper toe, at H, remained in position. As the ground on which it stood was higher, the embankment there was not as high as elsewhere, and the lubricating clay layer may not have reached under it. After the main slip had taken place this remaining mass, at H, must have been larger than it now is, and there was also a corresponding but smaller portion of the dam at the eastern end. These must have been left with high vertical faces which were incapable of standing, and directly afterward masses of these broke off and moved longitudinally toward the center, at G and F.

At K the remaining downstream toe stands to a height of 160 ft. above the valley floor and 70 ft. above the interior of the dam. This also must have stood after the first slip to a height that was not stable, and the higher portions of it broke off and slipped into the center of the dam.

Along the line of the center of the old dam, at I, E and J, there remains the hardest part of the remaining sluiced-clay core. Through this are interspersed masses of steam-shovel fill, and over it are other masses of loose steam-shovel fill that broke off after the main slip and came down from the lower toe. This part of the dam has been penetrated by the greatest number of test wells. Each of these wells has its own water level, but that level is always higher than lake level, and 100 ft.

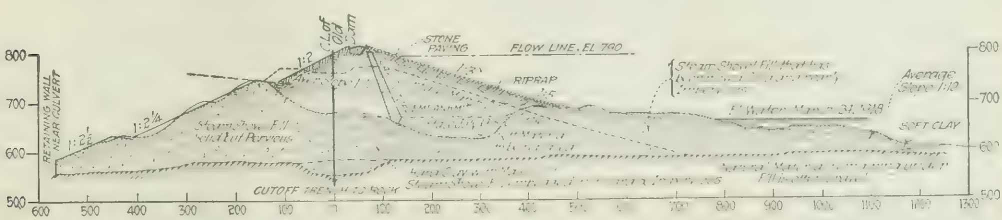


FIG. 3. DEVELOPED SECTION OF CALAVERAS DAM ALONG APPROXIMATE LINE OF CURVED THREAD OF VALLEY

Showing surface before and after the slip and the proposed outline for reconstruction

or more above the water below the dam. The fact that these water levels are retained even after months of exposure to evaporation under a hot sun, and with no rain, is the best and fully sufficient evidence of the substantial tightness of everything below. There is no need of taking a new cut-off trench deeper than is needed to pass the loose rock fill that has fallen down from the sides since the main slip occurred.

Coefficient of Friction of the Moving Material

An effort has been made to find the coefficient of friction of the moving material. Some of the conditions are known with definiteness, others with less certainty. Assumptions must be made, and the calculation at best will be open to some uncertainty. Nevertheless, it may be helpful, in discussing conditions of stability in reconstructing the dam, and may be of general interest.

On Mar. 24, before the slip, the pool in the center of the dam was 124.5 ft. above El. 630, which is taken as the top of the sluiced gravel and which is not brought into the calculation. The average weight of the sluiced material in this depth, as disclosed by tests of material that flowed and of material that remained, was about 100 lb. per cubic foot. The material was so fluid that it may be assumed that the whole of the weight is represented by horizontal pressure. The horizontal thrust per lineal foot computed from these data is 775,000 lb., or 387 tons.

In comparison with this, the solid material in the toe had a section of 32,000 sq.ft. and an average wet weight of about 120 lb. per cubic foot. The total weight per running foot is 3,840,000 lb. or 1920 tons. This weight is known with comparative definiteness from the sections and from the tests of material.

From these figures, the coefficient of friction for the whole mass at the start of the slip may be computed as 0.20. This may be taken quite definitely as the coefficient of friction of the whole lower toe as it existed Mar. 24.

Uncertainties as to Underlying Clay Layers

We now come to the uncertainties. How much of this upper toe was supported by clay layers that were under pressure due to the head of the material in the pool, and how far these clay layers lubricated, and perhaps encouraged, the movement of material over them, is not known and cannot be known. There is no doubt that such underlying clay layers played a part, and very likely an important part, in the movement, but it cannot be told how large it was and what coefficient of friction may be counted on for embankment that is not so lubricated.

It is interesting to note that a similar calculation made for the conditions of June 18, 1917, when the first slight movement of the upper toe was observed, and when the dam was considerably lower, indicates a coefficient of 0.175. This is not a coefficient of friction, because the pressure was not sufficient at that time to make the dam flow. But it does indicate a pressure that sufficed to produce a slight initial movement, sufficient to attract attention.

It is also to be noted that the front upper part of the dam, to the very bottom, moved forward in the slip. The concrete base at the bottom of the paving is found at the very front of the slipped material, 370 ft. from its original position, and is easily identified. This would seem to indicate that the sluiced gravel below El. 630 also slipped. On the other hand, the great solidity of the material farther up, which was able to resist the test piles, seems conclusive evidence that the slip did not extend to the lower layers where the piles were driven. If it had so extended, that space would now be occupied by the softer material that was in the heart of the dam.

As to the Progress of the Flow

The men who saw the dam go state that at first the whole mass seemed to move forward as a unit. Afterward it seemed to separate, and the parts that were farthest back stopped, while those that were further advanced continued to move forward. This method of movement is shown by the conditions of the remaining material. It is not evenly distributed, but is broken up into a series of ridges separated by valleys. Three main ranges of ridges are noted. Each of them is split into a number of secondary ones. The whole topography of the slipped dam reminds one of a miniature raised map of the surrounding mountains. If this upper toe had been moved over solid underlying material, it does not seem possible that this breaking up and progressive movement of parts of it would have taken place.

The observers' story and the topography of the remaining material suggest that the material was carried forward on a good lubricant, and that the lubricant first became used up or expelled near the center of the dam and left the higher parts of the dam on solid bottom while there was still lubricant to carry forward the lower and more advanced portions. Certainly, it would not be surprising if there had been a considerable dissipation and absorption of the sluiced clay during this process.

Looking at it afterward from the standpoint of the examination of the material by borings and otherwise, it is surprising to find what a large proportion of the whole mass of moved material is hard and solid and apparently entirely outside the range of materials that would flow. And it is also hard to find enough soft clay anywhere about this work to account for what happened.

It is also demonstrated, by a little work of reconstruction that has been done, that a mixture of soft sluiced clay and steam-shovel fill is quite as hard as, perhaps even harder than, the steam-shovel fill without the clay: In other words, in the Calaveras dam there were all the elements of a thoroughly sound construction. Only the method of combination was not such as to produce a stable result.

Outlet Tower Broke and Fell

The outlet tower broke and fell in two parts. It was built of concrete rings, each 4 ft. high, and was heavily reinforced. Thirteen of the joints between the rings opened. One broke entirely off, while 12 remain, with ⅛- to ¾-in. cracks. The two parts of the tower were moved forward, the lower one, 88 ft. long, about 370 ft., and the upper one about 445 ft. The lower one was apparently pushed by the solid material behind it and slid along on the ground ahead of the flowing earth.

The lower part of the tower shows well marked scratches, which were made no doubt by the passing rock on the lower 30 ft. of it while it still stood. Otherwise, the concrete of the tower is undamaged

The slip left about 3,000,000,000 gal. of water above the dam. The outlet conduit was left undamaged, but it was partly filled with mud and débris, and there was some seepage into it. The conduit was not a pleasant place to go into at first, and it was some time before the actual conditions were ascertained. But after the material in it had somewhat dried out, and the seepage did not increase, it was possible to explore the conduit to its upper end, and it was then found to be undamaged. Even the gates at its entrance were undisturbed.

The outlet tower had been built on an independent foundation at one side. The connection passage was 7 ft. square. Through this connection there had evidently been a flow of loose material, fluxed with water, for a few moments, until it became choked. It was this material which partially filled the conduit with débris.

To insure the remainder of the dam against destruction and to permit arrangements for reconstruction, it was necessary to get rid of the water above the dam, and to make provisions for passing the flows that must be expected during the reconstruction period. The end of the old culvert was covered by 60 ft. of débris, and the water line in the lake was slightly above this point. There might be rains that would raise the water level considerably before any work then started could be completed.

New Outlet Tunnel Built for Drainage

Three lines of protective work were decided upon, and have since been carried out. The first of these is an 8-ft. tunnel 1475 ft. long driven through rock outside the dam at a level to give complete drainage. This tunnel was broken through Oct. 4 and the reservoir began to drain through it on that date. Now that the water is out of the reservoir, the tunnel is being extended to a point selected for the intake. Gates have been set to control the flow and to permit 4,000,000,000 gal. to be stored during the coming season.

This tunnel is capable of carrying 1500 sec.-ft. The drainage area above the dam is 100 sq.mil., and is quite mountainous. Local data covering several years indicate a maximum flood of 10,000 sec.-ft., but it is recognized that a much larger flood is possible. The tunnel will not carry the largest flood flows as they come, but it will carry the largest average flow that is to be expected for any considerable number of days. It was not advisable to make the tunnel large enough to carry extreme floods. A certain amount of storage behind the dam can be utilized to help control them. But before doing this it was thought wise to strengthen the remaining parts of the dam.

The slip had left a depression at a point marked E, Fig. 2, where rising water in the reservoir might come against the loose steam-shovel fill of the lower toe and percolate through it in quantities sufficient to do damage. Accordingly, after borings had been made and an outline plan for reconstruction had been prepared, an embankment was started at this point as the second protective measure. This rolled-fill embankment has now been completed to El. 710. It will form a part of the permanent reconstruction. At this elevation 15,000,000,000 gal., or more than 8 in., of run-off from the tributary area may be held. In connection with this storage the 8-ft. outlet tunnel has sufficient capacity to handle any flood that may be anticipated, but the inlet to it will be far under water during a heavy flood and not accessible in case of accidental stoppage. The embankment as placed is believed to be almost water-tight, but in the reconstruction a new cut-off wall will be placed upstream from it.

As an additional precaution, and as the third protective measure, an open caisson has been sunk on the site of the old tower, connecting with the outlet tunnel at the bottom. This will furnish an outlet for an additional 1500 sec.-ft. with a point of entrance 60 ft. higher than the entrance to the tunnel.

Reconstruction of the Dam

I shall take this subject up very briefly at the present time. Professor W. H. Burr of New York City, and William Mulholland, of Los Angeles, have advised in a preliminary way in regard to it, and Professor Charles Derleth, Jr., of Berkeley, has made a detailed study of the materials and their stability.

The site for a reservoir is an excellent one. The materials of construction are sound, within their limitations. The dam as projected is none too large to develop the capacity of a magnificent catchment area. It can be and it must be rebuilt to the full intended height.

The elements of weakness in the old dam were mainly removed by the slip. Such parts of them as still remain in the softest parts of the sluiced material must be replaced by harder materials in the reconstruction. This does not mean necessarily that the soft material must be entirely removed, for when it is mixed with the soft sandstone, rock or other material it combines with it to form a mass well fitted for dam construction. It is only when it is by itself in two large masses and with an excess of water that it is dangerous.

The remaining lower toe of the dam is sound. The upper toe of the dam that slipped has come to a solid bearing in its new position. It will not ever slip again. It is not as highly compacted as it might be, and when further weight is put upon it some settlement is to be anticipated. But the bulk of the 1,400,000 cu.yd. of new material that will be required to finish the dam will come between those remaining parts of the old dam, and will not rest upon them, but upon the remaining material in the heart of the old structure. The materials remaining in the central part of the dam, ranging in depth generally from 60 to 100 ft., have been tested by borings, by driving piles into them, and by samples. They have also been tested by the embankment that has been placed since the slip, arranged to produce a heavy unbalanced load on the material underneath. In other words, the reconstruction so far carried out has been arranged to test the bearing capacity of the remaining materials that are to be utilized, and it appears possible and desirable to continue this policy throughout the whole reconstruction.

The rebuilt dam will have a larger section than the old one. The slopes will be flatter, especially near the bottom, where the great mass of slipped material will form part of the new dam. It would not be safe to count

upon this material on slopes as steep as might be used for material that was carefully selected and placed, but at the slopes which exist, averaging about 1 to 10, there is no possibility of its moving. A new cut-off will be established, not always in the center of the old dam, but at convenient points, usually upstream from it, where impervious material can be most easily reached. The reconstructed dam will be curved in plan, not because there is any merit in the curve, but because the curve permits better use to be made of the remaining materials.

The dam may be reconstructed of material placed dry with rolling. Materials are available for this, and there can be no question as to sufficiency of the process. As an alternative method, gravel like that used in the lower part of the dam may be used, with sluicing. If the whole dam had been constructed of this gravel there would have been no slip, but the best of the gravel is now at the bottom of the reservoir. It will be desirable, and it will be possible, to use the reservoir for storage of needed water to a limited extent, but this use will keep the best gravel covered by water. Handling it by dredges is a possibility, but it is not now apparent that it can be so handled at a material saving as compared with dry fill. It may be possible to use in reconstruction a deposit of schist on the east side of the valley. None of this material was used in the original construction, but it is near the dam and seems to have certain points of advantage over other local materials.

Sluicing soft materials that produce by their breaking down an excess of particles less than 0.01 mm. in diameter, and which may be classed as clay, will not be done again.

The valley of Calaveras Creek at the dam is very crooked. It is so crooked, in fact, that no section on a straight line gives an adequate idea of what happened in the slip. To show better what happened a developed section of the dam along an irregular line following approximately the thread of the valley is shown as Fig. 3. This section illustrates the dam as it was before the slip, the position of the material after the slip and the proposed section of the reconstructed dam. It is interesting to note that the slipped materials came to rest finally upon a general average slope that was only about 1 in 10, but nearly all of the material that slipped is entirely stable by itself on a slope of 1 on 2, and even on a slope that is considerably steeper than that.

Motor Trucks and Plank Roads Help to Get Out Airplane Spruce

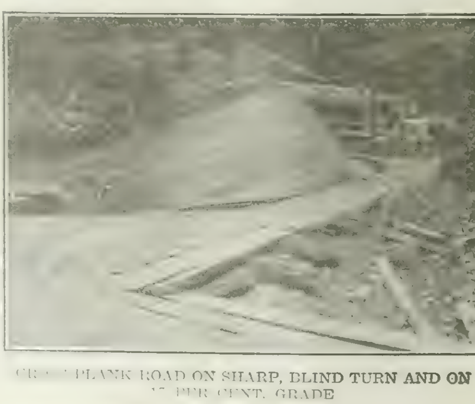
Heavily loaded motor trucks have been operated over unstable soils and through mountainous country, in bringing out airplane spruce from thinly scattered stands on the north Pacific coast. The seeming impossibility of this feat, under the natural conditions prevailing, was overcome by the construction of specially designed plank roads. High truck efficiency and low truck maintenance, despite the heavy grades and overloads, are reported.—Editor.

Plank Roads Help to Solve Spruce Production Problems

PLANK roads constructed at moderate cost made it feasible to get motor trucks into many of the thinly scattered stands of spruce along the north Pacific coast, and without the motor truck or some other form of mobile and quick transportation spruce from these forests could not have been brought out at the rate required by the Government's Spruce Production Division. Thus, plank roads suddenly became of greater importance, perhaps, than ever before, and various improvements in design and construction were developed. It is notable that, contrary to the usual practice on temporary roads, accurate location surveys with transit were made under the direction of an engineer. This has been particularly worth while, because of its effect in decreasing first cost and maintenance of the planked surface. A great decrease in tire wear on plank roads, as compared with gravel surfaces, is also reported.

Two types of construction are used on these roads. In one the planks are placed crosswise, while the other calls for longitudinal planking and is known as the "fore-and-aft" type. For the former type 8-ft. plank were used at first, supported on stringers placed under the lines that the wheel treads would follow. This did not allow much margin of safety, so 10-ft. planking was tried. On this wider roadbed, however, the drivers did not keep over the stringers, and this greatly increased the cost of maintaining the roads. To overcome this the standard width was again placed at 8 ft. for tangents and the "fore-and-aft" design was improved and used on all grades less than 4%. Where grades are steeper cross planking is considered necessary, to avoid slipping in wet weather.

For cross planking, the stringers are made of poles



CR[illegible] PLANK ROAD ON SHARP, BLIND TURN AND ON [illegible] PER CENT. GRADE

not less than 10 in. in diameter. They are laid in pairs and close together on each side of the road, so that there is no overhang of plank. The roadbed is graded so as to give the stringers a firm foundation. Where curves are sharper than 20 deg., the plank are cut 10 ft. long and two additional stringers are provided. For ordinary traffic 3-in. planking has been found to give good service, but, in the few cases where chains are used on grades, a 4-in. thickness is recommended because of the heavy wear. A road of this type around a sharp turn is shown in an illustration. Where the "fore-and-aft" construction is used, sleepers at least 12 in. wide and 6 in. thick are laid first. These are 10 and 12 ft. long and are placed on 4-ft. centers. Split cedar has been found to be about the best wood for this purpose. On these sleepers, two 4 x 12-in. planks are laid on each side for wheel treads, the outside width being 7½ ft. This has been found the best width for all vehicles from Fords to 5-ton trucks.

COMPLETED "FORE-AND-AFT" PLANK ROAD—NOTE THE GUARD RAILS AND THE METHOD OF BRACING THEM

What is considered a great improvement in the "fore-and-aft" construction was effected by putting guard rails in the center at the inner edges of the plank tracks, where they could be cross-braced. This is found to constitute a very safe type of construction, strong and stable, which does not require as many plank as the crosswise type. The guard rails must not extend more than 6 in. above the plank, so that they will clear the brake rims of the trucks. They are spiked to the sleepers with ½-in. boat spikes 12 in. long, and are braced with spreaders of such material as is at hand.

With the center guard rail design, the construction must change to cross-planking where turnouts are provided. The turnouts are put in every 500 ft. on tangents, and on all curves which do not admit of a clear view to the next turn. Turnouts for trucks with trailers must be 70 ft. long. They call for 38 planks, 18 ft. long, with a run-off of four 16-ft., four 14-ft., four 12-ft. and four 10-ft. planks at each end.

TABLE I. LABOR COST ON AN 8-FT. CROSS PLANK-ROAD

Item	Cost per Linear Foot of Road
Clearing 20 ft. wide and grubbing 14 ft. wide	$0 15
Grading	45
Laying four poles	.20
Laying plank	10
Total	$0 90

The labor cost for the cross-plank construction is given in Table I. To this must be added the cost of timber felled on the right-of-way, the timber used for stringers, the cost of plank delivered, and the cost of spikes delivered. Four 7-in. spikes were used per foot.

Table II shows the labor cost for constructing the two-track type. To this must be added the cost of timber felled on the right-of-way, the timber used for sleepers and guard rails, the cost of plank delivered, the cost of spikes delivered (two 7-in. spikes per foot), and the cost of boat spikes for the guard rails. Through swampy ground, poles are recommended for use under the sleepers. This gives an additional cost of 15c. per foot, plus the cost of stumpage, plus an extra 5c. per foot for labor on the sleepers. Table III gives the rates for labor and materials on this work.

TABLE II. LABOR COST ON "FORE-AND-AFT" PLANK ROAD

Item	Cost per Linear Foot of Road
Clearing 20 ft. wide and grubbing 14 ft. wide	$0 15
Grading	45
Laying sleepers	25
Laying plank	10
Laying guard rail	10
Total	$1 05

TABLE III. CURRENT PRICES FOR LABOR AND MATERIALS

Swampers	$0 45	per hour
Graders	45	per hour
Head faller	60	per hour
Second faller	55	per hour
Powder man	.60	per hour
Swamper foreman	72½	per hour
Grade foreman	87½	per hour
Plank foreman	60	per hour
Teamster	50	per hour
Teams	50 00	per month and board
Powder	16 95	per 100 lb.
Fuse	.79	per 100 ft.
Caps	3 25	per box
Spikes	4.95	per 100

The cost data were supplied by George W. Gauntlett,

SLEEPERS ARE LAID TO LINE AND GRADE AND ON FOUR-FOOT CENTERS READY FOR THE PLANK TRACKS

district superintendent for the Warren Spruce Co., at Raymond, Wash., to whom credit is due for pioneer work in the design and construction of plank roads of high quality.

Motor Trucks Haul Spruce Logs for Airplane Stock

TRANSPORTATION of logs for airplane stock by motor trucks in the forests of the Northwest has played an important part in the rapid development and success of the Government's Spruce Production Division.

Motor trucks have been used both in the construction work and in the actual delivery of spruce logs from regions where the spruce stand is light, and are reported to have proved very effective. They are expected to continue in the latter service as long as airplane stock is being produced, because it is believed that no other means of transportation would serve as well with the heavy loads and over the steep grades that are encountered.

Reports of truck operation in the various districts are best represented, perhaps, by the records of the 143rd Motor Truck Squadron, operating on the Olympic peninsula out of the town of Joyce, Wash. Road conditions there are entirely different from those under which the commercial vehicle ordinarily operates. The average haul is about 30 miles over a graveled country road, the greater part of which is on grades ranging from 3 to 10%. Motor trucks were put in service on June 25 last, and have frequently been operated 18 hours per day, the average being 14 hours. For the first three months they worked under dry weather conditions, but since then the rainfall has been almost continuous, so that the roads, being on poor foundation, have steadily deteriorated.

Owing to the frequent recurrence of emergency conditions, all the trucks were often loaded beyond capacity. The 5-ton trucks were carrying up to 6½ tons, the 2-ton models 3 tons, and the 5-ton with trailer sometimes as much as 15 tons. In the latter case the loads consisted of donkey engines and other machinery which had to be delivered with the greatest possible dispatch.

In the first four months of service the trucks averaged close to 5000 miles. At the end of this period no one of the trucks had received a general overhauling, and all of them were still hauling capacity tonnage or more. The reports show that the only renewals required were minor parts incidental to the general maintenance of the motors, such as carburetors, springs, spark plugs, fan-belts and bolts, or an occasional connecting-rod bearing.

The average gasoline consumption for the 5-ton truck was 3.1 miles per gallon; for 5-ton with trailer, 2.6 miles per gallon, and for the 2-ton model 5.6 miles per gallon. Using heavy oil, an average of 68.1 miles per gallon of lubricating oil was shown by the records of the 2-ton trucks; 51.6 miles for the 5-ton trucks, and 42.3 miles for the latter with trailer.

On the 2-ton model, using 36 x 6-in. solid tires, the average life of rear tires was about 2500 miles. At the end of four months of service it had not been necessary to replace any of the front tires. On the 5-ton truck with 40 x 6-in. dual solid tires the replace-

FIVE-TON TRUCKS WITH TRAILERS HAUL LARGE SPRUCE LOGS ON PLANK ROAD

ments have been confined to the inside treads. This is believed to be because the road has a crowned surface which throws the load chiefly on the inside tread. Most of the trucks have run their average of about 5000 miles without any spring breakage whatever. In the few cases where it has been necessary to replace springs broken in carrying heavy loads over the rough roads, the breakage is regarded as caused more by accident than by wear. The only tonnage records available are those for the month of October, covering the operation of 39 trucks. Of these 10 were 2-ton, 20 were 5-ton, and 9 were 5-ton with trailer. This was not a maximum month as it included 13 rainy days with consequent bad effect on the roads. For this month the mileage records were as follows:

Miles traveled	38,394
Miles loaded	20,214
Tons hauled	4,500
Gallons of gasoline consumed	11,7[illegible]2
Gallons of oil consumed	2,553

The costs in fuel oil, gasoline and tires are considered to reflect, primarily, the degree of attention given to keeping the trucks "tuned up" and the fact that only competent drivers were permitted to handle them.

In districts farther south than the Olympic peninsula, where plank roads have been very generally used, the tire wear has been less and, because of better roadbed, even heavier loads have been handled in emergencies. Such a road with several loaded trucks and trailers is shown in one of the views. On one road there is a 15% planked grade coming out of the woods and a 19% planked grade going into the woods. Tire chains are not used. On plank roads their wear on tires and plank is excessive, and the use of cross planks on grades, keeping them lightly covered with screenings, makes chains unnecessary, it is generally considered. In taking the heavier loads up grades of 15% or more, it has sometimes been necessary to use a helper truck attached by means of a chain to the truck carrying the load.

A feature of the work which should not be overlooked is the skill required in driving the loaded trucks down steep grades (up to 18%) having sharp turns. On one of these grades which was used temporarily there were blind curves of such radius that the loaded truck and trailer could just make the turn without backing. Under these conditions, it is apparent, the safety of truck and driver depend upon absolute control of the machine at all times. It is the custom to come to a stop just at the top of the hill and begin the descent very gradually. Considering the difficulties under which the work had to be done, the almost entire absence of serious accidents in the several districts is considered most remarkable, and is attributed largely to the skill of the drivers, all of whom are Government-trained men.

ON STEEP GRADES AUXILIARY TRUCKS ARE SOMETIMES NECESSARY

Various makes of motor trucks are used. Those referred to in the table, covering 39 machines on the Olympic peninsula, are all Government model standard trucks. On the planked-road district to which specific reference is made both standards and manufacturers' models are in use.

Supreme Court Fixes Responsibility of Contracts

Contractor Not Answerable for Consequences of Defects in Plans and Specifications—Spearin Case Decided

A DECISION of far-reaching importance to engineering contractors was rendered by the Supreme Court of the United States, in an opinion by Justice Brandeis, delivered Dec. 9, 1918. This decision sets at rest a question which has long been disputed, as to the extent of responsibility incurred by a public authority or other owner of work tendering plans and specifications on which a bidder based his proposal for doing the work. Some of the courts—and notably, the House of Lords, the highest legal tribunal of Great Britain—have held that an owner makes no warranty of plans and specifications tendered to a contractor in preparation for bidding, but that it is the duty of the bidder to decide for himself whether the plans are practicable. This conclusion was vigorously denied by the Supreme Court of Wisconsin in a decision which has been regarded in this country as laying down the sounder rule that the party who prepares plans and specifications impliedly warrants their sufficiency, and that the contractor cannot be held responsible for the failure of the work, if he complies with the owner's plans and specifications. The authority of the Wisconsin case has now received the approval of the Supreme

Court of the United States and may be regarded as definitely settling the question for the American courts.

Spearin, the claimant, was the contractor for a dry dock at the Brooklyn Navy Yard, to be built in accordance with plans and specifications which had been prepared by the Government. The site of the dry dock was intersected by a 6-ft. brick sewer, and it was necessary to divert and relocate a section thereof before the work of constructing the dry dock could begin. The plans and specifications provided that the contractor should do the work, and prescribed the dimensions, material and location of the section to be substituted. All the prescribed requirements were fully complied with by Spearin, and the substituted section was accepted by the Government as satisfactory. It was located about 37 to 50 ft. from the proposed excavation for the dry dock, but a large part of the new section was within the area set aside as space within which the contractor's operations were to be carried on. Both before and after the diversion of the 6-ft. sewer, it connected (within the Navy Yard, but outside the space reserved for work on the dry dock) with a 7-ft. sewer which emptied into Wallabout Basin.

About a year after this relocation of the 6-ft. sewer there occurred a sudden and heavy downpour of rain coincident with a high tide. This forced the water up the sewer for a considerable distance, to a depth of 2 ft. or more. Internal pressure broke the 6-ft. sewer as so relocated, at several places, and the excavation for the dry dock was flooded. Upon investigation it was discovered that there was a dam from 5 to 5½ ft. high in the 7-ft. sewer; and that dam, by diverting to the 6-ft. sewer the greater part of the water, had caused the internal pressure which broke it.

Both sewers were a part of the city sewerage system, but the dam was not shown either on the city's plan nor on the Government's plans and blueprints, which were submitted to Spearin. On them the 7-ft. sewer appeared as unobstructed. The Government officials concerned with the letting of the contract and construction of the dry dock did not know of the existence of the dam. The site selected for the dry dock was low ground, and, during some years prior to the making of the contract, the sewers had from time to time overflowed, to the knowledge of these Government officials and others. But the fact had not been communicated to Spearin by anyone. He had, before entering into the contract, made a superficial examination of the premises and sought from the civil engineer's office at the Navy Yard information concerning the conditions and probable cost of the work; but he had made no special examination of the sewers nor special inquiry into the possibility of the work being flooded thereby; and had no information on the subject.

Contractor Refuses to Resume Operations

Promptly after the breaking of the sewer, Spearin notified the Government that he considered the sewers under existing plans a menace to the work, and that he would not resume operations unless the Government either made good or assumed responsibility for the damage that had already occurred, and either made such changes in the sewer system as would remove the danger or assumed responsibility for the damage which might thereafter be occasioned by the insufficient capacity and the location and design of the existing sewers. The estimated cost of restoring the sewer was $3875. But it was unsafe to both Spearin and the Government's property to proceed with the work with the 6-ft. sewer in the condition in which it was then.

The Government insisted that the responsibility for remedying existing conditions rested with the contractor. After 15 months spent in investigation and fruitless correspondence, the Secretary of the Navy annulled the contract and took possession of the plant and materials on the site. Later the dry dock, under radically changed and enlarged plans, was completed by other contractors, the Government having first discontinued the use of the 6-ft. intersecting sewer, and then reconstructing it by modifying the size, shape and material so as to remove all danger of its breaking from internal pressure.

Supreme Court Affirms Judgment

The Court of Claims gave judgment in favor of the contractor, holding the annulment to have been wrongful, and adjudged to the contractor his reasonable expenditures in the performance of the contract up to the time of the breach, plus $60,000, the profits which he would have made if the Government had complied with its obligation and the contractor had completed performance. The Supreme Court affirmed that judgment. Its more important rulings are contained in the following extracts from the opinion:

"If the contractor is bound to build according to plans and specifications prepared by the owner, the contractor will not be responsible for the consequences of defects in the plans and specifications."

"This responsibility of the owner is not overcome by the usual clauses requiring builders to visit the site, to check the plans, and to inform themselves of the requirements of the work."

Reference is made to several previous decisions of the Supreme Court, where it was held "that the contractor should be relieved, if he was misled by erroneous statements in the specifications," and it was stated that "Spearin was under no obligation to repair the sewer and proceed with the work while the Government denied responsibility for providing and refused to provide sewer conditions safe for the work."

Schools at Dam Construction Camps

Camp schools at four of the dam-construction camps of the Miami flood-protection works have begun the year with 109 pupils. At Taylorville and Germantown camps schoolhouses have been built, at Englewood an old residence has been converted into a school, and at Huffman an existing schoolhouse has been taken over. Besides the regular school studies, there will be vocational training in carpentry, blacksmithing and simple domestic science. To serve the employees, night school is held two nights a week. The night-school studies include advanced mathematics, industrial arithmetic, penmanship, English for foreigners, mechanical drawing and first-aid work. The schoolhouses are also utilized as community halls and for church services. A special effort is being made to instruct foreigners in the ideals of American life. Instruction is free.

Structural Shop Diverted Largely to Ship Fabrication

Ferguson Company at Buffalo Fabricates Steel for Tugs and Barges with Minor Changes In Its Old Shop

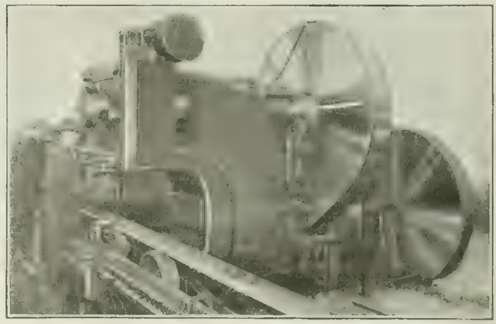
STEEL tugs of extreme complication of line and structure, and steel barges of the simplest straight-line type, are being built at the new shipyard of the Ferguson Steel and Iron Co., at Buffalo, N. Y. Both types of vessel are being fabricated at the structural shop of the company, where only a small amount of additional equipment has been installed and where the new ship-fabrication work now constitutes most of the production of the shop. The adaptability of the ordinary structural shop to ship work is thus being tested here with extreme types of ship framing.

The Ferguson Steel and Iron Co., started in 1913 as a steel warehousing proposition, grew very rapidly, until in the summer of 1917 it completed a new and exceptionally well laid out structural shop, which, in combination with an integrally connected warehouse, was capable of turning out 2500 tons of structural material and 2000 tons of warehouse material each month. A description of the new plant appeared in *Engineering News-Record* of Aug. 23, 1917, p. 362.

In the spring of this year the company decided to go into the shipbuilding business, and, following the obtaining of contracts for Navy tugs and New York Barge Canal barges, started to build the new shipyard described in *Engineering News-Record* of Nov. 7. This yard is planned to be self-contained in the future; in it ships will be fabricated as well as erected. Up to the present the fabricating shop has not been built, and all of this work is being done at the main plant of the company, two miles away, material being transported mainly by rail, but occasionally, when more speed is required, by motor truck.

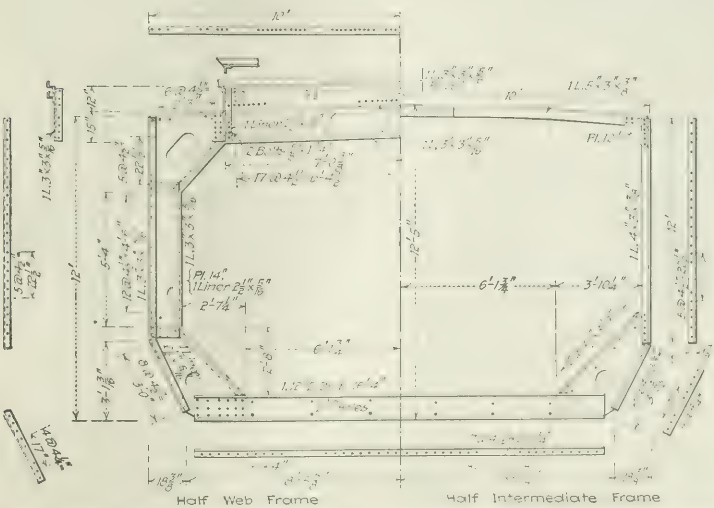
The contracts now held by the company comprise one for six Navy tugs and one for the fabrication of 24 canal barges, 16 of which are to be assembled in the company's shipyard and eight to be shipped to outside yards for which the fabricating is being done.

The tugs are 150 ft. long and have 1000 tons deadweight carrying capacity. They are for ocean use and are heavily built and engined, as befits such use. The boats were designed by the Navy Department after accepted models of this type of craft, and have no concessions whatever to structural-shop fabrication. Nearly every plate is curved, and the frames are not only curved, but are of bent shapes requiring special forging work. The barges are of 150-ft. length, 20-ft. beam and 12-ft. depth, containing about 140 tons of steel. They are of the simplest shape and construction, as the accompanying cross-sections indicate. Ordinary structural shapes in straight lines are used for the whole vessel, except for a slight curving of the bilge and of the bottom members at the bow and stern, which are of duplicate design.



THIS MAN PUNCHED 18,624 RIVET HOLES IN SHIP ANGLES IN A 10-HOUR DAY

The only building addition to the structural shop is a mold loft which has been erected alongside the shop itself. This loft is one of the Ferguson company's standardized factory building types, one story high and 200 x 50 ft. in plan. In it at present are being laid out the frames and plates for the tugs. The barge being of such simple lines as not to require any mold-loft work, instead there has been built a wooden model, shown in one of the views, reproducing in full size one-half the width of the duplicate bow (or stern) of the barge, and a length extending to the first straight strake beyond the curved end. From this full-size model the rivet holes and plate dimensions were laid out. This model was erected not in the mold loft but in the templet shop, which is part of the main structural



NEW YORK CANAL STEEL BARGE HAS LINES ADAPTED FOR STRUCTURAL SHOP FABRICATION

MODEL OF HALF OF CURVED END OF BARGE WAS USED FOR MAKING TEMPLETS

shop. For the straight part of the barge no laying-out work was required.

The shop had not been hitherto provided with any furnace equipment. There was added, therefore, as an integral part of the warehouse end of the combined shop and warehouse building a lean-to containing two new furnaces, one a plate furnace 21½ ft. by 10 ft. and another a shape furnace 40 x 6 ft. These furnaces open into the warehouse connection to the structural shop onto bending slabs in a space which before has been used for storage of cut-to-length material en route from the warehouse to the shop. The slabs are immediately alongside the first of the old angle punches with which the shop was equipped. A great amount of the angle forging for the tugs is being done in the already established blacksmith shop. The extreme complication of the tug framing makes this work slow and expensive.

For the present all punching is being done on the existing beam and angle punches, but multiple plate punches are to be installed as soon as possible. Punches will be also installed in a portion of the assembling space, which is not utilized because little assembling is done on the ship work. Very rapid work has been done on rack punches in the barge fabrication. For instance, one man with a helper, shown in one of the views at the machine, after a speeding-up effort of two to three days, punched in one 10-hour day 18,624 holes, which, it is said, is a record for this type of work. The punching was done on angles and was single-line work, generally about 4-in. spacing.

A final addition is the plate bender, which has been placed in the center of the shop just beyond the punches and leading to the riveting table, where the frames and bulkheads are assembled. A rotary scarfing machine has been added for scarfing plates.

No assembling of the tug frames is done at these shops, but the barges are assembled there by frames and bulkheads. A cross-section of the barge, showing a web frame and an intermediate frame, is given in the accompanying drawing. The bulkhead sections, of which there are four to each barge, are framed in the shop complete. The web and intermediate frames are fabricated in the shop in four pieces, as shown in the drawing—one bottom, one top and the two sides—and in erection require only 22 field rivets.

An innovation in the Ferguson plant is the detail shop. This section of the building was originally designed for a job shop, but since shipbuilding work has started it has been turned into a special detail section. Here all of the detailing for the ships, and incidentally for any other structural work the shop may be doing, is concentrated. Brackets, hangers, etc., are turned out as quantity work by a gang which is engaged only in this kind of construction.

Fabricated material is shipped to the shipyard, as a rule, on freight cars which are brought directly to the end of the shop and which also enter the shipyard. Although the two plants are only two miles apart, they are on different railroads and the cars have to go through an interchange yard, so that it generally takes about two days to get material across. In the earlier work in the yard the speeding up of ship erection was so great as to keep the shop up to capacity, and at such times transportation of material was made with motor trucks. This is, however, very much more expensive than the rail transportation and is resorted to only in cases of emergency.

The regular drafting-room force of the company detailed both tugs and barges. It is an interesting commentary on the types of ships that the shop pound-for-pound cost of the tug fabrication amounted to about three times the cost of the barge details. The Ferguson company spent $4000 in detailing the barges, of which they had at that time 24 under contract. Other companies having this same barge to build had to spend a similar sum in their drafting-room operations, although the finished shop drawings of the various companies were almost identical.

The Ferguson Steel & Iron Co. was founded by James E. Ferguson, who is president of the company and who has recently given up his commission as captain in the Signal Corps, U. S. A., in order to devote all his attention to the very necessary ship work which he has under way. The shop additions and operations are in charge of Thomas Leach, chief engineer of the company.

Dayton Plans Public Improvements

A special public vote is proposed at Dayton, Ohio, on a program of street, sewer and other improvements involving about $2,000,000. The only money otherwise in sight for such work for 1919 is about $300,000 for streets and sewers and $60,000 for water-works extensions and improvements.

The Influenza-Pneumonia Pandemic in United States Army Camps

Over 1 in 5 Had Influenza and 1 in 30 Had Pneumonia—Combined Death Rate Exceeded 14 per 1000

By Major George A. Soper

Sanitary Corps, United States Army, Office of the Surgeon General of the Army

THE influenza-pneumonia pandemic swept through the Army camps in the United States with great rapidity and intensity. Within about two months it had come and gone, so far as its violent manifestations were concerned.

To Nov. 21, 1918, the total number of cases of influenza reported from all troops in the United States has been 321,938; pneumonia, 52,777; deaths, 21,177. The strength has been about 1,500,000 men.

Although the outbreak is generally supposed to have begun in Spain, it is doubtful if it really started there. It might have begun in the United States. Certainly, a distinct wave of influenza passed over this country last spring. An epidemic of about 4000 cases, in a strength of about 28,000, was reported by the present writer from the Oglethorpe group of camps in March, 1918. In the latter part of March the disease appeared in the American Expeditionary Force, in the French and British armies and in the civil populations of Europe. The first cases in Germany were among troops which fought with an American regiment in July. The disease in this first wave was relatively mild.

During the summer, cases of influenza accompanied by peculiarly fatal pneumonia were brought to various ports along the Atlantic coast of the United States. It does not appear that this severe type of infection existed in the ports from which the vessels came. Some persons are of the opinion that the virulence was increased on shipboard. From the ships the disease spread to the land.

In September Camp Devens, Ayer, Mass., became affected from an epidemic in the neighboring civil population. Other camps almost simultaneously reported epidemics. The order of attack, showing the rapidity with which the disease swept through the principal camps of the country, is given in Table I.

Preventive measures were employed at all the camps, first to exclude the disease and later to limit it. It has not appeared as yet that any of these measures have been particularly successful. The prevention of respiratory infections, in and out of this pandemic, has been the least understood sanitary problem presented by the war.

The underlying principle upon which most of the suppressive measures have been based is isolation. The intention has been to prevent the formation of the link which binds one case with another. This has been attempted by separating the men as much as could be by space, masks and cubicles. A feature of the anti-epidemic work was an educational campaign designed to teach the men how they could help.

The data herein are based on daily telegraphic reports sent to the Surgeon General of the Army at Washington, and are the most accurate available at this writing. From the beginning a large amount of data has been collected and, as rapidly as received, tabulated, thrown into graphic form and assimilated. Important facts have been revealed. Tables II and III are presented by permission of the Surgeon General.

TABLE I. ORDER IN WHICH THE CAMPS WERE ATTACKED

Order		Date	Order		Date
1	Devens	Sept 12	11	Greene	Sept. 26
2	Upton	Sept 13	11	McClellan	Sept. 26
3	Lee	Sept 17	12	Kearny	Sept. 27
4	Dix	Sept 18	12	Bowie	Sept. 27
4	Jackson	Sept 18	13	Johnston	Sept. 28
5	Hoboken	Sept 19	13	Sheridan	Sept. 28
5	Syracuse	Sept 19	14	Sherman	Sept. 28
5	Gordon	Sept 19	14	Dodge	Sept 29
5	A. A. Humphreys	Sept 19	14	Shelby	Sept. 29
6	Logan	Sept 20	15	Custer	Sept 30
6	Funston	Sept 20	16	Hancock	Sept 30
6	Meade	Sept 20	16	Travis	Oct 1
7	Grant	Sept 22	17	Cody	Oct. 3
7	Zachary Taylor	Sept. 22	18	Forrest	Oct 6
8	Sevier	Sept 23	19	MacArthur	Oct 7
8	Lewis	Sept 23	20	Fremont	Oct 8
8	Newport News	Sept 23	21	Wadsworth	Oct 11
9	Pike	Sept 24	21	Wheeler	Oct. 11
10	Beauregard	Sept 25	21	Greenleaf	Oct 11
10	Eustis	Sept 25	22	Las Casas	Oct. 29

TABLE II. CASES AND DEATHS AMONG TWENTY CAMPS ARRANGED ACCORDING TO THE CHRONOLOGICAL ORDER OF THEIR ATTACK

	Total Cases Infl.	Total Cases Pneu.	Total Deaths Pneu.	Per Cent. Attacked Infl.	Per Cent. Pneu. to Infl.	Per Cent. Deaths Pneu.
Five camps attacked Sept. 12-18[1]	46,569	7,968	3,000	21.4	17.1	37.6
Five camps attacked Sept. 22-24[2]	44,000	8,011	2,867	21.4	18.2	35.7
Five camps attacked Sept. 29-Oct. 1[3]	36,044	7,387	2,484	23.8	21.8	31.7
Five camps attacked Oct. 3-11[4]	20,096	1,837	579	28.9	8.9	31.5

[1] Devens, Upton, Lee, Dix, Jackson.
[2] Grant, Zachary Taylor, Sevier, Pike, Newport News.
[3] Sherman, Dodge, Shelby, Custer, Travis.
[4] Cody, Forrest, MacArthur, Wadsworth, Greenleaf.

TABLE III. INFLUENZA, PNEUMONIA AND DEATHS IN THE LARGE CAMPS FOR PERIOD SEPT. 12 TO OCT. 31, 1918, INCLUSIVE

	— Cases —		Total	Per Cent. Attacked	Per Cent. Pneu. to	Per Cent. Deaths	Duration Epidemic,
GROUP I	Infl.	Pneu.	Deaths	Infl.	Infl.	Pneu.	in Days
Cody	2,337	252	46	49.8	10.8	18.2	26
Beauregard	5,252	1,007	422	39.6	19.2	41.9	36
Wadsworth	5,505	357	60	38.6	6.5	16.9	20
Bowie	4,052	119	104	38.1	2.9	89.8	32
Hoboken	13,563	2,280	794	30.5	16.9	34.9	42
Devens	13,398	2,288	794	30.1	17.1	34.9	49
GROUP II							
Dodge	9,398	1,847	570	29.0	19.7	30.8	32
Custer	11,626	2,437	669	29.0	20.9	27.8	31
MacArthur	6,010	852	188	28.1	14.1	20.4	24
Meade	11,449	2,013	796	27.8	25.3	27.4	41
Pike	13,273	1,379	455	26.7	10.3	32.7	37
Grant	10,717	2,335	1,068	25.8	21.8	45.7	39
Greene	4,200	626	258	25.8	14.9	41.8	30
Funston	13,526	2,328	888	24.9	17.2	37.4	41
Forrest	2,307	33	22	24.9	1.1	66.6	23
Travis	8,470	1,742	168	24.7	20.5	9.0	30
Logan	3,137	393	16	24.6	12.4	3.8	41
Lee	11,298	1,919	672	22.9	17.0	34.6	43
Hancock	7,715	1,209	462	22.2	15.8	37.4	31
Sheridan	4,758	521	132	20.4	10.3	24.6	28
Greenleaf	4,747	343	263	20.3	7.2	75.2	20
GROUP III							
Zachary Taylor	11,587	2,800	830	19.2	24.2	29.0	39
Dix	9,283	1,673	829	19.0	17.9	49.8	44
Jackson	7,500	1,114	362	18.9	14.9	31.3	43
Shelby	1,761	94	19	18.8	5.3	24.8	28
Syracuse	2,031	401	164	18.4	19.8	40.6	42
Sevier	4,526	896	319	16.3	19.7	35.7	38
McClellan	4,718	993	218	16.1	20.2	21.3	28
Eustis	1,745	67	10	14.8	4.0	16.2	36
Newport News	3,897	601	195	14.2	15.5	30.5	54
Upton	5,090	974	543	13.9	19.2	34.9	48
Sherman	4,789	1,717	1,058	13.5	35.7	61.3	32
Kearny	2,450	186	37	13.5	7.9	19.8	54
Gordon	4,155	626	192	11.3	14.8	30.4	42
Johnston	2,117	383	161	11.1	18.2	40.9	30
GROUP IV							
Fremont	2,347	392	132	9.8	16.1	31.2	23
Lewis	3,141	994	148	9.7	31.6	14.8	33
Wheeler	70	361	61	.8	516.0	17.8	

Stress Measurements on Niagara Gorge Railway Bridges

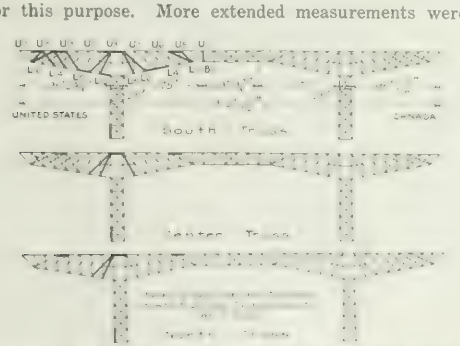
Permissible Loading Studied by Strain-Gage—Dead-Load Condition of Arch Determined by Forcing Crown Apart and Measuring Release of Stress

By Charles Evan Fowler
Consulting Engineer, New York

Keeping in service the great bridges of the country, vital links in the transportation system carrying troops, supplies and munitions, has called for unusually careful engineering study during the past two years, because of the imperative demands for economy in the use of steel. In the study of two of these bridges, the arch bridge and the cantilever which carry the Grand Trunk and the Michigan Central Railroads over the Niagara Gorge, the analysis by calculation was supplemented by extensive strain-gage measurements of the stresses in the members under actual train loadings, both static and moving. Repairs are being made, on the showing of the stress measurements, to keep the two bridges in the best condition for carrying the enormous traffic passing from the West through southern Canada.

The Niagara cantilever, one of the first large cantilever bridges, is a double-intersection structure with eyebar tension members. It was originally built with two trusses, but a center truss was added. The Grand Trunk arch is a double-deck structure, carrying a highway under the double-truck railway deck. It is of the two-hinged type; the end hinges are formed by circular rocker seats. In the erection of the arch the closure at the center was made by inserting a shim in the top chord after forcing the two halves of the structure apart by a toggle.

To show how the loads on the bridge distribute between the three trusses, measurements on certain selected members of all three trusses were necessary. As shown by the diagram, three top chord members and two web members in the east anchor arm were used for this purpose. More extended measurements were



ALL THREE TRUSSES OF THE CANTILEVER BRIDGE WERE INCLUDED IN THE STRESS MEASUREMENTS
(Heavy lines indicate members tested)

made on the south truss, as indicated. These latter include all critical members and such as would show the distribution of stresses between the two systems of the webbing and between the bars in a panel; some panels have as many as 14 separate eye-bars.

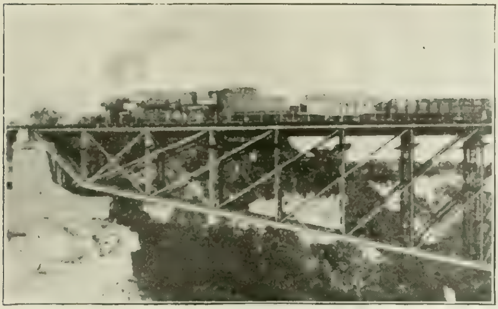
Wrought iron of very good quality was used in the original structure, except that the tower posts, the bottom chords, center and ends of posts were of high steel. In the new center truss the bottom chords and tower columns are of high steel, while the other members are

GRAND TRUNK ARCH BRIDGE

of medium steel. The best available data indicated that the moduli of elasticity of the material are: For the eye-bars and the compression members of the top chord of the old trusses, 25,500,000, and for other compression members 30,000,000; for all members of the center truss, except the tower columns, 29,000,000, and for the tower columns 30,000,000 lb. per square inch. These values were used in reducing to unit stresses the observed deformations of the members under load.

Gage points on the members were so located as to avoid so far as possible the regions containing unevenly distributed stress, as in the end details of the members, and also to make the position of the observer as easy as possible in order to assure most accurate reading of the gages. Spots of about 1½ in. in diameter were cleaned off at each gage point; holes for the points were drilled about 0.1 in. deep with a No. 56 drill, the burr was removed with a flat-angle countersink, and the hole was finished by rubbing with a punch. One hole of each pair was finished before the position of the other was marked. A gage bar with two center punches fixed in the ends was used for marking the location of the second hole of each pair. Vaseline was used to protect the holes from rusting between measurements.

Three Berry strain gages reading to 0.0002 in. were chosen for the live-load stress measurements. Two of these, of 20-in. gage length, were used for the greater part of the work, while an 8-in. instrument was used for the floor-beams and for the short diagonal equalizing links. Calibration by standard micrometer screws showed them to read high by 3 to 4 per cent., but the errors were practically constant and well within allow-



THREE OF THE TEST LOADS ON THE NIAGARA CANTILEVER FOR MEASUREMENT OF STRESS DISTRIBUTION

able limits, so that no corrections were made in the results. Two standard bars were made from pieces of ¾-in. gas pipe long enough so that caps screwed on the ends would not interfere with gage points 20 in. apart. An 8-in. length was also marked off on each bar. The caps, after being tightened down, were ground off on one side flush with the pipe, to form a plane surface on which the bar could rest. In each pipe a thermometer was placed at mid-length, and a slot was cut in the pipe over it to allow reading. The observations consisted in each series of (1) a reading of the gage on the standard bar; (2) a group of readings on the bridge members, and (3) a check reading on the standard bar. The thermometer in the standard bar was read for each gage record on the bar. Fourteen special Fahrenheit thermometers, calibrated against a standard, were fastened in close contact with the members of the bridge where measurements were to be taken; their bulb ends were bedded in putty to protect them from the air. It was not considered necessary to have a thermometer on each individual bar when it was measured, but temperatures were estimated from thermometer readings taken at the same time on bars similarly located.

All the thermometers were at all times kept in the shade. As much as 20° difference in temperature existed between different bars of the same members, due to the sun shining on part of them. In making corrections for temperature the coefficient of expansion of the metal was taken as 0.0000065.

Arrangements were made for the use of trains of known weight and wheel spacing. These were placed on the bridge, standing in one position long enough to allow careful readings to be taken on the members. By means of influence diagrams, these loads could be placed in position for maximum stress. Regular trains frequently stopped on the bridge for several minutes, and advantage was taken of this to obtain information on the behavior of the bridge under trains, though, as a rule, it was not practicable to obtain the weight or even the train numbers. More than 1500 readings were taken on the cantilever. Close agreement of calculated stresses and strain-gage stresses characterized the work. However, paradoxically, the distribution of stresses among the several members (of an eye-bar panel, for example) was found to be better under the heavier loadings than under the lighter ones, although, as was to be expected, the secondary stresses were higher under the heavier loading. Many more readings were made on the arch than on the cantilever, on account of the necessity of determining the secondary stresses due to the connections being riveted throughout. Some hundreds of readings were taken under moving trains, at speeds of 5 to 25 miles per hour, in 50 or 60 individual runs. In contrast, few readings under moving trains were taken on the cantilever; the speed there is low and the impact very small.

The highest impact observed in the arch truss members was about 50%. The percentages agreed closely with those given by the A. R. E. A. formula.

Other important matters were studied in the arch bridge by means of the strain gage. One of these was the movement of the segmental bearings which form the hinge joint at the end of the arch span. Another was the measurement of stresses in the swaybracing rods, and the subsequent adjustment of these rods. Most important of all, perhaps, was the determination of the actual distribution of dead-load stress by measuring the compression in the center member of the top chord.

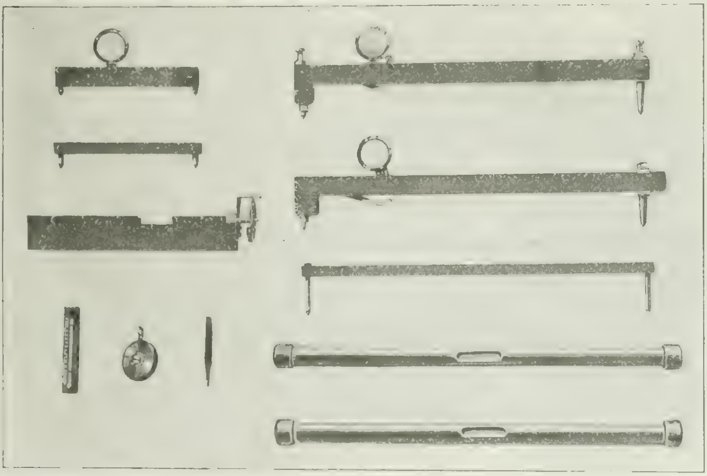
Locomotives weighing about 180 tons each and trains of loaded coal cars weighing from 3800 to 4500 lb. per linear foot were used for the tests. The heaviest loading consisted of two double-headed trains with 14 cars, a frequently possible loading.

Summarizing the work on the arch in a general way, it can be said that the results were very satisfactory. Full study of the readings (now in progress) is likely to show that the arch, after 21 years of service, is in

much better conaition than any other bridge of its general character. At it was designed with very low unit stresses for loading less than E40, there will have to be a comparatively small amount of reinforcing to bring the bridge up to E60 loading.

Calculations of stresses will be carried out for every condition of static and dynamic loading, with such allowance for secondary and impact stresses as the strain-gage measurements indicate to be reasonable. When all service stresses, then, are absolutely determined, comparatively high units will be allowed in the members for combinations of coexisting stresses.

Reduction of the readings shows a much closer agreement with calculated figures than other stress measurements of bridges in service have shown. Probably, in part this may be considered aue to the care taken in the observations, the correction for temperature, and the multiplication of readings. The instruments used were found to be perfectly satisfactory for practical use, and, in the writer's opinion, much better adapted to work of this character than those of a type which cannot be used for moving loads or which are difficult to employ under vibration of the structure.



INSTRUMENTS USED FOR STRESS MEASUREMENTS ON NIAGARA GORGE BRIDGES

Practical use was made of the strain gage in an unusual way, in the matter of the movement of the segmental rollers which form the hinge bearings of the arch span. The eye was unable to detect any movement. Points were, therefore, set, one on the top and one on the bottom casting of the bearing, for the 20-in. gage. Readings with this gage showed movements under trains of from 1/250 to 1/100 of an inch. Readings taken at varying temperatures led to the conclusion that the maximum movement from the highest summer to the lowest winter temperature, including live-load movements, may reach the amount of 0.1 in. Locking pins which had been fixed in these bearings have now been out for several months, but no signs of creeping can be detected. However, suitable locking devices, allowing free movement, will be added next year.

Running at speed over the bridge produced undesirable swaying, it was found in the course of the tests. This made it desirable to examine the adjustment of the vertical swaybracing under the highway floor. The strain gage showed some of the rods to have practically no initial stress, while others had initial stresses up to 28,000 lb. per square inch, or practically the elastic limit of the iron bars. All the bracing rods were then adjusted by the gage to have 7000 lb. per square inch initial stress. A noticeable increase in the stiffness of the arch resulted.

Uncertainty existed as to the amount of stress in the main members of the bridge from dead load. This was due to the use of a toggle in making the closure of the arch at the time of erection.

The two halves were erected as cantilevers. In the original operation a 1-in. shim was placed between the abutting ends of the top-chord section. It was considered necessary, for full knowledge of the stresses in the arch, to release the stress in the center member of the top chord and thereby determine its dead-load stress; with this figure known all dead-load stresses in the structure could be calculated. For releasing the stress, a special toggle device was built, quite different from the original one used in 1897, when the structure was erected. The special toggle was put in place Oct. 12 and 13, 1918. Additional rivets had been driven in the ends of the old abutment plates on the top chord, 1-in. bars bolted across near the ends of the plates with four 1-in. turned bolts to stiffen them further, in order to prepare the abutment plates for carrying a possible load of 500 tons. Two screw jacks were set just back of this point, inside each chord section, to take up the thrust of the toggle. The operation was carried out Sunday, Oct. 13, between passenger trains crossing at 12 and 4 o'clock, the passage of all other trains having been shut off for the day.

With the splice rivets cut loose on one side of the center joint, and some bolts inserted for safety, the toggle forced apart the joint until the shim would just rattle. Readings on the points set for the gages showed a reduction in stress in the center top-chord section amounting to 689,000 lb., which amount therefore indicated the dead-load compression in this member. This is a very satisfactory condition. Stresses in the arch had been calculated for full three-hinged condition or zero load in the center top chord, and stresses in this member of 200,000, 400,000, 600,000, 800,000, 1,000,000 and 1,200,000 lb. It was therefore possible to pick out a condition that would best serve the purpose of equalizing stresses in the various members so as to increase the capacity of the span. It has been decided that a stress in the middle section of the top

chord of about 350,000 lb. is desirable. To secure this end, the 1-in. shims will be removed later on, by using the toggle in somewhat modified form, and thinner shims inserted. The arch will then be somewhat nearer the three-hinged condition for dead load than it is at present; the stress in the top chord, and in the posts and diagonals will be reduced, and thus these members will be materially strengthened.

Thanks are due the owners of the two structures, whose farsightedness made possible this extensive investigation of two of the most remarkably designed of our great bridges. Acknowledgment is also due to H. G. Dickenson, superintendent of the Niagara Railway Arch Bridge, to J. F. Deimling, chief engineer, and H. Ibsen, special bridge engineer of the Michigan Central Ry., for permission to publish this account of the methods employed, and to their field assistants for coöperation in the work. The measurements themselves were carried out by the writer, assisted by Prof. C. T. Morris and Prof. A. H. Fuller.

"Imaginative" and "Speculative" Highways for Tomorrow

In Planning, Broad Vision Will Be Necessary—Roads Will Be Built Much Wider and Stronger, and Aesthetics as Well as Utility Will Affect Design

BY H. G. SHIRLEY
Secretary, Highway Industries Association
(From paper read before the Joint Highway Congress, Chicago, Ill., Dec. 12, 1918).

IN CONSIDERING "The Highways for Tomorrow," we must not set small limits for them in our minds, for the picture, as I see it, is one of magnitude, beauty and great material and recreational value to all the people. For the sake of distinction, I have separated these highways under two heads; the "Imaginative" and the "Speculative," and have made a further separation into national, state and county highways.

The "Imaginative" road is a dream of what the roads of our country will be 10 or 20 years from today. The "Speculative" road is what we estimate they will be, basing our assumption on past experience and what has been accomplished, as a basis of calculation. National highways will be built and maintained by the Federal Government, the state highway by the state, and the county highway by the county; furthermore, each group will be composed of three classes, such as Class A, B and C.

CLASS A NATIONAL HIGHWAYS

Class A, national highways, will be the main trunk highways passing through a state, connecting up the main centers of population, and serving the most densely populated sections, where the greatest volume of traffic will be found. The volume of traffic on a Class A road will not be less than 2500 tons per day. The width of the right-of-way will not be less than 100 ft., and the surfacing not less than 60 ft. The surfacing will be of the most durable materials, and designed to carry a moving load of 20 tons; 12 tons being concentrated on the rear axle of the vehicle.

All grade crossings of railways or trolley lines will be separated by overhead or undergrade crossings, and intersecting roads will have a clear vision, at all intersections, of 50 ft. or more. Large expenditures will be made to straighten alignments and in the reduction of grades. The surface will be smooth, giving the least amount of tractive resistance and vibration.

Curbs, gutters, inlets, catchbasins, and a complete subsurface storm-water drainage system will be provided. A sufficient width on either side of the roadbed will be set aside for the planting of trees and the laying of sidewalks, conduits, pipe lines and other surface or subsurface structures; also for buildings for public use, such as rest sheds and comfort stations.

All curves will have a vision of at least 400 ft., and the roadbed and surface around all curves will be elevated from the inner edge to the outer edge, the elevation being computed for the degree of curvature and for a speed of at least 35 miles per hour.

Great care will be taken in laying out and establishing a Class A road. Points of interest and of historical value will be marked with suitable tablets, or monuments, or other devices—the proper arrangement of trees and shrubbery being such as to make the layout most attractive. Care will be taken to have the slopes of the embankments and cuts planted in grass and other suitable foliage.

Direction signs of neat and attractive design will be erected at all intersecting roads. Signs giving the name of the city, town or village will be erected where the national road enters and leaves.

CLASS B NATIONAL HIGHWAY

The Class B national highway will consist of those roads having a density of traffic of over 1000 tons per day. They will have a right-of-way of at least 80 ft. in width and a surfacing of 40 ft. All drainage will be provided, and where necessary a subsurface and storm-water drainage system will be installed. The surface will be designed to carry the same loads as, and will be constructed of materials similar to those used in, the Class A highways. The treatment of the portion outside of the paved surface and shoulders will be of a rural character, trees being planted which will be both productive and ornamental.

This class of highway will serve sections of the country where the land is practically all under cultivation, where small towns and villages are not far apart, or where industries are established requiring considerable tonnage to be transported over the highway.

CLASS C NATIONAL HIGHWAY

The Class C national highway will be where the traffic does not exceed 1000 tons per day. It will have a right-of-way of not less than 60 ft. in width and a surfacing of 20 ft., designed for the same loading as Classes A and B.

This class of road will run through sparsely settled sections of the country, tying into Class B highways, and be the artery that will serve remote and densely populated sections of our country. It will make easy and convenient communication among all the people, inducing social intercourse and thereby making us all one great family. Without personal contact, both with persons and things, the East will never understand the problems of the West, nor the North those of the South, and vice versa.

Treatment of the right-of-way of this class will disturb its natural beauty as little as possible, but all means will be taken to bring it out with greater prominence. All historical points will be marked with attractive monuments and tablets. At points where there is beautiful scenery parking spaces will be provided, and observation and shelter sheds erected. Vistas through the trees will be cut at points of vantage, and where beautiful scenery can be opened up. Shelter sheds and lodging shelters will be erected at convenient intervals, and telephones will be installed.

Snow fences—Snow fences or breaks will be constructed on all highways at all points where the snow drifts, relieving as much as possible the necessity of snow removal. With such places protected, snow plows and shovels, operated by tractors and trucks, will keep the roadway free of snow and open to traffic at all times. Where there are heavy falls of snow, the maintenance department will be fully equipped with all necessary equipment and organization to remove the snow quickly after each snowfall. The width of road that will be cleared of snow will depend on the volume of traffic passing over the highway, but under all conditions at least 16 ft. will be cleared.

Guard rails—On Class A national highways, where curbs and gutters have been constructed, no guard rail will be required, except on the outer edge of the sidewalk along embankments to protect pedestrians, and it will be of shrubbery hedges. On Class B national highways, at points where necessary, guard rail of neat design and permanent nature will be erected. Guard rail for Class C national highways will depend on the availability and cost of materials. It will consist of all kinds of materials from concrete walls to large boulders or rustic fences.

Danger signs—Danger signs of standard design will be erected on all highways at approaches to all sharp curves, sudden breaks in a grade where the view is obstructed, and at other points where there are elements of danger. The signs will be equipped with a lighting device to illuminate them properly at night.

Bridges—All bridges on Class A national highways will be at least 50 ft. between the curb lines, with a suitable space for sidewalks. All bridge floors will be of the solid type and designed, with the other portions of the structure, to carry a 20-ton truck on four wheels, the distance between axles being 10 ft., and with a concentrated wheel load of six tons. Close study will be made of each location, and a design selected that will fit in with the general landscape and be most pleasing to the eye. Bridges erected on Class B national highways will be designed for the same loading as on Class A, but will have a roadway width of 40 ft. Bridges on Class C national highways will be designed for the same loading as Classes A and B, but will only have a clear width of roadway of 30 feet.

State Highways of the Future

Class A state highways will be the main arteries in the state, connecting up with the national highway system, or connecting large towns and cities which are not connected by the national system. They will be designed to carry traffic similar to Class A and B national highways and will have a right-of-way 60 ft. in width with a surfacing of 24 to 30 feet.

The treatment of right-of-way outside of the shoulders and gutters will be variable and according to the development of the country through which the roads pass. Spaces for telephone lines, conduits, water mains and other subsurface structures will be provided outside of the surfaced area, and a parking space will be set aside for trees. The general type of treatment of right-of-way will be similar to that of Class B national highways.

Class B State Highway—Class B state highway will have a right-of-way of not less than 40 ft. width and will be surfaced for a width of 18 to 24 ft. Careful study will be made of the traffic and the possible future traffic over this class, so that an accurate estimate can be made of the future needs and the weight of loads that it will be called upon to carry. If the traffic study shows that it will be quite a long time before the road is called on to carry a great amount of traffic, or that the traffic will be of a type that would not call for a strong surface, the surfacing will be designed for a maximum load of 16 tons, with a wheel concentration of five tons on the rear wheels. No greater load should be allowed over this type of road, except by written permission.

Class C State Highway—Class C state highway will be used through sparsely settled sections of the state and will tie into Class B roads, making a connected system. The width of right-of-way will be not less than 30 ft., and the surfacing not less than 18 ft. The surfacing will run from a sand-clay or top-soil road up to a higher type, depending on the availability of materials and climatic conditions.

County Highways of the Future

County highways will be exceedingly variable in the types that will be used, depending on the intensity of traffic. They will range anywhere from the highest type of national highway down to the earth road, which will constitute the greater number of miles in this system. The same markings and care of right-of-way will be taken that will be taken with the same class of state highway.

The earth road will be widened out, the right-of-way cleared for its full width, and the road kept well shaped up and dragged constantly. Much service can be secured from the earth road by properly maintaining the same, and very much greater care and attention will be given to this class of road in the future than have ben given in the past. It will necessarily contain the largest mileage of all the types of roads for many years to come. In the past it has been shamefully neglected and abused, no attempt being made to make

it give that service which it is capable of performing for at least nine to twelve months during the year, depending upon the severity of the climate and the locality.

The above are classes of roads that the speaker imagines and believes will be in universal use in the next 15 to 20 years in this country, and are therefore classified under the heading of "Imaginative" roads.

The "Speculative" Road

We will now take up the second heading, the "Speculative" road. Under this heading, as defined in the beginning, we will have to make a close study of what has been done in the past to see what we may expect in the future and what the "Speculative" road of tomorrow will be.

Highway Development of the Past—It was about 100 years ago that the national Government and a number of the states started a road-building program. The Government built a few hundred miles and the states a similar number. Shortly after the starting of this road program, all road building on the part of the national Government and the states ceased. The work was then taken up by many turnpike companies, which were formed and which built a number of roads in the Eastern states, operating them under the toll system. After the establishment of the toll road there was quite a long period of quietude in road construction. It was handled principally by the township and county officials, with no development in types of construction, or methods of maintenance, outside of the large cities. This condition continued to the late nineties, or practically to 1900, when the states, due to the change in the vehicular traffic passing over the road, saw the coming need of more and better highways, and began to make a study of the problem.

This study has been going on for 18 years, and, granting some progress has been made, there is by far a greater demand for more and better highways today than ever before. Why is this demand so great? It is because we have not kept pace with the requirements and needs of traffic and the development of the country. Therefore, if we should attempt to plan a system of highways, taking the progress of the past 50 years as a basis of calculation, we would fall far below the requirements of the future.

Highway Practice Today—One hundred years ago the national Government laid out the right-of-way for its highways 66 ft. in width and constructed the surfacing from 20 to 30 ft. wide and of considerable depth, yet today we see the main state highway trunk lines and the Federal-aid roads being surfaced from 14 to 18 ft. in width, with a right-of-way in many instances not exceeding 30 ft. and a thickness of surface incapable of bearing the loads now passing over them at critical periods of the year—that is, when the ground is saturated with moisture.

Review of Past Progress

All this is misleading for any basis of calculation and design to meet the future needs of the country's transportation. Let us now examine the mileage of roads constructed from 1909 to 1914, and see what progress has been made. From 1909 to 1914, a period of five years, there were constructed about 75,000 miles of roads, or so-called roads—that is, at the rate of 15,000 miles per year.

There are in this country today, under the headings of national highways, state highways, and county highways, with the exception of Class C county highways, about 500,000 miles of roads that should be improved, and their improvement will be a good investment for the people at large. Yet at the rate we have been going, and using the same character and means of construction, it would take 33 years to complete this mileage. If we constructed this mileage of highways to meet the traffic needs of today and the future, it would take at least 50 years at the rate of expenditure and progress that has heretofore been made. Therefore, any calculation or speculation we may make, using the mileage as heretofore constructed or what has been accomplished as a basis, would give such a small program of construction that it would be a very gloomy day for many of us who hope to see the building of roads put on a basis of keeping pace at least with the development of the country and the needs of transportation.

The development of the different types of surfacing is in its infancy, and much study, experimentation and development will be necessary. No field for the manufacturer of road material will offer greater possibilities. It is, however, most important that the highway engineer and the material interests work in closer harmony with each other, so that each type can be developed to the highest degree.

In laying out, constructing and maintaining the American highways for tomorrow, the highway engineer must not be bound by what has been done heretofore, or by any plan based on such accomplishments, but will have to rely to a great extent on his imagination, and picture the needs of and use to which the highways will be put in the future. As a note of warning, may I caution again that the limits of his imagination must not be small or restricted, but must be of wide vision?

Many of you will say that this is a dream of a road dreamer, but some bright morning the American people will awake from their slumbers, and this dream will be a reality and great will be the benefits therefrom.

Chicago Plans Numerous Bridges

A comprehensive program for construction of drawbridges over the Chicago River at new sites, and to replace old structures, which program has been interrupted seriously by the war, will be expedited shortly as a result of the recently altered conditions, it is expected. Most of the work now under way, including the Michigan Ave., Wells St. and Franklin St. bridges, is for substructures. The superstructure of the Monroe St. bridge is practically completed and work will soon be started on that of the Illinois Central bridge for the St. Charles Air Line. Plans are being prepared also by the city for new bridges at Madison, Clark, La Salle and Twelfth Sts., in the business district. The last named includes a long viaduct approach over the railway tracks. In the outlying districts bridges are being planned for No. Kimball Ave., So. Lawndale Ave., and Addison Street.

BUILT BY THE FRENCH, THE NEW SHOP BUILDINGS ARE IMPRESSIVE IN BOTH SIZE AND APPEARANCE

Railroad Repair Shops in France Equipped and Operated by American Forces

Regiment Recruited from Personnel of American Machine Shops Takes Over Group of Buildings Constructed by the French—Individual Electric Drive for All Machine Tools

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

EQUIPPED throughout with American machine tools and manned by American mechanics from one of our engineer regiments, the great central shops for the repair of both United States and French locomotives and cars have been placed in service, although not entirely completed at this writing, under conditions materially different from those contemplated when the regiment was being recruited in the United States a year ago. Our men expected to arrive in France and find shops built, fully equipped and ready to be taken over for operation by American troops. Almost on the eve of their departure overseas they were informed that upon them would rest the responsibility of obtaining and installing the entire equipment of machine tools, and providing power for running them.

This news, of course, necessitated a sudden and complete revision of the program, and a prodigious amount of rush work right up to the day of sailing. It meant the planning in detail, almost at a moment's notice, of the entire plant layout of a huge railway shop project, a job to which months would ordinarily be devoted. Undaunted by the new turn of affairs, the officers of the regiment, all of them specialists in railway machine-shop practice, set about their task, snatching a few hours' sleep at times, until they finally embarked on their transport with the finished schedule of machine-tool equipment and its layout in the French shops, and with arrangements made for purchase and shipment.

Ground Plan Shows Scope

The new shops, located in the intermediate section, east, of the American Army area, are under the jurisdiction of the general superintendent of motive power of the Transportation Service, which controls all matters of standard-gage railway traffic and maintenance of equipment for the American Expeditionary Forces.

A ground plan of the buildings, Fig. 1, indicates the scope of the project. Starting at one end of the site, there is the boiler shop, where both iron and copper boilers—the latter being common on French and Belgian locomotives—will be repaired. Next come the erecting shops for locomotives and tenders. The machine shop and tool room occupy an adjoining bay of the layout, and succeeding bays contain the electric-welding and boiler-testing shops, the spring, smith and forge shops, and the storeroom. After crossing an open space carrying tracks for incoming and outgoing equipment, one comes to the axle-storage yard, paint shed and wheel shop, and the temporary power plant.

At a near-by site is the car-repair yard, the general features of which are shown in Fig. 2. Here new track had to be laid and facilities provided for disabled storage, tear-down, overflow repair, unfinished-material storage and finished-material storage, in addition to the area devoted to the repair work proper. The car-repair yard has required, in all, about six miles of new track and 44 turnouts.

Enormous Demands on Shops

The need for the locomotive and car repair facilities is apparent when one considers the enormous demands which are being made upon the rolling stock of the various French railroads, in addition to the new locomotives and cars which are received from the United States and assembled here in France. The latest official figures announcing the arrival of American troops at the rate of between 200,000 and 300,000 a month give some indication of the load which is being placed upon the equipment of the steam railways in France. These statistics, as an index of railway traffic, mean not merely that so many thousands of men must be transported from seacoast to training ground, or from one battle sector to another, but that a steady stream of material and supplies must be kept moving after them. The movement of this vast tonnage results in wear and tear on locomotives and cars, to say nothing of the damage suffered by rolling stock subjected to shell fire or bombing. At the time of my visit to the shops there arrived a long train of *hospital* cars, all plainly marked with big red crosses, which had been pretty well shot up by the Boche.

It is true that the French railroads have their own shops, but these have long since been working to capacity, and it would have been out of the question to

have depended upon them for the repair of our railway equipment. In fact, the French are already utilizing our shop facilities and personnel for repairs to their own locomotives. Then, too, with the shipments of rolling stock we are receiving from across the Atlantic the number of engines and cars is constantly growing—not as fast, perhaps, as our railway operating officials would like, but, nevertheless, at a rate which makes obligatory a large-scale plant for repair work.

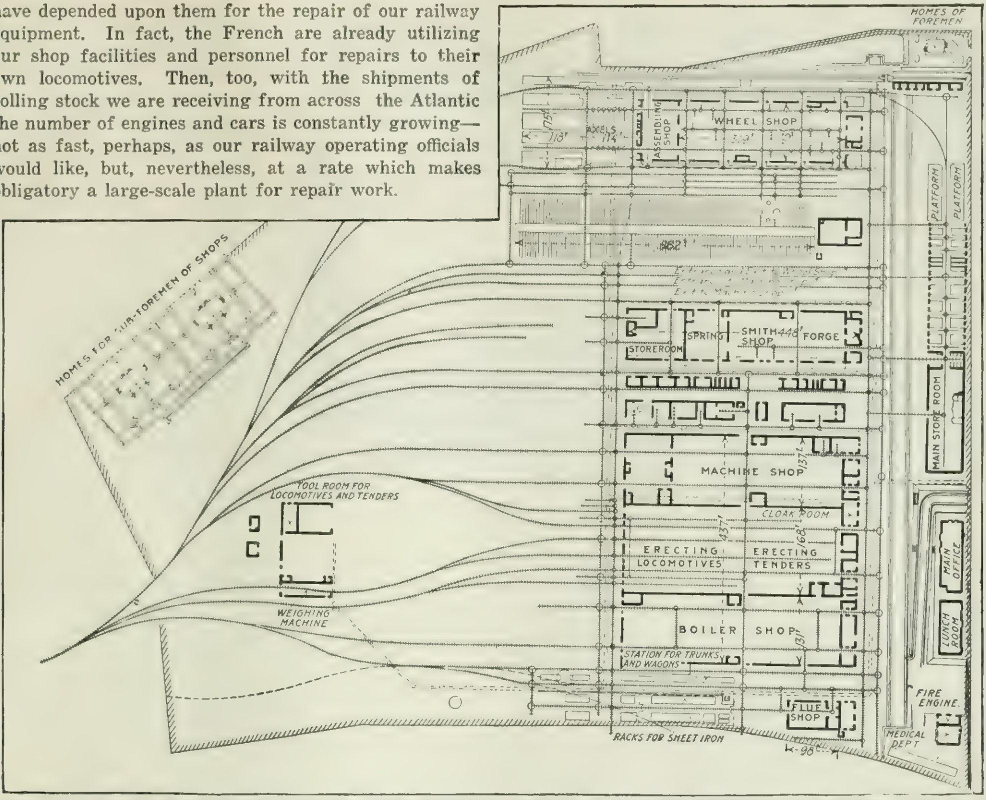


FIG. 1. PLAN OF THE CENTRAL SHOPS WHERE BOTH UNITED STATES AND FRENCH LOCOMOTIVES WILL BE REPAIRED BY AMERICAN ENGINEERS AND MECHANICS

The new shop buildings were constructed by the French. Concrete and steel forming long parallel bays with vaulted roofs have been handled with that artistry and painstaking attention to general exterior appearance which finds no place in the design of the average American industrial building. Here we have a shop for locomotive repair work which might well pass for a horticultural hall at an international exposition. Such results, however, are not achieved on a job where speed records for construction are broken, and it is small wonder, therefore, that the completion of the project, started by the French before the war, extended far beyond the date at which it was thought the buildings would be ready for the use of the American operating force.

It was our job to take the bare shells of these shops, as turned over to us by the French, equip them, and begin repairing railway rolling stock. Pending the completion of these structures and the arrival of our own machine tools, our shop regiment, organized primarily as a skilled operating force, was broken up into several units, some of them going to a base port to assemble American-made locomotives and cars, while others were detailed to duty at various existing repair shops of the French railroads.

This assignment of our men to work among French machines is said to have had both its advantages and disadvantages. The chief benefit has been the opportunity given to American mechanics to become familiar with French and Belgian locomotive construction, for in many features of design these machines are radically different from those of United States types. Inasmuch as our new shops will handle French as well as American work, this period of close contact with French locomotive repairs by members of our

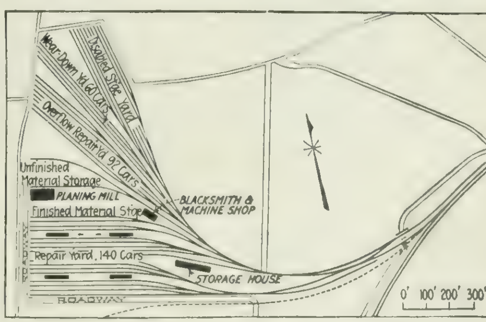


FIG. 2. LAYOUT AT THE CAR REPAIR YARDS, BUILT BY AMERICAN ENGINEER FORCES

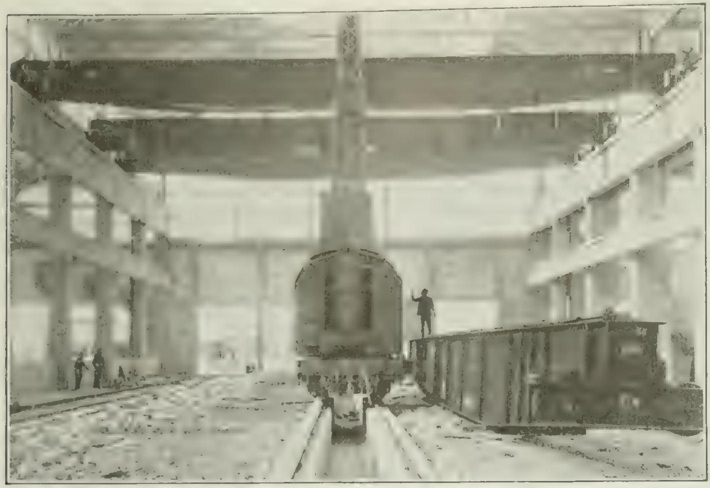


FIG. 3. LOCOMOTIVE CRANE PLACING THE BIG OVERHEAD TRAVELING CRANES IN ONE OF THE TWO LOCOMOTIVE ERECTING SHOPS (Taken July 12.)

own force has served to train them in handling any sort of a job which they may be called upon to perform after returning to the headquarters of their original regiment. As to disadvantages, the men assigned to French shops have, of course, been working elbow to elbow with mechanics who, as far as the day's work is concerned, are accustomed to go at things in a much more leisurely manner than is common under American shop management. It is, however, somewhat early to form an opinion as to the extent of this influence on our working force. A big difference in working conditions is that all of our machinists are enlisted members of military units and under military control, while such conditions do not obtain in the French shops.

The problem involved in getting the shops equipped and in operation was explained to me at some length during a conversation with the general superintendent of motive power, a colonel of engineers who is in command of the railway shop regiment. According to the original schedule, the buildings were to have been completed Sept. 1, 1917, and fitted up with machine tools, small tools, air, steam and water lines and electric power. This work all was to have been done by the French, leaving nothing for our regiment but to recruit its ranks from skilled shop men and begin operation. Subsequent events have indicated the extreme optimism of this program. The bare shells of the buildings were not turned over to the American forces until April, and the shipping crisis delayed the delivery of machine tools from the United States.

When the inventory of equipment for the shops was made up and orders were placed before the regiment sailed, three phases were planned for the shipment of material: First, construction tools, equipment and wiring immediately needed, to be shipped Sept. 1, 1917; second, machine tools, to be shipped Oct. 1, 1917; third, materials and supplies, to be shipped Nov. 1, 1917. It will give a fairly good indication of the difficulties our men faced to state that no machine tools had been delivered to the site on Apr. 1 of this year. By June, 20% of the machine tools had arrived, but, beginning with July, deliveries have been speeding up, and equipment is now being received in large quantities. These conditions are cited not by way of criticism, for delays have been inevitable, but rather to convey to our engineers in the states what the building up of our shipping tonnage actually means in the progress of our engineering work over here.

The first work done at the shops was on general engineering supplies, including the erecting and repair of piledrivers, cranes and steam shovels. By June 1, however, track had been laid in the erecting shop and work was begun on placing the big overhead cranes shown in Fig. 3. By July 1, with some of the cranes in place, work was started on locomotive repairs.

On July 27 thirteen locomotives, all French, were in the shops for repair. The wide variety in the design of these machines is a complicating factor in the repair work. Nothing approaching standardization

FIG. 4. ONE BAY OF THE MACHINE SHOP SHOWING OVERHEAD CRANES IN PLACE AND MACHINE TOOL INSTALLATION PROGRESSING

exists, and many parts are not interchangeable. For example, the colonel of the shop regiment told me that there were 37 different types of Belgian locomotives operating on French roads, and of these our own shops have already handled repairs on 15 types. The central shops expect to receive for repair and overhauling not only all United States equipment but a certain number of locomotives from such important French railroads as the P-L-M, the Paris-Orléans, the Nord, the Est, and possibly the Ếtat. Our own rolling stock, being standardized, will be handled far more easily and quickly in the shops than the wide variety of European machines in service.

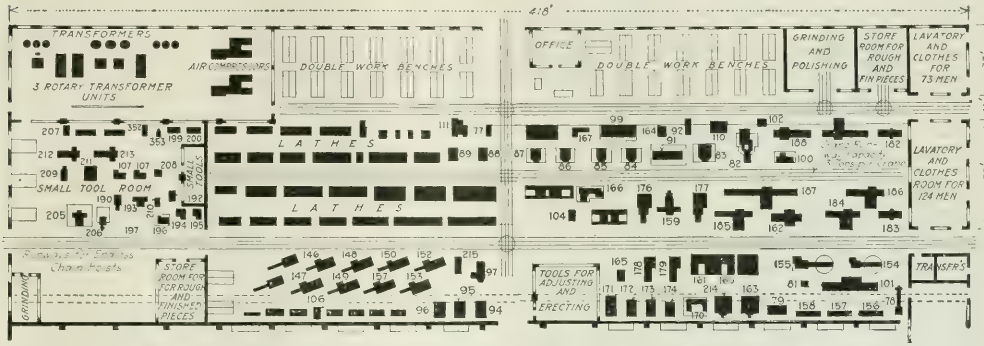


FIG. 5. LAYOUT OF MACHINE SHOP OF AMERICAN RAILROAD REPAIR SHOPS IN FRANCE

At the end of July the American operating force at the shops numbered about 800, and it was expected that the rolls for August would show a total of about 1500 men, for, with the buildings finished and the machine-tool installation progressing at a rapid rate, the policy is to call back to their own regiment, for work under the supervision of American officers, the details of men which had been assigned to duty in various French railway shops.

The thing to keep in mind in attempting to visualize the work which has been done at the central shops is the fact that practically everything, from small tools to big turret lathes, rolls and planers, has had to reach the job after a trip of more than 3000 miles. With the tremendous tonnage which is being delivered at our base ports here and handled by the various railway lines, it is no simple matter to have a big shipment of machine tools reach its ultimate destination without delay or actual loss of some crates. Sometimes crates improperly marked are sidetracked and diverted into some of our big storage centers, where they may not see the light of day again for weeks or months. Then, too, in the case of a bulky machine-tool unit, parts must be packed and shipped in separate crates. If these all arrive at one time, well and good. If they do not—and such cases are not uncommon—the work of installing that particular machine tool must be held up, for it is practically impossible to duplicate missing parts over here.

Every American manufacturer, of course, is trying to help the work here in France in every possible way. Let him therefore, pay particular attention to two matters connected with the shipment of machine tools: First, take rigid precautions in inspection during crating to see that not a single part necessary for the operation of the machine is missing, since replacements take months, not days; second, insist upon receiving accurate directions as to the marking of crates to insure prompt arrival at their proper destination in France. When such directions are received, follow

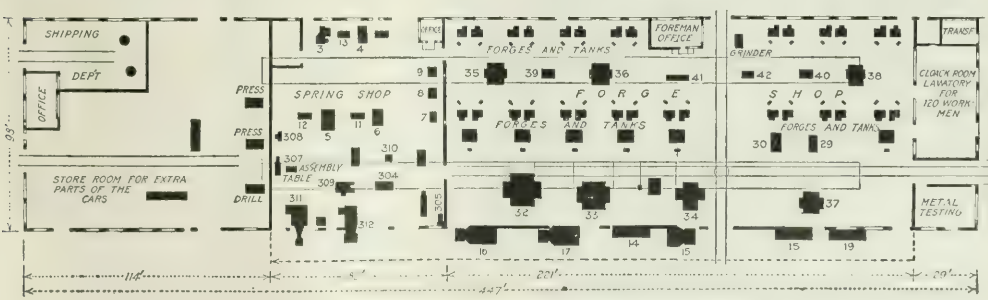


FIG. 6. LAYOUT OF THE FORGE AND SPRING SHOPS

them to the minutest detail. It is a big place, over here, and we have scores of shops where machine tools are being installed. Unless a package is started out on its transatlantic journey *complete in all parts and properly labelled,* all sorts of confusion and trouble result on this side. A crate stencilled with some such generality as "American Army, France" may arrive

here, but what will become of it after that only some of our stevedores may know for a while and promptly forget. When so many important things are demanding the best efforts of our engineers the pastime of organizing searching parties to ferret out missing equipment is one which is not popular over here.

All of the machine tools at the new railway repair shops, as well as the big overhead cranes, have individual electric-motor drives. The type of building constructed as shown in Fig. 4, was one ill adapted to the use of shafting and pulleys, on account of the height of the roof. Then, too, a big electric central-station development which the American Expeditionary Forces are completing at a distance of not many miles, makes available by means of a newly-built transmission line sufficient electric power for running the plant. Pending the delivery of this power, however, a temporary plant of steam-driven electric generator units was erected at one end of the shops and has been in service for some time.

A great deal of difficulty has been experienced in obtaining flooring material for the shops. Lumber is hard to get, but this difficulty is being met by employing for the flooring wood obtained from the packing cases in which the machine tools were shipped.

As to the layout of the shops, Fig. 5 shows the location of the various machine tools in the machine shop, while Fig. 6 is a plan of the forge and spring shop. There have been a few changes from the original plans, due to the nonarrival of certain machines and the receipt of others different in size from those expected. The scheme of individual electric drive for each unit, however, offers a considerable amount of flexibility in locating the machine tools, and changes from one place to another have not involved serious difficulty.

Erection Experiences at the Sciotoville Bridge

Machines Used Found Efficient—Adjustment of Bridge Easy—Deflections Agreed With Computed Values—Last of Three Articles on the Field Work

By Clyde B. Pyle
Manager of Erection, McClintic-Marshall Co., Pittsburgh

SUCCESS in erecting the Ohio River bridge at Sciotoville brought with it a number of experiences having application to large bridge work, especially continuous-span construction. On account of the magnitude of the work—the structure has two spans of 775 ft. each, continuous over the middle pier, with riveted connections throughout—and the new problems which arose from connecting the members in strained condition to eliminate secondary stresses, some of the conclusions drawn from the erection may be useful to the engineering profession.

First, notice is due the fact that the suitability and good service of the erection machines were important factors in the success of the work. The sequence of operations, described in *Engineering News-Record* of Jan. 10, 1918, page 62, and Jan. 31, page 219, made rapid and smooth progress a vital matter. Any long interruption of the construction work might have exposed the bridge to risk of destruction by flood. That the machines chosen turned out to be highly reliable and efficient was a most important and gratifying experience.

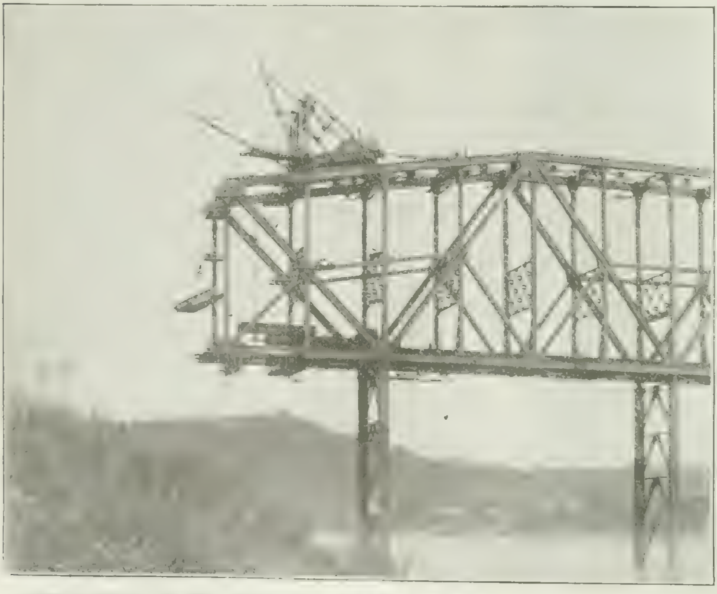


FIG. 1. TWO BOOMS ON CREEPER TRAVELER SPEEDED UP THE SCIOTOVILLE BRIDGE ERECTION

Different machines were used for the erection on falsework (Ohio span) and the cantilever work (Kentucky span), as previously described. Sketches of both machines are shown herewith (Figs. 2 and 5). The following briefly states the reasons which led to the choice of these particular devices.

Several points have to be considered in choosing bridge erection equipment: Simplicity, speed of operation, safety, low cost of construction and transportation,

and ease of setting up and getting ready for work. In addition, of course, the loads to be handled and the required reach must be taken into account. Machines that leave the supply tracks unobstructed and that do not have to run off the bridge frequently save time. In respect to all these requirements the machines selected are of high rank.

A gantry traveler running on tracks outside the bridge trusses was used for erecting the Ohio span on falsework because it is a simple tool to operate, it necessitated little or no additional falsework more than that required with any other erection device, it left both material tracks free, and it could erect both trusses simultaneously. A gantry traveler was already in stock, which furnished another motive for using it.

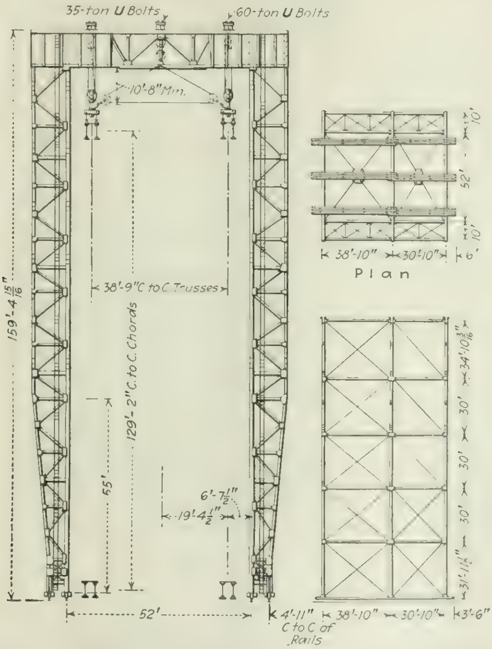


FIG. 2. GANTRY TRAVELER BUILT UP TO FULL HEIGHT FOR ERECTING TRUSSES OF OHIO SPAN

One objection to the gantry is the fact that its erection involves some time and trouble, but the advantages just cited outweigh this objection. The view in the adjoining column shows the temporary floor and the derrick used for raising the gantry.

Safety and simplicity of operation were the main reasons for adopting the top-chord or creeper traveler in the cantilever work.

A creeper with a single derrick boom had been used by the same contractors in erecting the Beaver Bridge (See *Engineering Record* of June 24, 1911, p. 704). While that machine did its work well, a large gain was made in the Sciotoville erection by providing two booms. The added weight was not great, and the speed of erection was doubled—an important matter because of ice and flood danger. Compared with the Beaver creeper, a much simpler structural design was possible, because the Sciotoville bridge has a stiff top chord and because

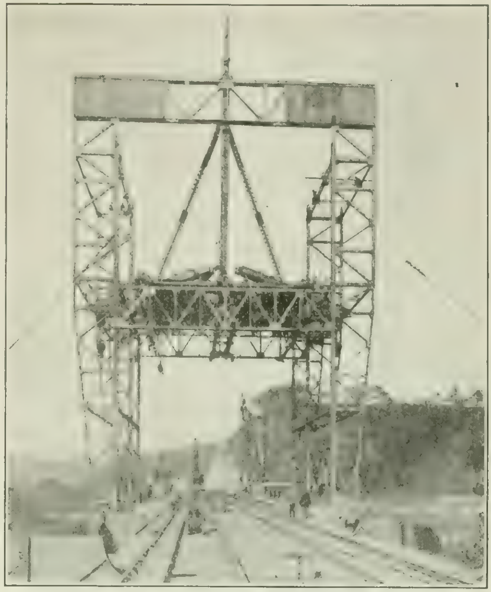


FIG. 3. STIFF-LEG DERRICK ON TEMPORARY FLOOR RAISING GANTRY TO FULL HEIGHT

only one slope of chord has to be provided for, in addition to the horizontal; at Beaver the top chord consists of eye-bars and has several slopes.

The outriggers of the Sciotoville creeper were used to support scaffolding. This facilitated work materially. A large float under the bottom chord, suspended from

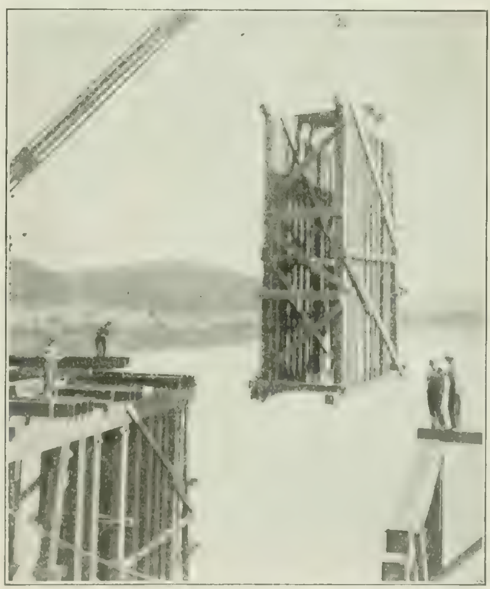
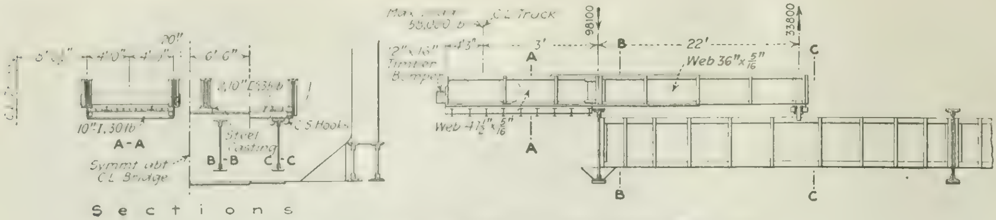
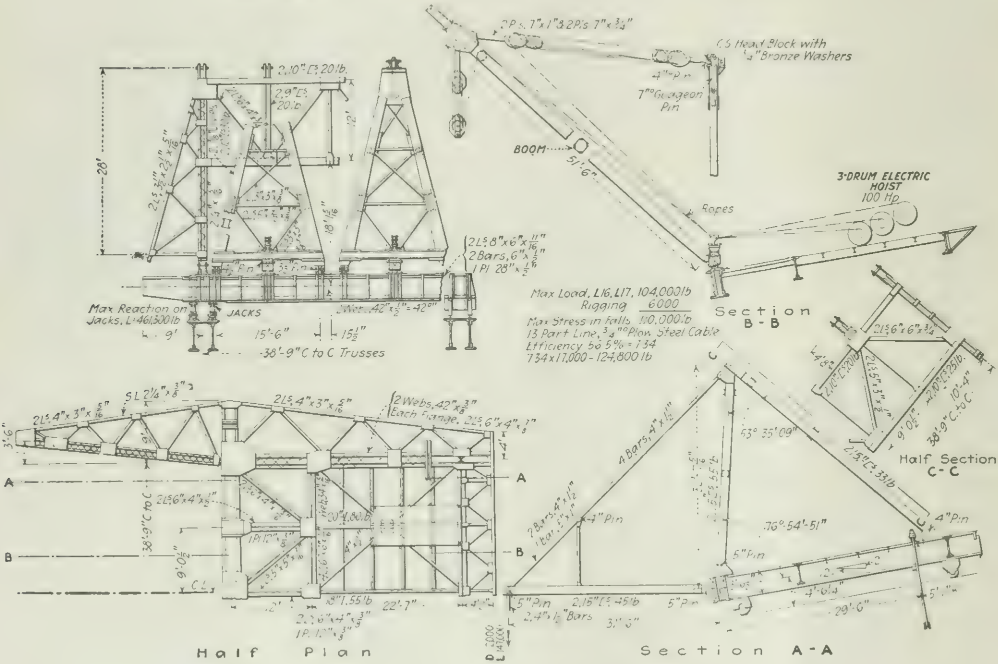


FIG. 4. TIMBER FALSEWORK ASSEMBLED IN PANELS HALF THE WIDTH OF ONE TOWER



Jigger Bridge for Material Cars Cantilevered Over Forward Floor-beam



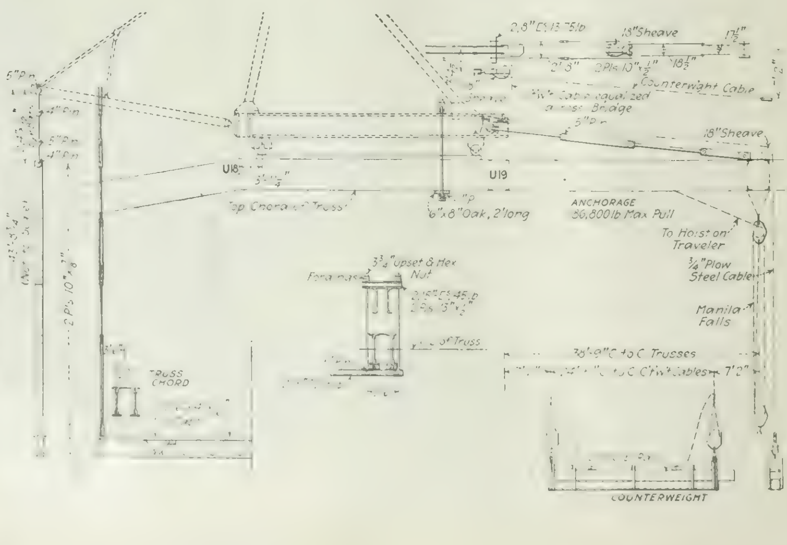


FIG. 5. TWO-BOOM CREEPER TRAVELER HANDLED MEMBERS OF BOTH TRUSSES. ADJUSTABLE PEAK CONNECTION TO SUIT HORIZONTAL AND INCLINED CHORD. MATERIAL BROUGHT OUT ON JIGGER BRIDGE; SUPPORT FOR JACKING UP TRUSS MEMBERS SUSPENDED FROM OUTRIGGERS OF TRAVELER. REAR OF TRAVELER ANCHORED AND COUNTERWEIGHTED

these outriggers, gave the riveting gangs easy access to the bottom-chord splices and laterals. Smaller scaffolds similarly supported were used for the top-chord riveting. These were in correct position for their service, in every panel.

Two portals were embodied in the traveler structure for lateral bracing. One of these was in a plane just back of the derrick masts or A-frames, while the other was in the plane of the backstays. These portals also served as trusses for taking the pull of the derrick A-frames and transferring it to the main triangles of the creeper frame on either side.

As the creeper had to work both on the sloping part of the top chord and on the horizontal, provision had to be made for keeping the A-frames vertical. This consisted of an adjustable link at the top of each A-frame, tying it back to the portals. Three pin-holes in the link made it equivalent to a long and a short link.

As explained in *Engineering News-Record* of Jan. 31, 1918, the stresses in a long continuous bridge are not greatly changed by slight variations in the elevations of the supports. Therefore, the use of this type of bridge is to be encouraged, since considerable metal is saved.

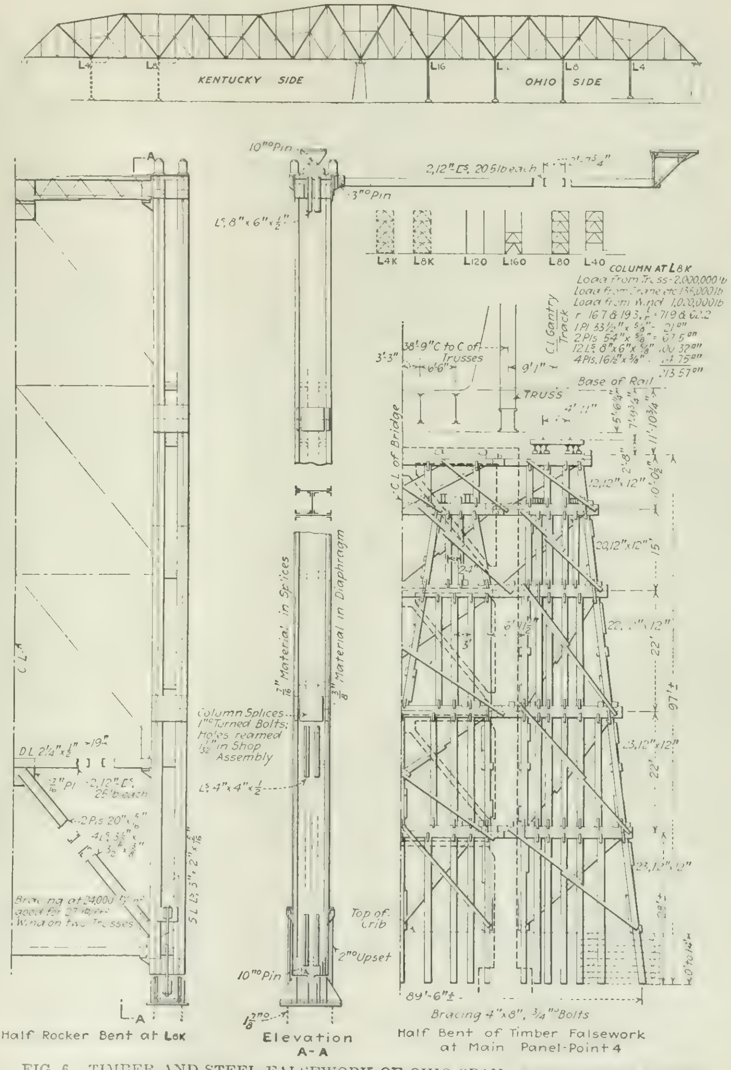


FIG. 6. TIMBER AND STEEL FALSEWORK OF OHIO SPAN; STEEL BENTS LATER USED AS SUPPORTS OF KENTUCKY SPAN

It is not necessary to leave a chord splice bolted for adjusting in case the end deflection is ot exactly equal to the computed amount, through the effects of inaccurate reaming done in the shop.

Secondary stresses can be eliminated from the completed structure as was done in this riveted bridge. This requires reaming the trusses point by point instead of entirely fitting together. The extra work involves some expense and some loss of time in erection.

Computed deflections agree exactly with the actual. In the deflections of the Sciotoville bridge acting as a truss this was the case for computed values which considered the sections of members increased 10% on the average for the influence of details on deflection. Bending of individual members as simple beams, cantilever beams, or beams fixed and hinged at one or more points, corresponded exactly with computed values. In computing bending of individual members the effect of details was taken into account as accurately as possible for each member. Computations of deflections of the structure as a whole and of the bending of members while erecting them, which were made for the entire bridge, proved invaluable. Serious difficulty in the field was thereby entirely avoided.

If the two members meeting at a joint were not tangent, thereby making the holes at the ends of the splice and top and bottom of chord a little out of match (after a few pins had been driven near the center of the splice), some pins driven simultaneously in scattered holes brought the whole connection near enough to match for easy entrance of the rivets. However, even a large number of pins never seemed to bring all the holes to absolute match.

For driving long-grip 1⅛-in. or 1¼-in. rivets, 130 lb. of compressed air was necessary. With less pressure the heads were often not brought to perfect contact with the plate, or the holes were not perfectly filled, and loose rivets resulted in many cases.

Tapered-shank rivets more perfectly fill the hole, but the expense of driving is increased by having to use a hammer to enter the rivets and by the loss of rivets due to collars forming while entering those slightly too large near the head. However, the advisability of using them can hardly be questioned, for long-grip rivets.

Trouble From Loose Rivets

With splices made up of several thicknesses of steel all coated with red lead, many loose rivets resulted from the burning out of the red lead. On the large splices, where 1¼-in. rivets were driven continually one after the other, red lead often flowed out from between plates in a large stream. In some of the splices as many as 60% of the rivets where loose, due chiefly to the red lead burning out. Upon redriving the loose rivets as many as half the other rivets were loosened by the redriving. It seems as though this was due to red lead. No doubt the condition was aggravated by the fact that there were so many thin plates at a splice. In some cases all of the mattrial was $\frac{13}{16}$-in. thick, with rivet grips as long as 7 or 8 in.; the material was made thin to enable it to be subpunched in the shop.. If it had been thicker, with fewer surfaces, no doubt the percentage of rivets cut out would have been smaller. It would be interesting to know the results of using less red lead, or oil only, and perhaps an economy could be brought about without injury to the structures.

In reading loads on hydraulic jacks with pressure gages, accuracy can be secured only when all pipe connections are perfectly tight; small leaks rendered readings uncertain to the extent of 10 to 25% in some cases, while when there was no leakage repeated readings were identical.

Falsework settlement, the bottom end of the falsework resting on shale-rock river bottom, amounted to $\frac{3}{16}$-in. per joint of bents. This takes into consideration every joint—between post and cap, between sill and cap, and between blocking.

Falsework designed for 25 tons steady load per 12 x 12-in. leg, or 37½ tons jacking load, carried 50 tons to 60 tons per leg in some cases for short periods with no sign of failure. The falsework was accurately plumb. The view, Fig. 3, shows its arrangement in integral panels. Fig. 6 gives some details.

Falsework bolts ⅞-in. in diameter are much more economical than ¾-in. bolts, because they do not bend so easily. The ¾-in. bolts were bent badly, to the extent of making it economical to scrap them in many cases, while most of the ⅞-in. bolts were used several times and were still in good condition.

The legs, caps and sills of the falsework were 12 x 12-in. timbers throughout. The diagonals in both directions were 4 x 8's, except in the lower stories, where 6 x 8's were used to provide against excessive cutting by ice. Each bent was built up of sections approximately 25 ft. square, which were erected in pairs.

The bridge was designed by Gustav Lindenthal, consulting engineer; O. H. Ammann was Mr. Lindenthal's principal assistant engineer and R. T. Robinson his resident engineer. It was built for the Chesapeake & Ohio Northern Ry. Co., Frank Trumbull, chairman of the board of directors; George W. Stevens, president, M. J. Caples, vice-president, and William Michel, chief engineer. It was fabricated and erected by the McClintic-Marshall Co., with Paul L. Wolfel, chief engineer; S. P. Mitchell, consulting enginer; E. A. Gibbs, manager of erection, and A. Toohey, superintendent of erection.

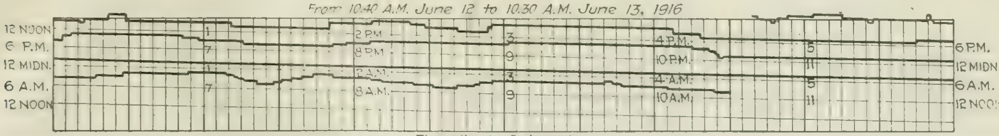
Water-Meter Flow Rates Recorded by Rain-Gage Mechanism

Studies at Hartford Water-Works Throw Light On Water Unaccounted For, Where All Services Are Metered

ADAPTATION of the recording mechanism of a rain gage to study the rates of flow through water meters was mentioned on p. 1074 of *Engineering News-Record*, of Dec. 12, 1918, in an abstract of a paper on "The Selection of Water Meters" by C. M. Saville, chief engineer of the Hartford, Conn., water-works, read before the New England Water-Works Association Nov. 13. Mr. Saville's description of the device, and some of the data obtained and conclusions drawn, follow:

Very little information seems to be available in regard to the rates of flow in service pipes and their duration, and no device was found on the market for getting an autographic record of the continuous use of water through service pipes and meters. Having had some experience with the Freiz automatic rainfall register, the writer suggested to one of his assistants the possibility of adapting the recording mechanism of this machine to the required purpose. After some experimentation, J. E. Garratt, office engineer, of the department's staff, made suitable electric connections between the meter-counter and a rain-gage recorder, and carried out in an able manner the field work of investigation. The apparatus is rather clumsy to take about, but it answers the purpose very well, and from its record some very interesting facts have been learned regarding the use and waste of water. The apparatus is carried in an 18 x 18 x 20-in. box and, including the box, weighs about 40 lb. The instrument is crude and probably not extremely accurate. Nevertheless, the records are submitted as throwing some light on the matter of water unaccounted for in systems where the services are very thoroughly metered.

The registering apparatus consists of an eight-day clock, with a driving mechanism for rotating a cylinder about 4 in. in diameter, around which the chart is wrapped in one fold. A very ingenious device, carrying the recording pen, is operated by electric contact at each tip of the bucket in the rain gage, or, in the case of a meter, at each revolution of a counter. The driving mechanism is so constructed that the drum makes an entire revolution every six hours, and the feed is so regulated that the pen describes on the rotating chart a spiral, the lines of which are about ¼ in. apart and thus avoid being superimposed. The rate of flow is indicated by the number of contacts registered by the

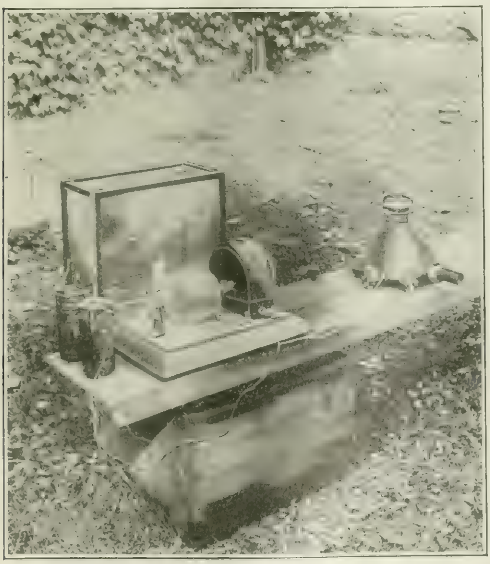


EACH STEP RECORDS ONE METER COUNTER REVOLUTION

From a ¾-inch water meter on a house in the best residence district of Hartford, generally occupied by six persons. Average water consumption for 1916, 56 gallons per capita per day. Water pressure, 70 pounds. Hot and cold water supplied to three laundry tubs, two sinks, four washstands and one bath tub. Cold water supplied to two tank water closets, two ½-inch hose bibs in garage and one ¾-inch sill cock.

pen on the chart. Each of these contact marks is in the form of a step, the characteristic trace being five steps down and five steps up. From top to top of any series of steps there are 10 contacts. The chart is marked vertically in five-minute lines. At a glance, therefore, it is possible to read the number of steps or revolutions in any given period, and also to observe the time at which the water was drawn. One defect in the registering device is its inability to record sudden flows of less than 1 cu.ft., although the total quantity is registered.

On the accompanying chart [for a house in the best residence district of Hartford] the record began about 10:40 a.m., Tuesday, June 12. Preparations for luncheon are clearly shown. At 11:47 a draft of about 2.5 cu.ft. per minute occurred, and at 12 noon another draft of a similar amount. Throughout the afternoon there was some use up to about 3 p.m., then a period of comparative rest until about 6 p.m., when for two hours during the dinner period there was intermittent use. At about 10:25 a use of about 5 cu.ft. in 4 min.



RAIN-GAGE PEN ELECTRICALLY CONNECTED WITH WATER-METER COUNTER RECORDS RATE OF FLOW

indicates, possibly, the filling of a bath tub. From this time until 6:17 the next morning there was no flow, indicating either remarkably tight plumbing or a meter which failed to register small flows. From 7:10 to 8:50 a considerable use of water is noted, probably for bathing and for the family breakfast. The maximum use in the house on this day was 1.25 cu.ft. per minute.

The recording mechanism checked the meter reading of 68 cu.ft. for the 24 hours' use. For the week that this house was under observation, the consumption and maximum rates recorded in the table just below were shown.

	—Consumption— Cu.Ft.	Gals. per Cap.	Max. Rate per Min., Cu.Ft.	Duration of Max. Rate, Min.
Thursday, June 5	65	81	1.00	3.0
Friday, June 6	24	36	1.65	2.0
Saturday, June 7	46	58	1.33	1.5
Sunday, June 8	34	42	pen out of order	
Monday, June 9	52	64	2.20	2.0
Tuesday, June 10	43	53	1.30	2.5
Wednesday, June 11	68	85	1.00	2.0
Thursday, June 12	68	85	1.25	4.0

From detailed studies of the records for this house it appears that probably at least 11% of the water delivered was unrecorded by the meter, while for the entire 24 hours, except for 3 min. at about 10:43 a.m., the rate of draft was below 2 gal. per minute.

These records and those for an apartment house indicate that for most of the time the flow through the meter lies in the zone between the 90 and 98% accuracy ordinarily guaranteed for disk meters. If this condition is characteristic of meter performance, at least it offers an explanation of some of the hitherto unaccounted for water reported from fully metered water departments, ordinary rates appearing to occur on that portion of the scale where the registration is the least accurate in the meters used.

Proportion Concrete to Weigh 173 Pounds per Cubic Foot

In designing the concrete counterweight for the Cherry St. bascule bridge in Toronto, Ont., it was assumed that the concrete weighed 173 lb. per cubic foot. According to George T. Clark, designing engineer, Toronto Harbor Commission, experiments were made to determine the mixture of cement, sand, stone and iron ore that would just give this weight at the end of 90 days, at which time, it was considered, the chemical and physical changes would be complete. A number of 1-ft. cubical blocks were made of ingredients carefully weighed, including the water. It was found that to obtain the specified weight the stone and iron ore had to be mixed in the proportion of 1 to 3 by weight; also, that of the 6½ lb. of water used per cubic foot in mixing 4½ lb. were lost in drip and evaporation and 2 lb. were required for the crystallization. The ore was magnetite and it was mixed with screened gravel.

Highway Administration and Maintenance

Abstracts of papers read before the Joint Congress and meetings of the American Association of State Highway Officials and of the Highway Industries Association, Chicago, Dec. 9-12. General problems of supplying highway engineers, preparing for the reconstruction period, and laying out and maintaining highway systems are dealt with.

Engineers for Highway Construction

By J. H. Mullen
Deputy Commissioner of Highways, Minnesota

DISCUSSION of the subject, "Engineers for Highway Work," was intended to cover the means for taking care of engineering on road work under war conditions, as practically all of the larger highway engineering organizations have been greatly depleted in the past two years. This deficiency has in many cases, particularly in the Middle West, forced the closing down or abandonment of projects which could have proceeded otherwise. It was the duty of those not so fortunate as to have participated directly in the war to adjust themselves to the conditions and do their share in maintaining the progress and efficiency of the country.

That is what we were to discuss, but, fortunately, the war has ended. However, our problems now seem even greater.

Great Highway Development in Prospect

Evidently the country has become aroused to the need for highway improvement, and is willing to spend millions of dollars for that purpose, provided there is assurance that the work will be properly handled. The public, however, does not know how this should be done, and has but a very hazy idea of the need for scientific organization and expert supervision of highway improvement.

In discussing the qualifications of highway engineers, it is frequently stated that they require only from 10 to 25% of technical knowledge, and the remainder of common sense. The natural consequence of such a statement is to mislead the public and discredit the profession. Common sense is necessary, it is true, but common sense is fundamentally necessary for any other important work. The highway engineer must have a groundwork of engineering knowledge, acquired through years of practical experience and study, or by technical schooling. Without advanced technical training a man is greatly handicapped.

Actual training in this branch of the profession cannot, generally, be obtained in engineering colleges. We are now at the opening of a new transportation era, with a great volume of important highway work to be done, and the special training of a large number of engineers is called for. As the engineering colleges are not generally equipped to produce them, it falls upon state highway engineers to lend assistance in directing the work of the students, so that upon leaving college they will not have to serve a long apprenticeship before taking charge of work.

To perform efficiently the duties of a highway engineer requires not only technical qualifications, but also a knowledge of public affairs and administrative ability. There is a growing tendency, especially in Western states, to place upon the engineer the complete responsibility for highway management. He must direct engineering operations, study present and prospective tonnages and passenger movements on the highway, investigate availability of road materials, select economical types of bridges and other structures, and do a tremendous amount of special study.

Highway administration offers a great field for engineers, and the prospect of supplying the number necessary in the near future does not appear difficult, provided that there is recognition of service and proper compensation. The profession will attract engineers who have been in military service and who have previously had training and experience on railroads or similar work. These men have seen the roads of France, have had some experience in taking care of them, and will be anxious to get in touch with this development in their own country. However, this is a practical age, and if men of the proper kind are to be employed, if initiative is to be encouraged and efficiency prompted, there must be a material reward. If this is not provided, some of the highway departments which are now held together through interest in the work and loyalty to the service will not be able to hold experienced men.

The returning men will no doubt supply the immediate need, but it is the duty of state highway engineers to develop the younger men. This policy of coöperation is in line with the recommendation by Dr. Mann, in his excellent report for the Joint Committee on Engineering Education. [See *Engineering News-Record* of Oct. 24, p. 742.] An attempt has been made in Minnesota to follow such a policy during the past summer, and a number of subordinate positions in the highway department have been filled with university students.

Preparing for After We Have Won the War

By S. E. Bradt
Superintendent of Highways, Illinois State Highway Department

THIS topic was assigned to me when after-war conditions were largely a matter of speculation, and even today, with the war won, there is still but little indication of what these conditions are to be. In the war just closed, the men actually engaged are counted by millions, as compared with hundreds of thousands in any previous war. Money has been expended by billions, as compared with hundreds of millions heretofore. The disturbance of normal conditions has been in proportion to the men and money involved; hence, the task of readjustment will be correspondingly greater than that following previous wars.

Two phases of the problem concern highway engineers more directly. These are its probable influence upon wages, and our duty to assist in this crisis through

the employment of labor. Labor seeking employment undoubtedly presages, among other things, a readjustment of the wage scale. The indications are that this readjustment will be very gradual, and that we may not reach the pre-war basis for many years, if at all. While the conditions following the Civil War may not be any guide to the present situation, yet it is of interest to know that wages from 1865 to 1870 made a gradual increase, while at the same time commodity prices gradually decreased. Although we may not expect a rise in wages now, on account of the fact that they are already so high, still, with all the conditions taken into consideration, very little decline can be expected before the next harvest, at least.

With this situation confronting us, shall we assume the attitude of holding our money, awaiting a considerable decline in prices of labor and material, or shall we proceed to carry on a moderate amount of work with the idea of giving relief to our citizens, both through the improvement of the roads and the employment of those released from war work?

Personally, I am of the opinion that the immediate economic value of highway improvement is so great that we can afford to carry it on, so long as its cost is not out of line with the cost of labor and commodities at the time the work is done. While the cost of improving the roads is in many instances double, the cost of revenue-producing products, such as the crops, etc., is also double, and therefore taxes may be greatly increased. The fact is, the cost of roads today, measured not by dollars but by the things that we produce on our farms and in our factories, and with the selling price of labor, is no greater than it was three years ago.

Helping To Employ Surplus Labor

Again, from the standpoint of assisting in employment of labor during this crisis, it is undoubtedly the duty of the state to do what it can to tide over the coming period of uncertainty. This problem of the unemployed is not alone the problem of the United States, but of the world. Representative men of both Europe and America have emphasized the necessity of making public improvements to reduce this unemployment to a minimum. As highway officials, we should make all preparation possible for the early resumption of work. I suggest, however, that it would be advisable to limit the amount of work to what can be completed during the season, with a clause providing for cancellation of the contract, at the option of the state, if the work is not completed within the time specified.

From answers received to inquiries sent to all state highway departments, it appears that there will be available for highway work during the ensuing two years approximately $700,000,000. This would involve the employment of approximately 400,000 men each year for the working season, estimated at 180 days. Undoubtedly, the amount available and included in this sum will be materially increased by many of the states.

In connection with preparations for highway work, there are several conditions which should be corrected. First, the control of highway bond issues by the Capital Issues Committee should be removed, so that money can be made available without delay. Second, while prior to the time of utilities commissions and the Interstate Commerce Commission many states received concessions in freight rates on road-building material, these have been removed, and in many cases rates have been increased out of proportion to the advance in other commodities. A release should be given, especially during this emergency. Third, a great many highway engineers have been taken into the United States service, and the Government should be urged to release these men as rapidly as possible, so that they may resume their work.

If we are to have great development after this war, as we did after the Civil War, brought on by returning soldiers settling on farm lands, we must give them good roads. Having seen the excellent roads of France and Belgium and Italy, reaching through the smallest hamlet, they will not be satisfied unless they have roads connecting them with adjacent communities.

Laying Out, Marking and Maintaining a State Trunk Highway System

By Paul D. Sargent

Chief Engineer, State Highway Commission of Maine

(From a discussion of the paper read by A. R. Hirst and printed in Engineering News-Record of Dec. 12 and 19, pp. 1065 and 1128.

Regarding the fundamental points of laying out a state highway system, so well brought out by Mr. Hirst in his presentation of the subject, I am sure that we can all agree. These points are specially valuable for states which are just undertaking the designation of a system of state trunk highways, together with their management.

In many of the states which undertook state highway work—say 15 to 20 years ago—no mention of trunk lines was made in the law. They were not popular, and each commission had to develop a system more or less piecemeal. This was especially true in most of the Eastern states. For example, the state-aid roads in Maine were originally designated by the county commissioner of each county, and this work was done without any particular reference to connecting the state-aid roads lying in the different towns. It was not until 1913 that the legislature created a highway commission and directed the laying out of an interlocking system of state highways. The system as laid out comprises 1300 miles, which is a fraction over 5% of the entire road mileage. It passes through 230 of a total of 521 cities, towns and unorganized plantations. Undoubtedly, from time to time slight additions may be made to this system, but I can hardly conceive that—in our state, at least—it will ever be necessary to include as much as 10% of our road mileage, as suggested by Mr. Hirst.

Marking the System

I feel hardly competent to discuss from personal experience the question of marking the system. I quite agree that it should be marked, but I must confess that up to within a year my personal position has been that no traveler, having fair general instructions, would ever leave an improved highway as long as he could see a good road ahead. However, properly marked highways are a very great convenience to travelers. An example of this is seen in the State of New Hampshire, which has an especially complete system of marking. Each highway has received a distinctive color, or combina-

tion of colors, and color bands are painted upon telegraph poles or trees on either side of each intersecting highway, and on the end posts of all guard rails.

Connecticut and Massachusetts also have a system of color-band marking as follows: North and south highways are marked with blue bands; east and west highways with red bands; and diagonal highways with yellow bands. The system outlined by Mr. Hirst is more complete than anything I am familiar with, and it seems to leave little to be desired in this respect.

Maintenance

Our experience in maintaining state highways has been similar to Wisconsin's, and I can agree with Mr. Hirst as to the desirability of a state immediately assuming the maintenance of the entire state system when laid out.

It has been our experience that most towns on our system have immediately lost interest in maintaining any section of road which has been designated, on the ground that the state will eventually build and maintain it. This condition has proved to be a very serious one for the traveling public, and upon the request of the highway commission permission was granted by the legislature to take over the entire maintenance of both improved and unimproved roads.

From Mr. Hirst's paper, I understand that the maintenance work of Wisconsin is actually done by the road forces of the various local communities, under the direction of the State Highway Commission. From an experience of two years in attempting to get maintenance done this way, I would say that I consider the method very unsatisfactory. As our system of improved roads was more or less disconnected, it seemed difficult to maintain it with patrolmen, and consequently arrangements were made with municipal officers and road commissioners in each town to do whatever work was laid out for them by the supervisors of the State Highway Department. The work was inspected from time to time, but we had difficulty in getting it done when we wanted it, and in the proper manner. In fact, it was found that some of the money was never expended on the roads where intended, but on entirely different roads.

As a result of the above experience, the legislature directed that all cities and towns coöperate with the highway commission for the maintenance of all the improved roads, and should themselves maintain the unimproved roads.

This work has been carried on for three years by the patrol method, the state having entire charge of the work. The patrolmen are hired from a list recommended by the local officials after the men have been interviewed by the state supervisor. Each spring they receive a complete set of instructions, and are visited as often as once in two weeks by one of our supervisors.

In 1916 patrolmen were paid \$75 per month. For this they furnished one horse weighing not less than 1200 lb., a drop-axle wagon and the necessary hand tools, and a drag built for one horse. During the present season we started in paying patrolmen with one horse 44c. per hour, and with two horses 55c. per hour. On Sept. 1 we increased the rates to the following amounts: 50c. per hour for a man with one horse; 60c. per hour for a man with two horses. Due to abnormal labor conditions prevailing, and to stabilize our patrol force, we made an agreement with every patrolman when we hired him that we would pay him only 95% of his wages each month. The remaining 5% was to be held back until the end of the season and paid if he remained. If a man was discharged on account of unsatisfactory work, he was not to receive this 5%. This method has worked very satisfactorily. The total expenditure for maintenance in 1916 averaged \$77.43 per mile; for 1917, \$117.19 per mile; and rough figuring indicates that this year, due to high prices, it will be \$157 per mile.

Use of Motor Trucks

Noting that Mr. Hirst does not favor the employment of trucks on patrol maintenance, I desire to refer to our experience in this line. During the season of 1918 we have had four one-ton trucks in patrol service. These trucks have replaced from two to four horses used under the old scheme; in other words, we have combined two, three or four patrol sections and have employed a truck driver with two to three helpers. Our observation is that these sections of road have been better cared for than in any previous season, and we plan to operate the trucks another year. However, one-ton trucks are not heavy enough for dragging, and when it has been necessary to drag the shoulders we have had to employ teams.

A comparison of the cost of patrol maintenance by trucks and by horses may be interesting. On one of our state highways, 35 miles in length, it cost \$10,711.77 to maintain it by the man-and-horse patrol system. During 1918 the cost, including an allowance of \$2 per day for depreciation of the truck, was \$8,098.01, or a saving of \$2500. On a 34-mile section it was, in 1917, \$4,392.38; in 1918, \$2,704.76, or a saving of \$1700. On a 20-mile strip of road there was an increase from \$3,599.65 to \$3,806.17, but it is fair to state that in this section there was a piece of road 1.7 miles long which was entirely constructed.

Utilizing More Mechanical Devices in Highway Work

By Frank F. Rogers
State Highway Commissioner of Michigan

During the past year, and in spite of adverse conditions due to the war, there has been so much good-roads sentiment in Michigan that it would have been impossible to shut down road building entirely. In fact, there never was so much money available for road-building purposes before. While these peculiar conditions existed and there was nothing startling in the way of the use of new kinds of equipment, still, there were some labor-saving mechanical devices used which seem worthy of note.

Some of the commoner devices, such as steam shovels, have been used quite extensively in road grading. The steam shovels have been used not only where the excavation is heavy, but sometimes on rather light work, where not more than a foot, or less, had to be scraped off from the old grade. Mechanical power for delivering materials to the roads has been used quite exten-

sively and ranges from the motor truck to the industrial railway. In fact, it may be said that mechanical hauling has very largely displaced team hauling on the Michigan roads.

In grading operations, tractors have largely superseded horsepower. Tractors were not only used for hauling graders, but ditching has been successfully done by using flat-board scrapers. A scraper is hitched to each end of the tractor, which has a very short wheel base. The tractor is then moved across the road alternately forward and backward, but with a slight angle to the center line of the road, so as to move along the road the width of the scraper with each move. As the tractor moves in this diagonal fashion ahead, the scraper hitched to the rear end draws a full load up onto the road, while the scraper hitched to the front end is backed to the ditch, and vice versa. This way of using the tractor is said to be much more rapid than the work of two teams. Ditching has also been done with the same type of scraper, by using a small gasoline reversible hoist placed on a truck stationed in the center of the road. A scraper is hitched to each of the two ends of a cable which run off opposite ends of the drum.

One report speaks of a tractor being used for dragging, but expresses doubt as to the advisability of using it where there is a crust on the road, as in sand-clay construction, because the lugs on the wheels do possibly as much damage as the dragging does good.

Car camps on wheels, with two units in each outfit, one a sleeping unit and the other a kitchen, have been used in one county. These, with two tractors, have maintained a road 70 miles in length in better condition than ever before, and at a saving in cost equal to the cost of the tractors. Great economy was effected by being able to move camp each day if necessary, thus keeping the crew adjacent to the work. This method was used in Gogebic County by the county engineer, C. F. Winkler.

A roller of novel design, for finishing concrete roads, is reported on by J. W. White, county engineer of Monroe County. It is built to roll lengthwise of the road, and its surface is concaved to give the required crown. The first roller built was of wood, was 3 ft. in diameter and $15\frac{1}{2}$ ft. long and weighed 2200 lb. This had a tendency to produce a wavy surface, so one of 5-ft. diameter, weighing about 2000 lb., was built of steel. The latter cost about $400. This rolling compresses the concrete slab between $\frac{1}{4}$ and $\frac{3}{8}$ in., squeezing out the water and closing the voids. Ten miles of road have been built thus, with perfect satisfaction.

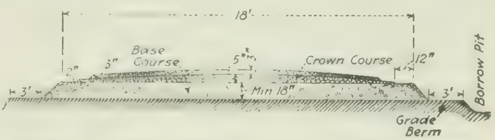
Besides the above, portable sand- and gravel-washing plants, special motor trucks equipped with spreading apparatus for surfacing, complete central distribution plants with proportioning apparatus, and an industrial railway to deliver the material to the mixer, have been used.

Constructing Gravel Road Across Salt Lake Desert

Lincoln Highway Has 17-Mile Tangent on Cut-Off Which Saves 50 Miles of Travel—Grading With Caterpillar Equipment

CONSTRUCTION of an 18-mile stretch of gravel road having a 17-mile tangent is included in the 142-mile cut-off on the Lincoln Highway in Utah. This cut-off shortens by about 50 miles the distance to be traveled on the highway. The route followed by the highway passes through Coe Cañon and will cross a spur of Granite Mountain, which juts out into the desert. Another section will cross a mountain range, where the present trail through Johnson Pass will be improved and widened.

This new road is built with a width of 18-ft. at the top of a base course which has a minimum thickness of 18 in. and a maximum of about 5 ft. Desert soil is used for the base, and is covered with a 5-in. course of gravel upon which is a second or wearing course of gravel 3 in. thick. The details are shown by the cross-section. The culverts are shallow wood boxes 6 or 12 ft. wide and 12 in. high, and are laid on the natural surface and covered with the roadway fill. In constructing the fill, the ground is broken by gang plows of the blade type, and elevating graders working on either side of the road build up the base course. This is then dressed to shape by road graders. Caterpillar tractors of 40 hp. and 70 hp. haul the plows and graders, respectively. After the roadbed has been finished with a five-ton roller, the gravel is hauled and distributed by motor trucks having steel-tired wheels, which serve to pack and consolidate the material. Heavy rains softened the loose, silty soil to such an extent that it would not carry the weight of the road-building machines. To meet this emergency, the bearing surfaces



TYPICAL CROSS-SECTION OF ROAD ACROSS DESERT

17-MILE TANGENT ON DESERT ROAD WITH CONSTRUCTION CAMP IN FOREGROUND

were widened by bolting pieces of heavy plank to the caterpillar tracks of the tractors and to the wheels of the graders. This was described in *Engineering News-Record* of Dec. 12, p. 1092.

On the desert section about nine miles of road had been completed early in November at a total cost of $56,166, or $6240 per mile. Work on the mountain pass section had only been commenced at that time. A

CATERPILLAR ROAD-GRADER AT WORK ON THE DESERT

force of 24 men was employed on the work, under charge of R. E. Dillree as superintendent, with a camp of large tents at Black Point. During the long summer days two-shifts were worked, in order to expedite the work.

The new road is being built by the State Road Commission of Utah, a portion of the funds being provided by the Lincoln Highway Association. The construction is under the direction of Ira R. Browning, state road engineer, and G. F. McGonagle, state engineer.

Cost-Plus Contracts Great Lesson of War Construction

Three Important Tasks Confront Organized Contracting, Asserts General Marshall, Chief of Construction Division of the Army

THREE lessons of vital importance to organized contracting have come out of the experience of the United States in contracting for war construction. In his address at the Chicago convention of the Associated General Contractors of America, Brig. Gen. R. C. Marshall, Jr., chief of the construction division of the War Department, presented these lessons in the following words:

"First, the economic problems with which this country is about to be confronted can be solved only through the hearty and intelligent coöperation of those men most intimately associated with the labor problems. This is the primary function of this new organization—the cementing, through honest and equitable dealings, of a harmonious relationship between the contractors and the labor of the country. Readjustments must happen, but these readjustments must be made in the development of the reconstruction period and must not be revolutionary in their character.

"The next great lesson is that bearing upon the relationship between the contractor and the owner. No contractor should be called upon or permitted to undertake the performance of any contract such that within the four corners of the paper upon which it appears, is, or may be, written the financial bankruptcy of the contractor. It is unjust, it is inequitable, it is uneconomic.

"The great lesson of this war on the subject of the relationship between the contractor and the owner is the cost-plus contract. This represents the only equitable basis upon which a contractor may perform constructive and economic services for the owner. It is the only form of contract which affords protection to both parties. All of the energies, the thought and the experience of this country within its own continental lines during the past year and one-half of this world struggle shall have been in vain unless out of it shall grow, as a permanent institution, solidifying the economic relationship between the contractor and the owner, the cost-plus contract.

"There is one other thought. This association should undertake to encourage coördination between contractors, engineers and architects, through which coördination not only will friendly relations be encouraged, but a united effort will be made to attain the unification of the energies of all of these three groups, each of which is equally interested in the one problem of construction.

"An effort should be made by this association for direct contact with associations of engineers and architects, by which contact there may be afforded a medium of exchange of ideas, to the end that there will be a perfect harmony of action on all of these mutual problems."

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Why Offer Such Low Government Salaries?

Sir—Recently I received a typical civil service announcement from the Navy Department asking for draftsmen of different grades, the salaries ranging from $4 per day in Grade 1 to $6.88 and over in Grade 4. Practically only in Grade 1 are men accepted who are not graduates of schools of recognized standing. In addition to this, considerable practical experience is required.

It states that many vacancies now exist, and, further, that "the department is finding difficulty in obtaining for the rates of pay it has to offer men with the qualifications necessary to meet its requirements. As the need for ship draftsmen is pressing, qualified persons are urged to enter this examination."

It struck me that if the Government is having difficulty in finding men at the salaries offered, why are they not increased? That is the customary thing in other professions; why should the Government appeal to engineers' patriotism in a case like this, when the engineer has no chance to appeal to anyone's patriotism in meeting the high expenses caused by the war?

I think it is time that the engineering profession got

together to require just compensation for service. During the war the American engineers have shown ability to adapt themselves to extraordinary conditions and make good. The profession is probably now recognized as of much greater importance in the world's affairs than ever before. I believe the time has come to use this recognition to obtain greater recompense. By organization, other workers have increased the recompense for their services tremendously, while professional men have stood still. I believe it is not below the dignity of the profession to bring pressure to bear upon both Government and private organizations for greater recognition in the form of higher salaries.

State College, N. M. A. F. BARNES,
Dean of Engineering, New Mexico College of Agriculture and Mechanic Arts.

Equivalent Uniform Loads for Maximum Stresses Discussed

Sir—I have read with great interest D. B. Steinman's article in your issue of Aug. 1, page 231. I believe, however, that cases frequently occur in statical indeterminate structures in which it is difficult to apply the results directly.

It will, for instance, be difficult to apply Dr. Steinman's values in cases of reversal of live-load stress where the influence area for the larger stress is shorter than the influence area for the smaller stress. To be consistent, the same train length with engines headed the same way should be used for both influence areas, the reversal of stress being understood to occur during the passage of the live load.

I wish, therefore, to mention a somewhat different method for reading influence lines, for engine and train load, which may be applied in cases where Dr. Steinman's equivalent values cannot be directly applied. This method is to substitute a uniform loading equivalent to the engines only, followed by the specified uniform train load. This equivalent loading will answer the purpose for any form of the influence line, whether curved or triangular, and for any length of loading longer than about twice the length of the engines. This form of equivalent loading will further take care of any lack of symmetry of a segmental influence line, which lack of symmetry frequently occurs to a pronounced extent; for instance, for the bottom chord members nearer the center of a spandrel-braced two-hinged arch.

The position of loading which gives maximum stress is found quickly by applying a transparent scale made as follows: On the ordinate to a horizontal line, plot 1 unit = the intensity of equivalent engine load; for instance, 1 unit = 8500 lb. On another ordinate at a distance from the first equal to the length of the engines —for instance, 100 ft.—plot 1 unit = the difference between engine intensity and train-load intensity; for instance, 1 unit = 8500 — 6500 = 2000 lb. The position of loading which gives the same reading of the subdivisions of the two scales, simultaneously, is the position which gives maximum stress; these values correspond approximately to E 65 loading.

An equivalent loading of this character can be made to give readings with a deviation of less than ½% average and less than 1% maximum from exact reading with wheel loads; for lengths shorter than about 200 ft. an exact reading with wheel loads should be used.

The proposed method may, however, be adopted for shorter spans by using one uniform load intensity for the engines and another load intensity for the tenders. In the case of investigating a bridge for one heavy engine followed by train load, there should be three ordinates on the scale; one ordinate with unit equal to the engine load, one ordinate with unit equal to the difference between the engine and the tender load, and one ordinate with unit equal to the difference between the tender and the train load. The maximum position is found when the reading on the engine ordinate is equal to the sum of the readings on the two other ordinates.

It may be added that, for the lower half of verticals in K trusses and for the bottom chord in Petit trusses a uniform load as here proposed would fulfill the condition better than Dr. Steinman's loading, on account of the broken shape of the influence lines.

Detroit, Mich. C. L. CHRISTENSEN,
Assistant Bridge Engineer, Niagara River Bridge, Michigan Central R.R. Company.

[The foregoing letter was submitted to Dr. Steinman, who made the following reply.—EDITOR.]

Sir—The method of finding live-load stresses submitted by Mr. Christensen should be of interest to bridge computers. The principle applied therein for fixing the position of a chain of uniform loads to produce maximum stress is capable of a strikingly simple demonstration which shows the criterion to be correct for any form of influence diagram. The only limitations of the method arise from the evident inaccuracy of substituting a fixed average uniform load for the wheel concentrations of the locomotive loading.

If Mr. Christensen's method has any practical usefulness, it is only for long-span structures or influence diagrams exceeding 200 ft. in length. For shorter influence lines, the method cannot be used without further subdivision of the train into separate uniform loads for engines and tenders, respectively; and when this is done the increased complication of applying the criterion and the extra labor of evaluating the load-area products destroy whatever time-saving advantage this method may have over the ordinary and more reliable procedure of moving-wheel concentrations.

Even for longer spans, the proposed method cannot be relied upon for accurate results. Its application to some simple examples selected at random by the writer yielded errors ranging from 2 to 5%. With the writer's "Chart of Equivalent Uniform Loads" (*Engineering News* of Apr. 22, 1915), the same stresses are obtained, correct within 0.1% and with an expenditure of but a small fraction of the time and effort.

Mr. Christensen's method requires an accurate scale drawing of the influence lines, and involves the labor of first determining the load position for each stress, and the succeeding measurements and computations of load-area products multiply the opportunities for mistakes. In the writer's method, even a freehand sketch of the influence line can be dispensed with; the trouble of finding the load position is entirely eliminated; there is no scaling of ordinates or measurement of areas; and the entire operation is reduced to a single multiplication. Moreover, the method is applicable to all lengths

of span without modification, being just as simple and accurate for short influence lines as for long ones.

The foregoing observations would appear to exclude the proposed method of Mr. Christensen from consideration as practically advantageous with influence lines of any form shorter than 200 ft., or with rectilinear (triangular) influence diagrams of greater length. For curved influence lines exceeding 200 ft. in length, the wirter's "Chart of Equivalent Uniform Loads" gives the stresses within a fraction of one per cent. even without applying any correction for curvature. Consequently, there would appear to be no advantage in the new method over existing methods for any ordinary case of influence lines, either rectilinear or curved, short span or long.

Mr. Christensen cites some special cases which he regards as limitations of the writer's method of Equivalent Uniform Loads. The first of these is a rather far-fetched case arising from an unusual specification relating to reversing stresses. Even in such a case, the error arising from the use of the writer's method without modification would be small and on the side of safety; and considering the uncertain and debatable nature of all provisions for reversal of stresses, there would appear to be little need for over-nice distinctions in such stress calculations.

With unsymmetrical curved influence lines and other forms of peculiarly irregular shape, it is questionable whether the proposed method would give better results than the writer's. In these exceptional cases the writer would prefer to use the old method of moving wheel concentrations; if these are applied with a transparent scale (as described by the writer in *Engineering Record* of Apr. 24, 1915) the exact stress is quickly obtained by the simple addition of the ordinate readings, and the time required will be less than in Mr. Christensen's method of products of average loads and areas.

New York. D. B. STEINMAN.

Luxury or Necessity?

Sir—Referring to the editorial, entitled "Luxury or Necessity?" in your issue of Oct. 31, I am gratified to note your appreciation of the fact that Government control has, in the matter which you discuss, accorded recognition to the necessity for maintaining corporate organizations of the railroad companies during the period of Federal control. I cannot help regretting, however, that you did not acquaint yourself with actual circumstances before venturing upon the subsequent observations contained in the editorial and relating to the recall of an Army officer to become engineer of a railroad corporation. There can, I assume, be no question that the editorial has reference to the Pennsylvania R.R. Co., and to the release from the service of the United States Army of Col. H. C. Booz to become our corporate engineer. At any rate, "the coat fits," and I am not aware of the existence of any similar case which you might have in mind.

What hurts in your article, by reason of its injustice, is the reference that, in asking for the release of Colonel Booz, our company acted selfishly and placed corporate interests before patriotic considerations. As this was by no means the case, I will endeavor to make clear what the exact facts were.

In September, 1917, Colonel Booz, then assistant chief engineer of our company, was granted leave of absence to serve in France on the staff of Gen. W. W. Atterbury, director general of transportation of the American Expeditionary Forces, and operating vice-president of this company. Colonel Booz was appointed engineer of construction under General Atterbury, and in this capacity had charge of planning and constructing the wharves, docks, rail lines, and other new port and railroad facilities necessary for the entrance of the American Army into France and its maintenance there. He was abroad one year, and in that period perfected full plans for, and, in major part carried to actual completion, the work coming under his supervision. The uncompleted portion, prior to the initiation of steps looking to his return, had very largely been taken over by the regular Army engineering forces. In fact, during the course of the year, the railroad problem connected with the presence of the American troops in France changed from one of engineering construction to one of actual operation, so that the engineer taken from civil life to plan and start the work, and execute its principal portions, could be safely withdrawn without in any way affecting the carrying out of our country's war plans.

It seems pertinent to refer at this point to a fact which heretofore could not be published; namely, that with the return of Colonel Booz to this country steps were immediately taken to send to France an experienced transportation officer to serve on the staff of General Atterbury. The official selected, J. G. Rodgers, is a member of our corporate organization and assistant to the president of the company. He was formerly general superintendent of the northern division of the Pennsylvania R.R., and, on the entrance of this country into the war, was detailed to duty in Washington as one of the aides of the railroads' war board. Mr. Rodgers has been commissioned lieutenant colonel and is now on his way abroad to assume charge, as an operating expert, of the transportation facilities which Colonel Booz planned and largely carried to completion. Therefore, even on the man-for-man basis, the arrangements made by our company with the military authorities do not involve any diminution of railroad experts at the service of the Government.

Before any formal steps were taken to request the withdrawal of Colonel Booz, the military authorities here and abroad were consulted, and they were found entirely agreeable to the action contemplated. We would think the fact that the release of Colonel Booz would, of necessity, have to receive the approval of the War Department ought to be a sufficient guarantee that no interference with, or risk to, the military plans of the United States was involved, but we regret that you did not view the situation in that light.

You suggest that we might have sought a corporate engineer elsewhere, and I have no doubt that this was based upon the assumption that other trained civil engineers were available in the railroad organization. This, however, was not the case, as the entire civil engineering official staff of our company at home was taken over by the Railroad Administration, as a war emergency step, to assist in keeping the railroads in this country in operation for military purposes—a primary necessity to the successful conduct of the war abroad—and, at the

same time, to make possible the maintenance of an adequate service for the general public. Colonel Booz was, therefore, the only properly qualified man available, and in view of the advanced stage reached by the work under his charge, and the full assurance of the military authorities that the time had been reached when he could be released without detriment, we felt fully justified in taking a measure which is necessary for the protection of the stock and bond holders of this railroad system, who, it is well to bear in mind, have more than $1,750,000,000 worth of property at stake.

You threw in a remark to the effect that you were informed that the engineer in discussion was by no means anxious to be withdrawn from service abroad. This is entirely correct, and is in the highest degree creditable to Colonel Booz. It is, in fact, entirely natural in the case of a man who is still young and possesses spirit and patriotism. Nothing could be more in accord with human nature than a desire on his part to see the conclusion of the great events which he had been witnessing for a year, but such desire did not stand in the way of acquiescence in a call for performance of duty to his railroad corporation, after his duty to his country had been performed.

I might perhaps pass by the uncertainty created by the title "Luxury or Necessity?" but feel that it is probably better to deal with all matters fully. Our corporate organization consists of less than 200 officers and employees, and this very modest force must deal with all the extremely difficult and complicated accounting, legal and other matters arising out of the relations between the company and the Government, as well as protect the financial interests of stock and bond holders amounting, as I have stated, in the Pennsylvania System, to about $1,750,000,000. As contrasted with this corporate organization, it may be well to bear in mind that, in round figures, 260,000 officers and employees of this railroad system are now in the service of the Government.

The necessity for a corporate engineer may be judged from the fact that such an office is necessary under the terms of the standard clauses of the contract with the Government. These require, on the company's part, supervision of plans and estimates for, and of the actual carrying out of, all new construction work, the cost of which is to be borne by the corporation; also protection of the company against being charged with work for which it should not properly pay (i.e., pure war facilities), as well as inspection to assure the upholding of Pennsylvania R.R. standards in maintenance work, reconstruction of buildings, bridges, and other facilities during the period of Government control; and, in addition, supervision over maintenance and depreciation charges to operating expenses during Federal control. Mr. Booz will be in charge of this work for practically all the lines of the Pennsylvania System east of Pittsburgh and Erie, and *the new construction work alone, already planned and coming under his supervision, amounts to more than forty million dollars.*

May I close by briefly calling attention to the fact that this railroad system has still a representation in the Army of the United States of which we feel that we have just reason to be proud? Our vice-president in charge of operation is still the director general of transportation for the American Forces in France. We have also in France the president and operating head of the Cumberland Valley R.R., of which the Pennsylvania R.R. Co., is sole owner; the general manager of the Long Island R.R., of which our company is practically sole owner; the comptroller of the Pennsylvania R.R. Co., and many other of our most valued officials and employees. Altogether, considerably more than 20,000 Pennsylvania R.R. men are in active military service and many of them entered the army as volunteers before any draft law or selective service act was put in force, and when men of experience were badly needed, especially in making up railroad engineering regiments of the Army.

We particularly regret the inference in your editorial because our company and its men were among the very first to make heavy sacrifices toward winning the war, and the release of experienced officers and men beyond draft age added to the burdens and sacrifices necessary on the part of those who were left behind to carry on their work—a work just as necessary to the successful outcome of the war as has been that of the soldiers in the field.

A. J. COUNTY,
Vice-President in Charge of Accounting,
Pennsylvania Railroad Company.
Philadelphia.

Modified A. R. E. A. Impact Formula

Sir—I was much interested in the article on impact formulas in your issue of Nov. 21, and wish to add another formula that seems to agree with the A. R. E. A. tests fairly well and is somewhat more simple than some of those I have seen proposed. It is a modification of the Schneider formula, which I first incorporated in our specifications in 1908 previous to the publication of the A. R. E. A. test results. It is

$$S = \frac{300}{2L + 300} \text{ for main line}$$

$$\frac{150}{2L + 150} \text{ for spur tracks.}$$

This impact addition is used with 15,000 lb. per square inch working stress. It gives slightly heavier construction than the A. R. E. A. specifications for spans up to about 50 ft. and lighter beyond that, when the main-line formula is used. As we have a number of bridges on stamp-mill approaches, where the main-line formula would give excessive results, the spur-track formula was adopted to cover such cases.

F. L. BATCHELDER,
Chief Engineer, Copper Range Railroad Company.
Houghton, Mich.

Reduction in Cement Sack Loss Saves $25,000

Every empty cement sack in good condition returned to the cement mill brings 25c. On the Miami Valley flood-protection work enough cement will be used to bring the sack salvage credit to $500,000, providing there is no loss of sacks. In ordinary construction operations the sack loss is between five and ten per cent per 100 sacks received. A 5% loss on $500,000 is $25,000. This is the sum which will be saved if loss is reduced, by care, from ten sacks to five sacks per hundred.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Costs Are Not Trade Secrets to Be Concealed

CONTRACTORS as a whole keep cost records from the eyes of all but a few of their principal assistants. One contractor, known to the writer, has adopted the opposite plan. He opens his field-construction cost records to any man in his organization who is interested enough to ask to see them. He invites his foremen and machine operators to study these records, and takes pains to make the figures so plain that no one can fail to understand them. He goes even further in his cost-publicity practice; he bives to the engineer or architect who is supervising the work access to the records. No idealistic thought stands vaguely behind this policy of cost publicity. The contractor argues that the more men there are in his organization who are familiar with costs and their analysis, the more intelligently and efficiently will his work be handled. He argues further that the more nearly the engineer or the architect knows the contractor's actual costs the more reasonable he will be in consenting to modifications in plans and in granting allowances asked for by the contractor. More surprising than all that has been told, this contractor denies that publishing his costs gives a competitor any advantage. It is efficiency, he says, and not cost data, that makes for low costs. C. S. H.

Other Articles of Interest to Contractors In This Issue:

Ore Cars on Flat-Cars Charge Paving Mixer

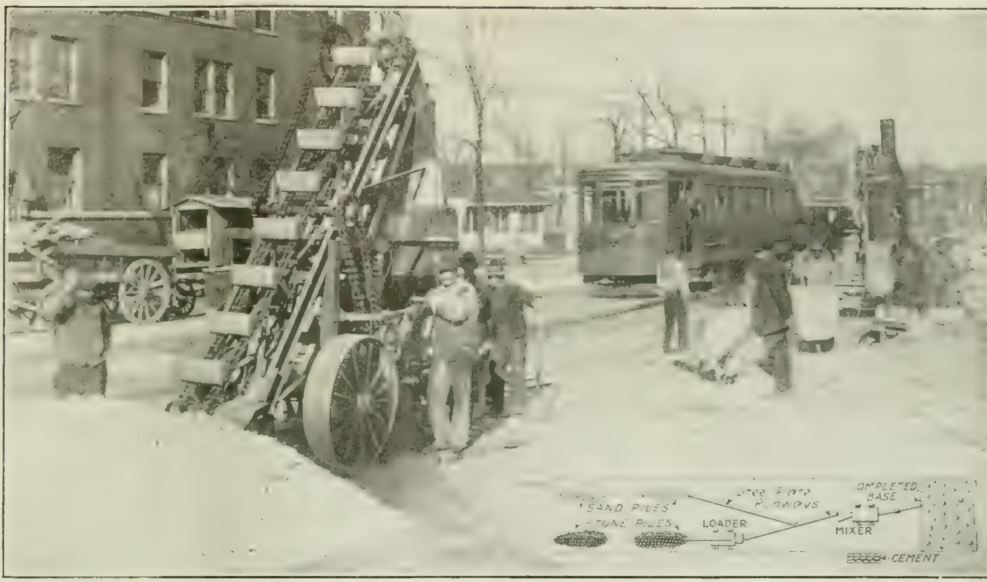
STANDARD flat-cars, each carrying 16 ore cars, holding 16 proportioned batches of concrete materials, supply a mixer which is paving street railway track in Denver, Colo. This outfit, operated by the Denver Tramways Co., consists of a mixer, a service car and three supply cars. Each car has tracks on top capable of holding 16 ore cars of 13 cu.ft. capacity each. The ore cars are loaded at the materials yard with proportioned batches.

In operation, the service car remains behind and serves the mixer, and the three supply cars ply between the mixer and the materials yards. On the service car are three narrow-gage tracks converging to one track at the front end. Two tracks are occupied by loaded cars, and the third track is a spare track for empty cars.

In charging, a loaded car is pushed onto the end track, where it is caught by the hooked rail ends and its load is tilted into the mixer hopper. After being emptied, the car is run back onto the spare track.

When the 16 ore cars on the service car have been emptied, a supply car with 16 loaded cars runs up behind, shifts its loaded cars to the service car, and

PAVING MIXER CHARGED BY ORE CARS CARRIED ON FLAT-CARS



SELF-FEEDING BUCKET LOADER FILLS WHEELBARROWS FROM STONE PILE

replaces them with empty cars from the service car. The runs of the supply cars are scheduled so that one is at the yards being loaded, the second is on its way to the mixer with loaded cars, and the third is returning from the mixer with empty cars. Altogether 64 ore cars are employed. At the service car two men handle an ore car. The "concrete train," as it is commonly called, has worked successfully, and as it keeps the street free from stock piles has met with favor from the business concerns in streets being paved.

Self-Feeding Loader Eliminates Stone Shoveling for Concrete Base

STONE shovelers were replaced by a mechanical outfit for loading wheelbarrows, on recent concrete-pavement base construction in Chicago. Two men trimming the stone stockpile and two men operating the loader kept four wheelers busy on a haul of not to exceed 75 ft. In fact, the loading machine had frequently to wait on the mixer and the concreting crew, although some 1500 sq.yd. of 6-in. base was being laid each day. During war times shovelers for the hard work of loading crushed stone have been difficult to obtain. The mechanical loader was the means sought to relieve this scarcity.

As shown by the view, a bucket elevator takes stone from the pile and discharges it into a forward hopper with a gate under which the wheelbarrows pass and take their loads. The distinctive feature is the bucket-feeding device. This consists of two horizontal steel disks, set close to the ground, which slip under the edge of the stone pile, and revolving toward the buckets, convey the stone to them. The bucket lips just clear the tops of the disks.

The entire outfit is mounted on a truck and is self-propelling, so that, as the stone is taken up, it can be kept in constant contact with the pile. The plant layout on the work referred to was about as indicated by the sketch plan drawn on the view. Four men operated the loader—two trimmers, an operator and a gateman. Four wheelers delivered the stone to the mixer. Sand was loaded and wheeled by four men. Two men handling cement, two men on the mixer and three or four men placing concrete rounded out the working crew. The contractors were the Ryan Co., Chicago.

Following of Definite Rules Improves Construction Photographs

EXACT rules for taking photographs of construction work in progress or completed are necessary for uniformly good results, in the experience of the Austin Co., Cleveland, Ohio. Only 8 x 10-in. films or plates are used. Photographs during construction and after building is completed are taken from the same points. A point is selected which gives a three-fourths front view and shows at least a part of the side of the building. Generally, the best time for an exterior picture is when the shadows are fairly prominent, so that brick work, door openings, etc., are accentuated. Whenever possible there should be one person in the picture to serve as a scale of size. Telegraph poles are to be avoided, but trees covering a small part of the building are not objectionable. A margin is necessary to serve as background. In taking interiors, a view straight down the center of the building is preferred, unless columns interfere; the camera should be slightly to one side of the center and at least 20 ft. from the nearest column. Every print should bear the date of taking and the title.

NEWS OF THE WEEK

New York, December 26, 1918

Harvard Engineering School Reorganized

Undergraduate and Advanced Courses Offered by Independent Teaching Staff

The reorganized Harvard School of Engineering will begin work on Jan. 2, and will continue in session until next September, in order to complete a full school year. The reorganization supersedes the earlier plan for a merger of engineering instruction by Harvard and the Massachusetts Institute of Technology at the new buildings of the latter. This plan was upset by a decision of the Massachusetts Supreme Court that the Gordon McKay millions willed to Harvard could not be used for the merger.

At the outset there will be six departments; (1) mechanical; (2) civil, (3) sanitary and (4) electrical engineering; (5) mining and metallurgy, and (6) industrial chemistry. The school [presumably in accordance with the McKay will—EDITOR] will provide "all grades of instruction from the lowest to the highest," and will be "accessible to pupils" with only high-school education.

The school work will be carried on at Harvard, but one-year arrangements may be made for the use of facilities of other institutions for any part of the school work in advanced technical courses. There may also be interchange of instruction with other institutions, and instruction may be given to students from other schools.

The degree of B.S. will be given on satisfactory completion of a four-year course in any of the departments, and of M.S. for one year's additional study. For a doctor's degree the requirements will be the same as those in the Graduate School of Arts and Sciences.

The school will be administered by a faculty composed at the outset as follows:

Abbott Lawrence Lowell, President.

George Fillmore Swain, Gordon McKay professor of civil engineering.

George Sharp Raymer, assistant professor of mining.

Arthur Edwin Kennelly, professor of electrical engineering.

Henry Lloyd Smyth, professor of mining and metallurgy, and director of the mining and metallurgical laboratories.

Harry Ellsworth Clifford, Gordon McKay professor of electrical engineering.

Lewis Jerome Johnson, professor of civil engineering.

Albert Sauver, professor of metallurgy and metallography.

George Chandler Whipple, Gordon McKay professor of sanitary engineering.

Comfort Avery Adams, Abbott and James Lawrence professor of electrical engineering.

Frank Lowell Kennedy, associate professor of engineering drawing.

Lionel Simeon Marks, professor of mechanical engineering.

George Washington Pierce, professor of physics, and director of the Cruft Memorial Laboratory.

Hector James Hughes, professor of civil engineering and director of the engineering camp.

Edward Vermilye Huntington, associate professor of mathematics.

Gregory Paul Baxter, professor of chemistry.

Lawrence Joseph Henderson, assistant professor of biological chemistry.

Louis Caryl Graton, professor of economic geology.

Arthur Edwin Norton, assistant professor of mechanical engineering.

Harvey Nathaniel Davies, assistant professor of physics.

Grinnell Jones, assistant professor of chemistry.

Emory Leon Chaffee, assistant professor of physics.

Bill for $1,000,000,000 Highway Bond Issue Introduced

A bill providing for the issuance of $1,000,000,000 in bonds, to be used in Federal coöperation with the states in building good roads, has been introduced in Congress by Senator Smoot of Utah. Expenditure of equal amounts by the state and Federal Governments, under state control with Federal approval, is provided for. The bill is similar to that introduced in 1914 by Senator Jonathan Bourne.

New Members Elected to Highway Industries Association

At the annual meeting of the Highway Industries Association, held in Chicago recently, the National Vitrified Pipe Manufacturers' Association and the Lime Association were elected to membership. John L. Rice was elected director to represent the former organization, and R. F. Hall the latter.

Fitting-out Record Made on Lakes

In fitting out the canal-size steamer "Lake Cathcoon" in 13 days and 4 hours from the time of launching, the Buffalo yard of the American Shipbuilding Co. on Dec. 7 achieved a new record for the Great Lakes district, and probably for the entire country. The working time of fitting out was only 12 days and 5 hours.

Bridge Renewal by Rolling Done in Fast Time

Five-Span Greenfield Bridge Replaced In Two Minutes—Old and New Bridges Coupled

Working under adverse weather conditions, bridge erectors replaced the five-span Green River Bridge of the Boston & Maine R.R., at Greenfield, Mass., by a new structure, in less than two minutes' moving time. During the work the atmospheric conditions were such that it was impossible to see the length of the bridge after the hoisting engines started, but the work was completed without delay or difficulty.

Rebuilding the Fitchburg division bridges of the Boston & Maine R.R. is in progress to accommodate increased traffic. The division is double-tracked, but on account of the heavy traffic neither of the tracks can be given up for erection purposes. Detouring was not feasible at the Green River crossing, and the rolling method therefore had to be adopted. The old bridge consisted of three deck truss spans 154 ft. long and two deck girder spans 52 ft. long. The new bridge uses the old masonry. It was erected on falsework upstream of the old structure and swung on timber pier extensions. Similar pier extensions downstream carried the track to receive the old bridge after the moving. The two bridges, resting on roller nests on rails laid on the piers and extensions, were coupled together. Motive power was provided by four hoisting engines set on the new spans, with lines to nine-part $\frac{3}{4}$-in. wire rope tackles at each end of each span, made fast to the downstream end of the pier extensions. When the tracks were cut the hoisting engines were started, moving the ten spans downstream simultaneously. The pair of bridges was landed against the bumpers at the ends of the roller tracks in 80 sec.; about 30 sec. more was consumed by final adjustment.

The weight of the two bridges was about 2800 tons, and the distance of rolling 26 ft. The Boston Bridge Works, Boston, Mass., carried out the work, under the direction of the engineering department of the railroad.

Rivers and Harbors Congress Will Be Held Next February

Announcement has been made that the fourteenth convention of the National Rivers and Harbors Congress will be held at the New Willard Hotel, Washington, D. C., Feb. 5-7, 1919.

For this convention a radical change in the character of the program has

been decided on. Instead of being taken up with a series of prepared papers and addresses, the time will be given almost entirely to the discussion of transportation questions, including those on which there is the greatest difference of opinion. The opening addresses on both sides of these questions will be given by prominent men who have given special study to the subjects of debate, after which the matter will be thrown open for general discussion. The time of each speaker will be limited.

Engineering Council Resolutions On Land Reclamation

At the regular meeting of Engineering Council, Dec. 19, the following resolutions, submitted by the Public Affairs Committee, was passed:

"Whereas, plans have been prepared, under the direction of the Secretary of the Interior, for the reclamation on a large scale of arid lands, swamp lands, and land from which timber has been removed, with an extent of over 200,000,000 acres, in order to provide employment for returning soldiers and others, and adding to our food-supply resources; and

"Whereas, the need of increasing the area within our borders available for agriculture at this time of world-wide food scarcity is evident to everyone, and

"Whereas, these plans have already been urged upon the attention of Congress by President Wilson in his message of Dec. 2:

"Resolved, that the Engineering Council requests the favorable attention of Congress to these plans; and, to the end that this work shall be conducted on a sound, economic basis, the council especially urges liberal provision for thorough engineering investigations prior to actual construction, so that, in inaugurating this work, selection may be made first of tracts which offer the best prospects of profit in their reclamation, and the plans may be so prepared that the work can be done in the most expeditious and efficient manner."

Car Movement Believed to Establish World Record

What is believed to be the world's record for the greatest number of freight cars passing a given point in 24 hours is indicated in the report of conditions made by the Director General of Railroads to President Wilson. It is stated that in one day 9531 cars passed Columbia, Penn., on the Philadelphia division of the Pennsylvania R.R. The division operates between Harrisburg and Philadelphia, and is directed by Superintendent F. W. Smith, Jr., previously division engineer of the New York and Conemaugh divisions.

The report states that 250,000 freight cars passed Columbia in one month. The average daily movement was 8544 cars, or an average of about six cars per minute.

Negligence Responsible for Forest Fires in Minnesota

Laxity in enforcement of law, carelessness of individuals, unnecessary drainage, and an insufficient ranger force, were responsible for the recent destructive forest fires in Minnesota, according to the report of the state commission appointed to make an investigation. Correction of these shortcomings in the future and immediate state aid for the many sufferers in the present fire are recommended. The commission's report to the Governor says, "We do not find any evidence of any wilful setting of fires for the purpose of intentionally burning any city, town, village or habitation, but negligence under the conditions existing is all too evident." The practice of some settlers in burning over lands to clear them is censured, and it was intimated that railroads, under Government control, had been very negligent.

The fires, which swept over 200,000 acres, taking more than 500 lives and causing property damage of $20,000,000, had no common origin, but were the result of many fires, some of which had been burning for several days. The tremendous wind of Oct. 11 and 12 fanned these into a furnace, and they rapidly spread over the country, which was very dry from lack of rain. There was evidence that several fires, of separate origin, joined and swept on, leaving a wide path of desolation.

In addition to the dryness, the commission found that many needless drainage projects had exposed the peat soil, producing an added danger on account of the inflammability of this material. The report recommended that in the future such projects be studied from the standpoint of their value to the general public, rather than to drainage contractors who wished to do the work. While the commission does not desire to cast any aspersion upon worthy drainage projects, it disapproves of extensive drainage where the soil value of the land drained does not justify the expense. It doubts whether too much importance has not been placed upon the necessity of drainage to protect the public health.

Cleaning up of the débris on burned-over sections was recommended as a precaution. Other recommendations were more stringent laws and greatly extended forest ranger service. It is understood that the forest service department proposes to ask the legislature to appropriate $330,000 per year for this work, instead of the $50,000 allowed for the past year.

Water Power Bill Postponed

An agreement has been reached between the conferees of the House and the Senate who are in charge of the water-power bills now pending in Congress, to take no action in conference until after the first of the year.

Only one meeting of the conferees on the water-power bill has been held since the election in November. This took place a few days ago, but two of the principal members of the conference were absent, and their respective colleagues agreed not to proceed until they can be present. At the meeting of some of the conferees a few days ago, it is reported, Judge Sims, chairman of the House conferees, again strongly urged that action be taken by the conference so that the conference report may be brought before the House and Senate as soon as possible, especially as it is expected there will be extended debate on the conference report in both houses as soon as the report is brought in. But Judge Sims was unable to do more at the meeting than again to call the attention of the conferees to the importance of the proposed measure.

Minnesota Plans for State Trunk Highway System

Tentative plans and a map for a state trunk highway system, for Minnesota, of approximately 6000 miles have been prepared by Charles M. Babcock, commissioner of highways. These plans will be recommended to the coming session of the legislature, for submission to the people at the general election of 1920, as an amendment to the state constitution.

The program provides for the creation of a system to be constructed, reconstructed, improved and forever maintained by the state. A special fund for carrying on the work of improving and building the highways will be created by the amendment, and the legislature will be authorized to levy a higher license tax on motor vehicles than is now levied. This license will cover all other taxes on motor vehicles. The income from this source, together with such Federal-aid money as may be received, and such other receipts as the legislature may authorize, will be applied to the state trunk highway fund. Authorization for bonds to be issued when needed, and to expire in 20-year periods, is planned. A further feature will provide that the state can engage in the work of building highways, a thing the state constitution now prevents.

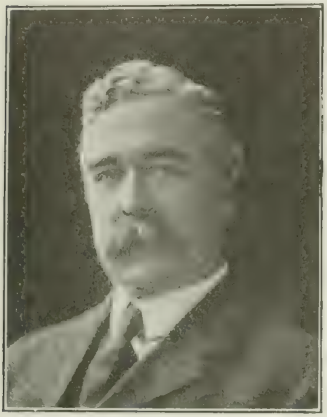
The plans contemplate the connecting of every county seat and every city of 2000, or more. In the selection of the system, the people will be given opportunity to be heard on the routes, and changes will be made where necessary to meet the needs.

Mr. Babcock believes that there will be no objection on the part of the motorist to the increased license fees, as the saving in operation of his vehicle will more than cover the extra expense. There is a unanimous sentiment in the state for a comprehensive system of hard-surfaced highways, according to the commissioner, and he believes that the proposed legislation will meet with the hearty approval of the people of the state.

John Sterling Deans

The death of John Sterling Deans, on Dec. 16, at his home in Phoenixville, Penn., removed one of the most prominent men in the engineering fraternity. The word "fraternity" is used advisedly, for Mr. Deans was a man of magnetic personality who made friends wherever he went.

Engineers are almost invariably wanderers, changing frequently from one situation to another; but Mr. Deans spent practically his entire business life with one organization—which is in itself a tribute to his ability and fidelity.



JOHN STERLING DEANS

Mr. Deans was born in Chester, Penn., and was trained in engineering at the Polytechnic College in Philadelphia. Thirty-nine years ago he began work for the firm of Clarke, Reeves & Co., builders of iron bridges at Phoenixville, Penn. This firm was reorganized a few years later and became the Phoenix Bridge Co. Young Deans gained steady promotion year by by year, and in 1892 he was made chief engineer, succeeding the late Adolphus Bonzano. He held this position for 23 years, until three years ago, when he became vice-president and consulting engineer of the company.

During Mr. Deans' active professional life of nearly 40 years, the modern art of scientific bridge construction has been developed from small beginnings. The substitution of steel in place of iron as a structural material was one of the most notable changes of the early years, and Mr. Deans did pioneer work in the development of the modern steel structure. Particularly noteworthy was his work in connection with some of the early high viaducts. The Kinzua viaduct in Pennsylvania was built in 1882, the Pecos River viaduct on the Southern Pacific ten years later. The Red Rock cantilever bridge over the Colorado River was erected about the same time.

Other notable structures for which he was responsible were the bridges over the Mississippi River at Rock Island and Davenport, and over the Ohio River at Cincinnati and Louisville. In fact, his company, under Mr. Deans' leadership, played an important part in the development of the modern long-span steel bridge.

Nothing serves more certainly to reveal the character of a man than the test of adversity. The Phoenix Bridge Co. undertook the construction of the first Quebec Bridge over the St. Lawrence. The circumstances are still fresh in the minds of most engineers. The attempt was made to build a bridge within too close limitations of cost, and with inadequate knowledge of the strength of great compression members. The disastrous fall of the south cantilever arm when near completion was such a blow to Mr. Deans' professional and business ambition as it falls to the lot of very few men ever to meet.

The engineers who visited the scene of the disaster immediately after the wreck, and there met Mr. Deans, will always remember his frank and manly bearing, his courage and fortitude. His middle name well expressed his character.

Mr. Deans married Miss Clara Barr of Cincinnati, who survives him, with four children, Capt. John Sterling Deans, Jr., of Buffalo, N. Y., Lieut. Robert Barr Deans of Phoenixville, and two daughters. C. W. B.

Army Organizes Bureau To Dispose of Surplus Property

In order to centralize the disposition of the quantities of stores and supplies for which the Army now has no use, a special bureau of the War Department has been organized.

Benedict Crowell, assistant secretary of war, has appointed C. W. Hare, assistant director of munitions, to have general supervision of this work, and Brig. Gen. C. C. Jamieson has been appointed director of sales in direct charge of an organization to be perfected for the disposal of surplus property.

Form Trunk Highway Association

Meeting in Chicago, Dec. 10, at the time of the Joint Highway Congress held under the auspices of the American Association of State Highway Officials and the Highway Industries Association, were representatives of 12 organized trunk line highways. Preliminary arrangements were made to form these into an association and to hold a meeting at Kansas City as soon as possible after Jan. 15. The newly formed organization tendered its support to the associations holding the congress, for a broad-gage policy for the construction of a system of national highways not to exceed 50,000 miles, to connect the important centers of population and industry, without regard to state lines.

H. O. Cooley, of Minneapolis, representing the Yellowstone Trail, and Wesley L. Connett were elected president and secretary, respectively.

Luten Patent Decision Upheld in Higher Court

On Nov. 11 Judges Sanborn, Carland and Stone, sitting in United States Circuit Court of Appeals, Eighth Circuit, upheld the lower court decision (United States District Court, District of Colorado, Judge Lewis, Nov. 13, 1915) against certain claims in United States Patents No. 825,970, 853,183, 853,202, 853,203, 979,776 and 989,272, issued to Daniel B. Luten, for improvement in concrete bridges. The suit was brought by Mr. Luten against George Washburn and Weld County, Colorado.

Allegheny River Bridge Plan Approved

Plans for the new bridge over the Allegheny River at Sixteenth St., Pittsburgh, drawn by J. G. Chalfant, county engineer, were approved by the county commissioners of Allegheny County last week. The architectural treatment of the bridge is to be referred to the Municipal Art Commission. A ferry has been operated across the Allegheny since the old wooden bridge was destroyed by fire last winter.

Other delayed county improvements in the neighborhood of Pittsburgh are under active consideration by the commissioners. These include a tunnel through the South Hills and a bridge over the Ohio River at McKees Rocks.

Notes from the Field

RECONSTRUCTION PROBLEM

Six of us were in the smoking car on the way back from the reconstruction congress at Atlantic City, when he got on at Hammonton. He wasn't exactly drunk, though the black bottle sticking out of his pocket was evidently not there for decoration, but he was effusively friendly. His cigar wouldn't stay lit, and soon he was begging the loan of a match. The unaccustomed cigar once going again, he swayed in the aisle solemnly, and, looking us over one by one, inquired pleasantly enough, but thickly, "You a bunch of college fellers?" The desired answer was only a step in his train of thought, for there was not a hint of question in his tone when he continued "You fellers all theorists. Me, I'm practical man." Then, fearing that the wide gulf he had put between us might offend, he reassured us. 'S'all right, though. Both of us neces'ry. You theorists, me practical man. Gotta have us both." And, having established his point, he got down to the story he was itching to tell.

"I'm metal lather," he said. "Been metal lather 19 years. Best damn lather in New Jersey. All summer I been workin' down loadin' plant. Got seven'y-two dollars week. Seven'y-two dollars every Friday night all summer." And he paused for emphasis. "Quit the job today, though. Quit'm cold. Wa'je think? Want me—reg'l'r metal lather like me—work for thirty-three dollars week. Can't work for no money

like that." And he became plaintive. "Can't live on less'n seven'y-two dollars week. Can't support family less'n seven'y-two dollars week. Ain' goin' work for nobody less'n seven'y-two dollars week. Let'm go 'thout metal lathers." And he finished with an assertive flourish and retired justified, to his seat, his cigar, his bottle and his grievance.

Next morning there came to the office a well-remembered engineer in the uniform of a major of artillery. Eighteen months ago he was manager of a large contracting company in the Middle West; a year ago he landed in France. Only last October he was in command of one of Pershing's batteries working its way behind the doughboys through the murderous woods of the Argonne. Today he was looking for a job. Not "seeking a business connection" not "offering his services," but just plain "looking for a job."

It is a far cry from the tanned, serious soldier, with technical training plus that executive experience that comes only with high military command, to the dissatisfied workman on the train, but all our plans for reconstruction must reckon equally with the two of them. F. C. W.

Talked Water Meters and Visited Manufacturing Plants

Papers on the use of water meters were read after the luncheon of the New York Section of the American Water-Works Association on Dec. 20, and then those in attendance divided themselves, in so far as they so desired, into three groups for visits to the plants of the National, Neptune and Thompson meter companies.

The meter practice of the Hackensack Water Co., which owns and maintains about 45,000 meters in various New Jersey cities and towns, was outlined by D. W. French. When a meter had passed a given quantity of water it was the practice of his company for many years to take it to the shop, test it and, if need be, overhaul it, regardless of the years the meter had been in service. More recently, under rules of the New Jersey Utility Commission, meters are taken out after a given number of years of service, or after passing a stated quantity of water. The company accounts for 71 to 74% of all water pumped, with no allowances for pump slip, pipe leaks or meter inaccuracies.

W. R. Edwards, of the East Jersey Water Co., speaking of experience in the Paterson-Passaic-Montclair territory, said that over-large meters were to be guarded against on account of under-registration. If the meter is too small the consumer will complain. Up to six families on one service the rule is to use a $\frac{5}{8}$-in. meter. As many as 12 families have been supplied satisfactorily through a $\frac{5}{8}$-in. meter, Mr. Edwards said. Allen Hazen stated that the Spring Valley Water Co., San Francisco, is changing larger meters to smaller ones.

A. R. Hirst, President of American Association of State Highway Officials

A. R. Hirst, recently elected president of the American Association of State Highway Officials, is state highway engineer of Wisconsin, where he has supervised state highway development from its inception in 1907. He has seen appropriations for the engineering expense of the state highway department rise from $10,000 per year to $185,000, and the amount of work supervised rise to an estimated cost for 1919 of $8,000,000.

A. R. HIRST

Mr. Hirst was born on Long Island, Mar. 31, 1881. He was graduated from the civil engineering course at what is now Maryland State College in June, 1902, with the degree of B. S. in Civil Engineering, and shortly afterward entered the employment of the Pennsylvania R.R.

In April, 1903, he entered the employ of the highway division of the Maryland Geological and Natural History Survey, as transitman and draftsman. When the highway work of Maryland was taken over by the Maryland Roads Commission, he was made engineer of surveys and plans, remaining with the commission in that capacity until May, 1907, when he accepted a position with the Illinois Highway Commission as construction engineer. In August, 1907, he accepted the position of highway engineer of Wisconsin, in the highway division of the Wisconsin Geological and Natural History Survey.

With the passage of the state-aid law in 1911, he was made chief engineer of the Wisconsin Highway Commission, with the title of acting state highway engineer. Within a few months he was made state highway engineer, and has since held the office.

St. Louis Needs $94,000,000 Worth of Public Improvements

Studies made by the City Plan Commission of St. Louis, and published in a pamphlet entitled "St. Louis After the War," show specific public improvements totalling $93,972,000, with no allowances for transit or housing. Estimates made by city department heads, presumably with a view to the more immediate needs of the city, total about $34,000,000. The available borrowing capacity of the city, under a 5% bond limit, is $23,500,000. The City Plan Committee of the Chamber of Commerce, with a membership of 75, recently voted in favor of a $22,000,000 bond issue. Mayor Kiel has appointed a citizens' committee of 25 members to act with city officials in canvassing the whole situation. This committee includes a number of architects and engineers and has as chairman John L. Mauron, president of the American Institute of Architects.

The $34,000,000 estimate made by department heads is as follows:

Improvement of River des Peres	$11,780,000
Repair and construction of sewers	5,655,000
Parks and playgrounds	6,005,500
Municipal convention hall	2,500,000
Municipal farm	700,000
Robert Koch Hospital improvements	200,000
Municipal railroad and docks	2,100,000
Elimination of grade crossings	3,142,200
City's share of street openings	600,000
Garbage reduction plant	550,000
Department of Streets and Sewers	450,000
New fire engine houses and equipment	400,000
Municipal garage	125,000
Additional cells in city jail	100,000
Total	$34,227,700

These items agree in a general way with the estimates of the City Plan Commission for the same objects. In addition, the commission put down $25,000,000 for river-front improvements, $20,000,000 for water-works, and $15,000,000 for public buildings and a group plan. The water-works extension may be financed outside the bond limit.

Seattle Plans for Reconstruction Period

Reconstruction questions of the City of Seattle, Wash., and King County are to be considered by a large commission which has been appointed by Mayor Hansen and which will coöperate with similar commissions throughout the state. In addition to this the city authorities are already planning to commence work on a water-supply extension to cost nearly $4,000,000, a hydroelectric plant to cost $5,500,000, and street and sewer work totaling about $3,000,000.

Steamer Turned on Side Passes Through Canal

Rolled over on its side, a large lake steamer of beam exceeding the width of the locks has been passed through the Welland Canal. The steamer "Charles R. Van Hise," a 9000-ton Great Lakes freighter, was chosen for a tryout of this new method. It was first cut in two lengthwise, as has been done previously with lake steamers too long

for the canal locks but not exceeding in beam the 44-ft. width of the locks.

With a view to securing larger Lake ships for ocean traffic, F. A Eustis, of the United States Shipping Board, suggested that a ship (or half section of a ship) might be sent through the locks when turned on its side, the depth being less than the beam. The "Van Hise" experiment was planned in consequence, and this experiment has just been carried out with success. On Dec. 5 the forward section of the vessel was turned on its side at Buffalo by the agency of pontoon tanks placed along its side at the deck line and filled with water. The half ship was then towed to the Port Colborne entrance to the Welland Canal and passed down to Lake Ontario.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

NATIONAL RIVERS AND HARBORS CONGRESS; 824 Colorado Bldg., Washington, D. C.; Feb. 5-7, Washington, D. C.

The American Metric Association will hold its second annual meeting Dec. 27 in Baltimore and Dec. 28 in Washington. The opening session of the meeting will take place at Johns Hopkins University, Baltimore, in conjunction with Section 1 of the American Association for the Advancement of Science. The Washington session will be held at the United States Bureau of Standards. Joseph Hartigan, former commissioner of weights and measures, New York City, will read a paper on "Two Million New American Users of the Metric System."

The Montreal Branch of the Engineering Institute of Canada held a discussion on "Legislation" at a meeting Dec. 19. A welcome was tendered to members who had just returned from overseas, including Lieut Col. A. E. Dubuc, D.S.O., Officer of the Legion of Honor, commanding officer of the 22nd Battalion.

The New Jersey Association of County Engineers will hold its annual meeting Jan. 21. A special meeting is to be held in Newark Jan. 10-11.

The San Francisco Association of Members of the American Society of Civil Engineers held its annual meeting Dec. 17. H. L. Haehl, member of the Committee on Development of the society, reported on the progress made at the Chicago meeting, and the association unanimously passed a resolution requesting that the Board of Direction approve the holding of the next Development Committee meeting during the week of the 1919 annual meeting. The Committee on Licensing Engineers reported the draft or the licensing bill as nearing completion, and it was voted to hold a special meeting to consider the final draft. The election of officers resulted as follows: President, E. J. Schneider; vice-president, M. M. O'Shaughnessy; secretary-treasurer, Nathan A. Bowers. The address of the evening was delivered by Maj. George F. Sever on the subject of "Economic and Financial Aspects of the Water-Power Situation on the Pacific Coast."

The Idaho Irrigation Congress will be held at Twin Falls, Jan. 13-16 as a joint conference between the agricultural, livestock, engineering and irrigation societies of Idaho. Among the subjects to be discussed are the electrical reduction of ores, the highways of Idaho, and the irrigation possibilities in Southern Idaho.

The Colorado Association of Members of the American Society of Civil Engineers held a meeting and dinner Dec. 21 at which Thomas L. Wilkinson, member of the Committee on Development of the society, reported on the work of the committee at the first meeting in Chicago, as outlined in *Engineering News-Record* of Dec. 5, p. 1045. The association's Committee on Legislation, appointed in accordance with resolutions adopted at the previous meeting, reported on the question of licensing civil engineers in Colorado. Arthur O. Ridgway addressed the meeting on "Unit Values for Transportation Service."

The Calgary Branch of the Engineering Institute of Canada held its annual meeting in Calgary Dec. 9. M. C. Costello and R. C. Marshall, candidates for the mayoralty of the city, spoke on their respective programs, deeling particularly with matters of interest to the profession and including a proposed sewage disposal plant for the city, town planning and housing.

The Nebraska Association of Members of the American Society of Civil Engineers will hold its annual meeting at Lincoln Jan. 4, at which meeting the work of the Committee on Development of the society will be discussed. It is also planned to discuss matters which will come before the next meeting of the Nebraska legislature.

The Chicago Association of Commerce Engineers' Subdivision on Dec. 18 elected the following officers for 1919: Chairman, W. W. DeBerard; vice-chairman, J. N. Hatch; additional members of the executive committee, C. O. Billow, H. W. Clausen and C. E. Keller.

The Engineers' Club of Minneapolis is holding a series of meetings for the purpose of discussing post-war problems. The meeting Nov. 29 was devoted to a discussion of "Education of the Coming Engineer," at which extracts from Dr. C. R. Mann's recent report on engineering education were read by C. L. Pillsbury. The discussion was led by John R. Allen, dean of the College of Engineering, University of Minnesota. On Dec. 16 L. S. Gillette, of Minneapolis, director of the United States Chamber of Commerce, addressed the club on "Reconstruction Problems." He included an account of the recent reconstruction congress at Atlantic City. At the next meeting in January the topic will be "Road Program in the State of Minnesota."

The Detroit Engineering Society was addressed Dec. 20 by William B. Landreth, deputy state engineer of New York, who read a paper on "The New York State Barge Canal," illustrated with lantern slides and moving pictures.

The Spokane Association of Members of the American Society of Civil Engineers elected the following officers Dec. 13: President, H. J. Doolittle; vice-president, C. A. Burnette; secretary-treasurer, Charles Davis.

The Pittsburgh Chapter of the American Association of Engineers was addressed on Dec. 20 by Prof. H. R. Thayer, of the Carnegie Institute of Technology, who spoke on "The Problem of Reconstruction."

The Toronto Branch of the Engineering Institute of Canada elected the following officers at a recent meeting: Chairman, A. H. Harkness; secretary-treasurer, W. S. Harvey.

The Engineers' Club of Trenton, N. J., elected the following officers at the annual meeting held Dec. 12: President, Charles R. Fairchild; first vice-president, Alfred P. S. Bellis; secretary, Joseph E. English.

The Engineers' Club of Philadelphia will be addressed by Fullerton L. Waldo of the Philadelphia *Public Ledger*, on "America at the Front," at the weekly luncheon to be held Dec. 31.

Personal Notes

S. M. FELTON, director general of military railways, has resigned, effective Dec. 31, when, it is expected, he will resume his duties as president of the Chicago Great Western Railroad.

MAJ. F. L. C. BOND has been appointed chief engineer, Grand Trunk Ry. System, with headquarters at Montreal, succeeding H. R. Safford, recently appointed engineering assistant to the regional director of the Central Western region, United States Railroad Administration. He recently returned from overseas after two years' service with the 10th Battalion, Canadian Railway troops. Major Bond was born in Montreal in 1877, and received

his education at the Collegiate Institute and McGill University. After his graduation from McGill in 1898 he entered the service of the Grand Trunk as assistant resident engineer, eastern division, and in 1901 was appointed engineer in charge of double-track construction. In 1913 he became division engineer, Grand Trunk, Eastern Lines.

CAPT. JOHN P. WENTWORTH, Sanitary Corps, U. S . A., formerly of Metcalf & Eddy, consulting engineers, Boston, has been transferred from Camp Wheeler, Macon, Ga., to Camp Bragg, Fayetteville, N. C., as camp sanitary engineer.

LT. COL. H. S. BAKER, 111th Engineers, in service in France, formerly first assistant city engineer, Chicago, is now Colonel Baker. At the beginning of the war Colonel Baker was constructing quartermaster at Camp Bowie, Texas, with the rank of captain.

JOSEPH B. EASTMAN of Massachusetts has been nominated by the President to succeed George W. Anderson as a member of the Interstate Commerce Commission. Notification of the nomination was received from the President by wireless Dec. 19.

FRANKLIN D. HOWELL resigned recently as chief engineer of the Board of Public Utilities, Los Angeles, to become general manager of the California Highway Transportation Co., recently organized to carry on motor transportation.

CAPT. D. D. GUILFOIL, 108th Engineers, now in France, and formerly contracting engineer for Sauerman Bros., Chicago, has been promoted to the rank of major. He was one of the original members of Co. A., Corps of Engineers, Illinois National Guard, which formed the nucleus of the 108th Regiment of Engineers.

CARL R. GRAY, formerly president of the Western Maryland Ry., has resigned as director of the division of operation, United States Railroad Administration.

IRA E. TAYLOR has been appointed assistant engineer of the drainage and irrigation department, extension division, Kansas State Agricultural College, Manhattan, Kan. Mr. Taylor has just returned from the Engineer Officers' Training School at Camp A. A. Humphreys, Virginia. He will specialize in farm drainage work.

F. P. WILLIAMS, Rochester, N. Y., division engineer, New York State Barge Canal, has been appointed special deputy state engineer. After his graduation from Cornell University he entered the State Engineer's Department as assistant engineer in 1904, engaging in highway work. He became resident engineer in the canal department in 1906, and in 1914 was made division engineer.

ROY D. CHAPIN, for the past year chairman of the National Highways Transport Committee, resigned recently to return to his duties as president of the Hudson Motor Car Company.

LIEUT. THOMAS B. BERGAN, who received leave of absence as city engineer of Auburn, N. Y., to enter the Sanitary Corps, U. S. A., has returned to his work as city engineer.

FREDERICK HOLBROOK, president of the American International Shipbuilding Corporation, has tendered his resignation. He will be succeeded by M. C. Brush, chairman of the board of directors and former president of the Boston Elevated Railway Company.

JOHN CRAVEN, chief of the field section of the Council of National Defense, is now chairman of the National Highways Transport Committee, in succession to Roy D. Chapin, who resigned, as mentioned elsewhere in this column.

MAJ. EDWARD BOSTOW, Sanitary Corps, U. S. A., in charge of water analysis laboratories, and formerly director of the Illinois water survey, has been promoted to the rank of lieutenant colonel.

MARTIN C. POLK, city engineer of Chico, Cal., and for several years surveyor of Butte County, has been placed in charge of all highway construction and maintenance in the county. The office was recently created by a newly adopted county charter.

OBITUARY

CHARLES E. PHELPS, former chief engineer, Public Service Commission of Maryland, died in Baltimore, Dec. 22, at the age of 47.

CAPT. CLYDE L. WESTCOTT, formerly superintendent of construction, Los Angeles Union Terminal buildings, died recently in Los Angeles. Captain Westcott was commissioned Oct. 21 and had been stationed at Fort Douglas, Utah.

A. R. W. SPERRY, whose death Dec. 6 was noted in these columns last week, was graduated from the University of California in 1910, after which he became inspector and instrumentman for the Associated Pipe Line Co. He was also identified with various irrigation construction enterprises in the Central Valley, being for three years associated with the Natomas Co., engaged in developing extensive irrigation tracts and building irrigation structures. At the time of his death Mr. Sperry was chief engineer of the Anderson-Cottonwood Irrigation District.

BERNARD NADAL BAKER, Baltimore, retired capitalist and steamship operator, died at Santa Barbara, Cal., Dec. 20. He was formerly a member of the United States Shipping Board, and in business was best known as the organizer of the Atlantic Transport Co. He was born in 1854 and attended Sheffield Scientific School, Yale University. He started the Atlantic Transport Co. with one steamship in 1886, remaining in control of the company until it was absorbed by the International Mercantile Marine Co. in 1902, when 17 steamships were turned over to the new organization. He took an active part in the movement for strengthening the merchant marine of this country and supplied much data, for the Shipping Bureau, debated in the United States Senate in 1915. He was one of the four recognized transportation experts selected by Secretary McAdoo for the National Subcommittee on Transportation Problems.

HERMANN LAUB, consulting engineer, Pittsburgh, died in that city Dec. 10 at the age of 63. In 1881 and 1882 he was assistant engineer on the location and construction of the Guanajuato branch of the Mexican Central Ry. between Silao and Marfil, later becoming principal assistant engineer under A. M. Wellington on the location of the Pacific branch, between Guadalajara, Ameca, Tepic and San Blas. The maps in Wellington's "Railway Location" were made by Mr. Laub. In 1884 he returned to the United States and became connected with the Iron City Bridge Works, Pittsburgh, later becoming associated with Gustav Lindenthal, consulting structural engineer. Subsequently he engaged in private practice, and was in charge of the design and erection of various structures in the Pittsburgh district.

J. HUMPHRIES, Winnipeg, Man., engineer, good roads department of public works of Manitoba, died Dec. 15 at the age of 33. He enlisted in the Canadian Engineers in 1915 and was in active service on the Somme. He had received his discharged on account of ill health.

T. M. CHAPMAN, superintendent of fire prevention, Central of Georgia R.R., died Dec. 4 at the age of 45. Almost all of his engineering experience was in railroad maintenance and construction. He was a member of the National Board of Directors of the American Association of Engineers.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Argentine Railways Offer Market for Equipment

Inspector Estimates $100,000,000 Will Be Spent on Rolling Stock and Appliances

The railways of Argentina will spend over $100,000,000 on rolling stock and equipment in the next two years, according to a statement by Fred A. Lagrange, technical inspector of the Argentine Government railways. If the manufacturers of American railway supplies will conform to Argentine railway standards, he says, there will be a market for their products, and even the introduction of American standard equipment, though difficult at any time, will be easier in the immediate future on account of the temporary withdrawal of European competition. European manufacturers, he states, will have to give close attention to necessities at home for some years to come.

The complete system of railroads in the republic has about 11,000 miles of track, of which about 6500 miles are of 6-ft. 5-in. gage, about 900 miles of 4-ft. 9½-in. gage, and about 3600 of the 3-ft. 4-in. gage. The Argentine government owns about 1900 miles, or 18% of the total, which is under the direction of the "Administraccion de los Ferrocarriles del Estado," a board composed of a chief engineer, a chief of exploitation and an auditor general. It is presided over by an administrator who is appointed by the President of the republic. The other members of the board are appointed by the administrator. All of the railroads are under the control of the "Direccion General de Ferrocarriles" (Argentine Administration of Railroads) which is headed by an Argentine engineer reporting directly to the Minister of Public Works.

During the last four and a half years the railways have been unable to obtain materials, so that their maintenance and reserve stocks are very low and an expenditure of about $100,000,000 for the next two years is probable. In addition to this, extensions are to be built, for several of which there is urgent need. It is expected that they will amount to about 1000 miles and entail an expenditure of $75,000,000. This is exclusive of the electric lines, which will also receive considerable attention, according to Mr. Lagrange.

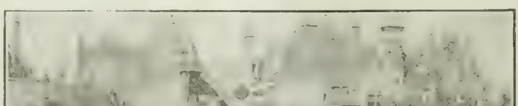
In conclusion, he points out that although the opportunities are favorable for the introduction of American equipment, the market cannot be gained without a struggle, and that success will depend on close study and sound business principles.

Auto Industry Will Absorb Surplus Government Machines

The surplus stocks of automobiles and trucks in the War Department will be taken up by the automobile industry. An agreement to this effect was recently made between representatives of the auto manufacturers and officials of the War Department, the action having been taken to prevent a disorganization of the business by a possible flooding of the market with Government machines. The War Department announces, however, that there is no immediate probability of this, because the indications at present are that the Government machines will be needed for some time, and care will be taken to cause the trade as little disturbance as possible.

Car-Building Plant to Cost $2,000,000 Projected

The Youngstown Steel Car Co. has announced that plans have been completed for the erection of a $2,000,000 car-building plant. It will be located at Niles, Ohio, will employ approximately 2000 men and will have a capacity of 75 cars per day.



SWEEPER AND SPRINKLER ADAPTED TO MOTOR TRUCK CHASSIS

Increased Facilities for Promoting Foreign Trade Asked

Expansion of Government facilities for promoting foreign trade is urged in the annual report of the Chief of the Bureau of Foreign and Domestic Commerce. The measure is advocated on the strength of the important position the United States will hold in international trade.

Extension of the field of the commercial attaché and trade commissioner for this work is particularly urged in the report, because the value of the promotive work done by these field representatives in the past is generally conceded. Trade commissioners, who can travel from place to place in specified districts, are also needed to send in news of the national resources and the trade opportunities in their localities. New attachés are asked for Rome, Madrid, Ottawa, Mexico City, Santiago (Chile) and Athens, and trade commissioners in Colombia and Venezuela, the Dutch East Indies, Egypt, South Africa and New Zealand.

Bridge Builders Report 27 Per Cent of Capacity Taken

The records of the Bridge Builders' and Structural Society, as collected by its secretary, show that during November, 1918, 27% of the entire capacity of the bridge and structural shops of the country was contracted for.

Sweeper Sprinkler Attachment for Motor Truck

Any standard motor-truck chassis may be converted into an efficient street sweeper by the rotary broom and sprinkler attachment, as in the accompanying view. The connection of the broom is the important detail. An A-frame and boom provide for raising and lowering the broom by means of a hand winch. Once set to proper height, the broom is held from going down further by the chain shackle between the top of the A-frame and the boom tip; as the broom wears, the chain is lengthened. Vertical adjustment of the broom to irregularities of the pavement is provided for by its suspension from a counterbalanced lever hinged to the boom. The broom sweeps 6 ft. wide. The water is supplied by a force pump from a 350-gal. tank to the transverse sprinkler pipe set ahead of the rear wheels and is applied to the pavement by atomizers.